2023 THE LONG COURSE JOURNAL DU LONG COURS

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L'École de Régiment Royal de L'Artillerie Canadienne (ÉARC)

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Foreward

Welcome to the sixth edition of The Long Course Journal, which is a compilation of research on various topics that are extremely relevant to The Royal Regiment of Canadian Artillery (RCA). The publication of this journal creates a forum to educate readers on topics relevant to the Artillery and promote professional discourse on a myriad of subjects.

It is a compilation of work that will serve to challenge our technical and tactical ideas so that we are poised to adapt and ensure the continued delivery of world class air defense, surveillance and target acquisition and indirect fire support for the Canadian Army. The contributors should be congratulated on producing well researched work that I have no doubt will provoke professional discussion across the RCA and challenge us to evolve. Finally, I would like to thank all the staff and contributors whose hard work and dedication to excellence have made this publication a success.

Avant-propos

Bienvenue à la sixième édition du Journal d'Enseignement Élancé, qui est une compilation de recherches sur divers sujets extrêmement pertinents pour le Régiment royal de l'Artillerie canadienne (ARC). La publication de ce journal crée un forum pour éduquer les lecteurs sur des sujets pertinents pour l'artillerie et promouvoir un discours professionnel sur une myriade de sujets.

C'est une compilation de travaux qui serviront à remettre en question nos idées techniques et tactiques afin que nous soyons prêts à nous adapter et à assurer la prestation continue de services de défense aérienne, de surveillance, d'acquisition d'objectifs et d'appui-feu indirect de classe mondiale pour l'armée canadienne. Les contributeurs doivent être félicités pour la production d'œuvres bien documentées qui, je ne doute pas, provoqueront des discussions professionnelles à travers l'ARC et nous mettront en mesure d'évoluer. Enfin, je voudrais remercier tout le personnel et les collaborateurs dont le travail acharné et le dévouement à l'excellence ont fait de cette publication un succès.

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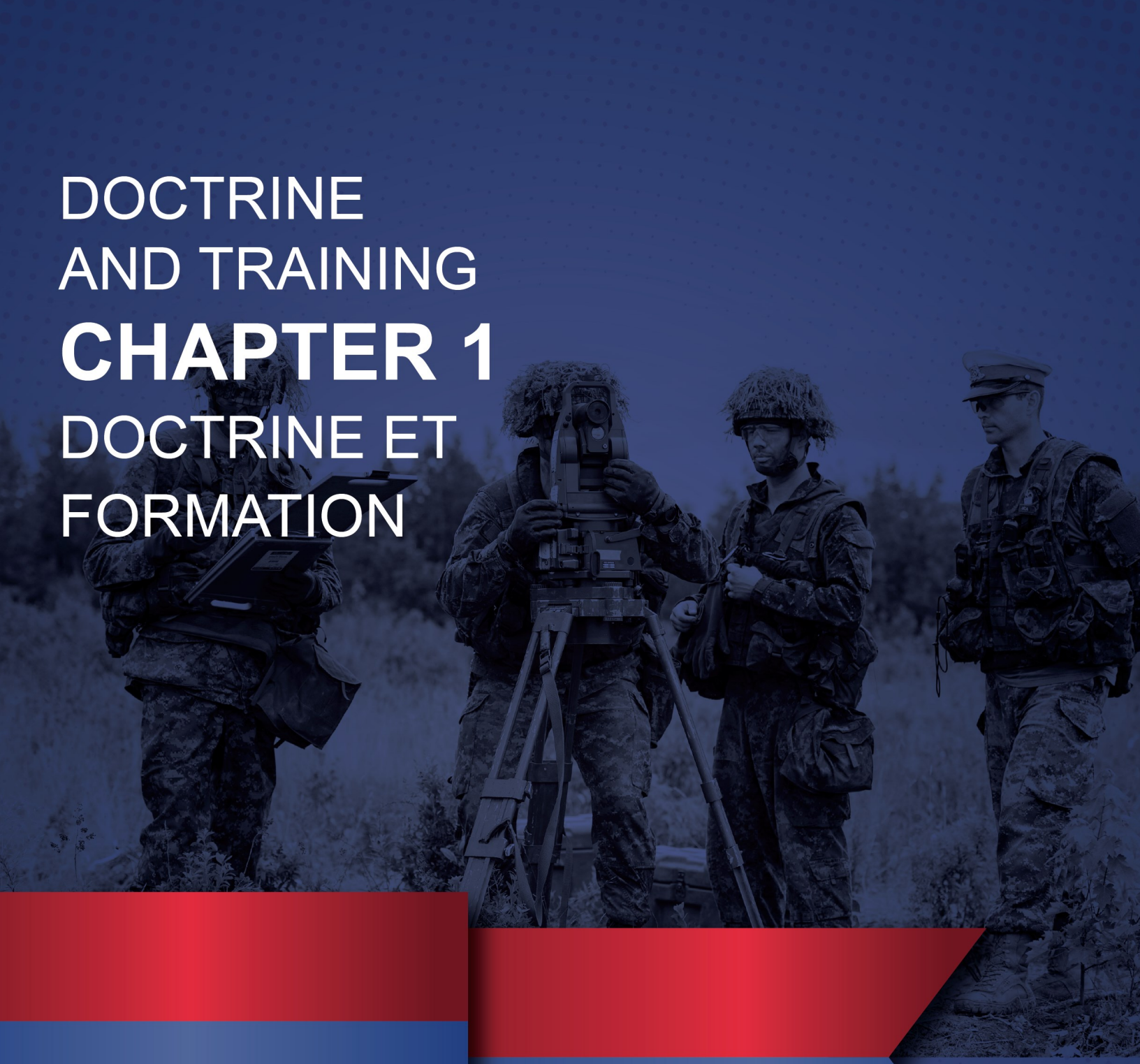
DOCTRINE ET FORMATION



Training for Competency – The Disparity in Training between the Reserve and Regular Force Artillery

WO Doug Bailey

Introduction

“Train as you fight”, “Train to one standard”, “Training is command driven”. [1] All too often, these words are spoken on the armoury floor, in gun parks across Canada and throughout every training establishment. These are three of the principles of training set out by the Canadian Army (CA). For the Army Reserve (ARes) gunner, the CA is missing the mark on the foundational training tenets set out in doctrinal army training documents.

Our members' training has always been a top priority. Our military would not be as competent as it is today without soldiers who had received proper training. Nevertheless, there has always needed to be a careful balance between the training we provide for gunners in the Regular Force (Reg F) and those in the ARes. Due to the part-time nature of the Reserve Force, members frequently do not have as much time for training and courses as their counterparts in the Reg F. The ARes soldier does not demonstrate competency for the course until all supplemental training has been completed, according to the classification of "essential" and "supplemental" Performance Objectives (PO) within Course Training Plans. In contrast to their Reg F counterparts, the majority of ARes gunner Non-Commissioned Members (NCMs) are underqualified for their rank due to the majority of ARes units not being able to conduct the supplemental training.

In Strong, Secure, Engaged - the government's defence policy released in 2017 - the Government of Canada established its vision for the Reserve Force that will "enable Reserve Force Units and Formations to provide full-time capability through part-time service; ensure Reservists are a well integrated component of the total force; and appropriately train, prepare and equip Reservists in sufficient numbers to be ready to contribute to operations at home and abroad.” The vision continues, "There will be no difference in the operational excellence of a task or duty performed by a member of the Regular or Reserve Force."[2] While we use ARes personnel on overseas missions, those personnel had to overcome training gaps before deployment, some of which are sizable. Additionally, while many overcame those deltas, they are not necessarily skilled in the abilities they had recently learned.

According to a 2016 report by the Auditor General of Canada, in comparison to their Reg F counterparts, ARes Infantry soldiers had 25 percent fewer days of formal individual training (IT) over the course of their careers. [3] The report also stated that the CA had acknowledged the need to fill those ARes training gaps during the pre-deployment training of ARes soldiers for overseas operations. While the example used is ARes Infantry, the gunner trade also has a 25% difference in training days compared to the average Gun Area (GA) career. What is this discrepancy, why does it exist, and how can it be corrected?

Discussion

“Train as you fight.”

As has been seen in the news, recruitment is down, releases are up. Add to this the current plan for reconstitution, and the current geopolitical landscape, the demand for soldiers from the ARes at all levels for augmentation to the Reg F is becoming more common. “As part of Strengthening the Army Reserves (StAR), 2nd Regiment, Royal Canadian Horse Artillery began working closely with the six Reserve Force Artillery units in 4 Division running several M777 conversion courses. This training enabled the primary reserve to provide gunners that could potentially deploy as ROTO 0 augmentees, far above and beyond the mandated ROTO 1

role they currently fulfilled."[4] While this takes care of training the ARes soldier on the different howitzer the Reg F uses, there is no mention of addressing the other deltas the reservist faces: unqualified on various weapon systems, not proficient in the force protection of a battery, not current on the Tactics, Training and Procedures in use by the Reg F units gained through experience and lessons learned on operations.

Almost every Qualification Standard & Training Plan (QSTP) within the GA NCM progression states "Successfully meeting the standard for all supplemental POs is required for Primary Reserve (P Res) employment in support of operations."[5] While the authors of the Canadian Army Journal article mentioned above may think that reserve force artillery personnel could deploy as ROTO 0 augmentees, this is really only true in the artillery for a small number of Gunners and Bombardiers who successfully completed M777 conversion courses and have either successfully completed the supplemental training for Basic Military Qualification - Land or who have successfully completed the more recent Rank Qualification - Artillery Detachment Member, Common. This is a result of the ARes' notable training for war - training as we fight - delta. The ammunition distribution between Reg F and ARes courses (tables 1 and 2) demonstrates how great the resource disparity between Reg F and ARes courses can be, which in turn degrades the training.

A common justification for the reserves' failure to provide their members with competency-based training is the lack of ammunition for supplemental training. Ammunition is a very

4. Ammunition **4. Munitions**

SER/ SÉR	LOG GUIDE/ GUIDE DE LOG	DESCRIPTION		QTY/QTÉ	REMARKS/ REMARQUES
a.	0059	5.56mm Ball	5.56mm Ball	8640	
b.	0061	5.56mm 4 Ball/1 Tracer	5.56mm 4 Ball/1 Tracer	4800	
c.	0100	7.62mm 4 Ball/1 Tracer	7.62mm 4 Ball/1 Tracer	5280	
d.	0382	Ctg 40mm x 53 TP-T link	Cart 40 mm x 53 TP-T (lien)	128	
e.	0371	Rocket 21mm M72-subcal	Rocket 21mm M72-subcal	0	
f.	0410	Cartridge 84mm TP/T	Cartridge 84mm TP/T	72	
g.	0720	155mm HE Plug	Projectile Bouchon de 155mm	301	
h.	0740	155mm SMK	155 mm SMK	16	
i.	0811	Primer percussion	Amorce à percussion	301	
j.	0812	Charge Propellant M231	Charge propulsive M231	150	
k.	0813	Charge Propellant M232A1	Charge propulsive M232A1	151	
l.	0840	Fuze MTSQ (HOW) M577A1	Fusée MTSQ (obusier) M577A1	16	
m.	0820	Fuze M739	Fusée M739	301	
n.	1250	Grenade Hand Smoke	Grenade à main fum	30	
o.	1362	Flare Para Hand Fired	Fusée écl. Tirer è la main	30	
p.	1390	Sim Proj Grd Burst C1A1	Simulateur expl. au sol	30	

Table 1: Regular Force ammunition allocation taken from A-P2-002-TSM/PG-B01 Qualification Standard and Training Plan Gun Area Troop Sergeant Major dated 13 Jul 18 last modified 30 Oct 20

4. Ammunition **4. Munitions**

SER/ SÉR	LOG GUIDE/ GUIDE DE LOG	DESCRIPTION		QTY/QTÉ	REMARKS/ REMARQUES
a.	0720	155mm HE Plug	Projectile Bouchon de 155mm	98	
b.	0820	Fuze M739	Fusée M739	98	

Table 2: Reserve Force ammunition allocation taken from A-P2-002-TSM/PG-B01 Qualification Standard and Training Plan Gun Area Troop Sergeant Major dated 13 Jul 18 last modified 30 Oct 20

important resource because it allows them to train as we fight. For the GA Troop Sergeant Major (GATSM) course, local defense and quick actions (PO 004 Execute the Gun Area Force Protection Plan) are Reserve Force Supplemental; less local defense training means less ammunition is needed. One can infer that this enables training facilities to train our Reserve Soldiers more quickly and efficiently, two concepts crucial to the success of the Reserves. The failure to allocate ammunition appropriately to ARes courses and making performance objectives (PO) that would use that ammunition supplemental prevents the ARes gunner from training as they fight, and could potentially cause poor performance when required or, in a worst-case scenario, death or injury to personnel. "The importance of addressing all gaps in individual training during pre-deployment training was noted in a 2014 inquiry into a 2010 training incident in Afghanistan in which four Army Reserve soldiers were injured and one was killed. The casualties occurred while the soldiers were training to operate a particular weapon that was part of the mission's equipment but had not been included in pre-deployment training. The inquiry concluded that the lack of this pre-deployment training contributed to this incident."[6]

"Train to one standard"

The average Reg F GA soldier completes 223 days of training from Gun Detachment Member up to and including GATSM, not accounting for any driver or specialty qualifications. For the same period of their career, the average ARes GA soldier completes 168 days of training (table 3).

The remaining 25 percent is known as Supplemental Training and is meant to be trained at the home unit or, as part of pre-deployment training.

The Canadian Army publication Training for Land Operations states, "Within the CA, soldiers of the Reg F and P Res will train to the same standard; however, the breadth and scope of training for the two will be different. Due to that difference, soldiers and units of the P Res are not expected to achieve the same number of standards or subcomponents of the QSs (Qualification Standards), IBTSs (Individual Battle Task Standards) and BTSs (Battle Task Standards) generally expressed as PO for IT (Individual Training) and subtasks for CT (Collective Training) as their Reg F counterparts. The resultant delta between Reg F and P Res soldiers will need to be identified and addressed during pre-deployment training for operations."[7] Tables 4, 5, 6 & 7 illustrate some examples of this delta within the GA stream.

The passage from Training for Land Operations mentioned above is accurate for many non-artillery trades. Within the artillery, however, level 4 (Regimental) live training for ARes Artillery is mandated. In accordance with B-GL-383-002/FP-001 Battle Task Standards for Land Operations, Canadian Army Order (CAO) 23-21 (table 8) and the Canadian Army Operations Plan (Op Plan) (Figure 1), the Reserve Artillery unit is not meeting its annual mandated Battle Task Standards (BTS) without having its

Course	Reg F Days	A Res Days	Difference
Gun Detachment Member	25	16	9
Army Tactical Basic Dismounted Communicator	9	9	0
Army Tactical Basic Mounted Communicator	10	10	0
Army Tactical Artillery Communicator	5	5	0
Command Post Technician	29	18	11
Artillery Reconnaissance Technician	18	18	0
Gun Detachment Second-in-Command (Gun Det 2ic)	15	14	1
Gun Detachment Commander (Gun Det Comd)	18	14	4
Gun Area Technical Supervisor (GATS)	58	44	14
Gun Area Troop Sergeant Major	36	20	16
Total	**223**	**168**	**55**

Table 3: Training duration for standard GA courses

E = Essential/Essentielle S = Supplemental/Supplémentaire

PO/ OREN	PO TITLE	TITRE DE L'OREN	PRES TRAINING CATEGORY / CATÉGORIE D'INSTRPRÉS
099	Comply with the CAF Code of Values and Ethics	Respecter le Code de valeurs et d'éthique des FAC	E
001	Execute Gun Area Preparation	Préparer le secteur de pièces	E
002	Execute Gun Area Occupation	Occuper le secteur de pièces	E
003	Conduct Sustainment of the Gun Area Operations	Assurer les maintien en puissance des opérations dans le secteur de pièces	E
004	Execute the Gun Area Force Protection	Exécuter le plan de protection de la	S
005	Conduct Quick Action	Effectuer une mise en batterie rapide	S
006	Direct the Deployment of Troop Hides, Harbours and Leaguers	Diriger le déploiement de la troupe dans les caches, les refuges et les laagers	E
007	Professional Development	Perfectionnement professionnel	S

Table 4: Qualification Table – A-P2-002-TSM/PG-B01 QS/TP – Gun Area Troop Sergeant Major (2018) Note PO 004 Execute the Gun Area Force Protection Plan is Supplemental

TRAINING MATRIX

PO	PO Title	P Res Training Category		
		Essential	Supplemental	Residual
PO 099	Comply with the CAF Code of Values and Ethics			
PO 001	Supervise essential duties of a Gun Detachment	x		
PO 002	Execute Fire Discipline Orders on the Gun platform	x		
PO 003	Maintain the use of Artillery Ammunition	x		
PO 004	Supervise maintenance of the howitzer and ancillary equipment	x		
PO 005	Implement the Force Protection Plan		x	
PO 006	Conduct Gun Detachment Special Procedures for firing	x		

Table 5: Training Matrix – A-P2-002-GDC/PC-B01 Qualification Standard, Gun Detachment Commander. Note PO 005 Implement the Force Protection Plan is Supplemental

TRAINING MATRIX

PO	PO Title	P Res Training Category		
		Essential	Supplemental	Residual
PO 099	Comply with the CAF Code of Values and Ethics			
PO 001	Command a Gun Detachment during normal indirect fire missions on a TP/Bty gun position	x		
PO 002	Issue Fire Discipline Orders to the Gun Detachment	x		
PO 003	Control Artillery Ammunition	x		
PO 004	Conduct maintenance of the howitzer and ancillary equipment	x		
PO 005	Implement the Force Protection Plan		x	

Table 6: Training Matrix – A-P2-002-GD2/PC-B01 Qualification Standard, Gun Detachment Second-in-Command. Note PO 005 Implement the Force Protection Plan is Supplemental

PO/ OREN	PO TITLE	TITRE DE L'OREN	PRES TRAINING CATEGORY / CATÉGORIE D'INSTR- PRÉS
099	Comply with the CAF Code of Values and Ethics	Se conformer au code de valeurs et d'éthique des FAC	
401	Supervise the operation of the Theodolite (T-16) during the occupation of a gun position	Superviser le fonctionnement due théodolite (T-16) pedant l'occupation de la position de pièces	Essential/ Essentielle
402	Supervise the operation of the Gun Laying and Position System during the occupation of the gun position	Superviser le fonctionnement du système de pointage et de positionnement des pièces pedant l'occupation de la position de pièces	Essential/ Essentielle
403	Supervise the conduct of Battery survey	Superviser le déroulement d'une arpentage de	Essential/
404	Supervise the operation of the battery Command Post	Superviser les opérations du poste de commandement de batterie	Essential/ Essentielle
405	Supervise the production of firing data using the Manual Artillery Plotting System	Superviser la production des données de tir à l'aide du système manuel de transposition graphique en artillerie	Supplemental/ Supplémentaire
406	Supervise the production of firing data using the Manual Artillery Plotting System for a basic mission	Superviser la production des données de tir à l'aide du système manuel de transposition graphique en artillerie pour une mission élémentaire	Essential/ Essentielle
407	Supervise the production of firing data using Indirect Fire Control Computer Software for fire plans using more than one firing unit	Superviser la production des données de tir à l'aide du logiciel ordinateur de conduite du tir indirect pour les plans de tir lorsque plus d'une unité de tir	Supplemental/ Supplémentaire
408	Supervise the production of firing data using Indirect Fire Control Computer Software during a fire plan, as the shooter	Superviser la production des données de tir à l'aide du logiciel ordinateur de conduite du tir indirect pour les plans de tir comme tireur	Essential/ Essentielle
410	Conduct an Artillery Command Post Exercise	Mener un exercice de poste de commandement d'artillerie	Essential/ Essentielle
411	Supervise the production of firing data using the mortar plotter	Superviser la production de données de tir à l'aide de l'abaque de mortiers	Supplemental/ Supplémentaire
412	Instruct an Artillery Technical Training Class	Présenter un cours d'instruction technique en artillerie	Essential/ Essentielle
413 (PD)	Prepare a unit level course	Préparer un cours au niveau de l'unité	Essential/ Essentielle

Table 7: Training matrix – A-P2-002-GTS/PG-B01 Qualification Standard and Training Plan, Gun Area Technical Supervisor last modified 1 April 2022. Note PO 405 is special procedures missions using MAPS and PO 407 is Regimental level missions and fire plans.

	Lvl 2	Lvl 3	Lvl 4	Lvl 5—Cbt Tm	Lvl 6	Lvl 7
Bde HQ						X
BG/Bn Gp HQ					X	
Tank	X	X	X	X	X	
Recce	X	X	X		X	
Mech Inf	X	X	X	X	X	
Lt Inf	X	X	X		X	
Engr	X	X			X	
Arty	X	X			X	
CSS	X	X			X	
Signal	X	X				
Intelligence	X	X				
EW	X	X				
MP	X					
IA	X					
HSS	X	X				
X	May be assigned (lead elm if applicable)					
*	Specialist intelligence capabilities (i.e. L2EC Lab) will be prescribed separately					
	Participates in by providing support to manoeuvre elms					

Table 8: graphic illustrating the maximum annual foundational training levels able to be directed to field force units. Deviations from this are to be articulated in the Canadian Army Op Plan. CAO 23-21, para 27

Appendix 1 to Annex A
To Chapter 2, Op Plan FY 23/24
December 2022

MANDATED FT FOR THE CA

* Assigned FT BTS as per Annex A of CAO 23-21 for all elements listed to include units committed and not committed to *Contingency* remits

Regular Force FT

Infantry: level 3 live, level 5 dry (without tanks)
Armoured (tanks and recce) – level 3 live, level 4 dry (Level 5 permitted)
Artillery (Field) – level 4 live
Artillery (STA) – level 4
Engineers – level 4
Signals – level 4
Electronic Warfare – level 4
CSS – level 4
HSS – level 4
Intelligence – level 4
Influence Activities – level 2
Unit HQ – level 6 CAX
Formation HQ – level 7 CAX

Cold Weather Training

Common to All
Operate in a Cold Weather Environment to level 3, Execute Administration and a core BTS at level 3 dry in cold weather conditions to include snow.

Regular Force
In the *Build* year operate in a Cold Weather Environment to level 3, Execute Administration and a core BTS at level 4 dry in cold weather conditions to include snow.

5 Cdn Div Intelligence, Influence Activities and Electronic Warfare to level 2 dry

ARCG
Operate in a Cold Weather Environment to level 3, Execute Administration and a core BTS at level 4 dry in cold weather conditions to include snow.

Army Reserve FT

Infantry – level 2 live, level 3 dry
Armoured – level 2 live, level 3 dry
Artillery (Field) – level 4 live
Engineers – level 3
Signals – level 3
Electronic Warfare – level 3
Intelligence – level 3
CSS (Tn and Supply) – level 3

Army Reserve Mission Tasks

Inf MT – level 3 dry/live
Recce – level 3 dry/live
Engr – level 3
Lt EW – level 3
IST – level 2
FMV – level 2
OSIS – level 2
Tac 1st Line CSS – level 3
CBRN Recce – level 3
AASI – level 2
Cyber protection – level 2

2A1 – 1/5

Figure 1: screenshot of mandated foundational training for the CA from the fiscal year 23/24 Op Plan illustrating Army Reserve Artillery (Field) is to achieve level 4 live BTS.

members first complete additional training. The foundational training levels for the artillery are not exempted under the Canadian Army Operational Plan for Fiscal Year 23/24. An ARes Artillery unit cannot competently reach level 4 due to a lack of NCMs trained in Regimental or multi-unit missions.

Further review of the BTS manual reveals that in levels two through four of the Artillery BTS, "Local Defense is [initiated/briefed/implemented] IAW BTS A02304174E EXECUTE LOCAL DEFENCE" is a common requirement for the GA. As has already been shown, the GA NCM courses almost exclusively train local defense during the supplemental training only. The Reserve Force is completely ill-equipped and unqualified to carry out or implement force protection of the gun battery.

So how do we train to the same standard? The current "essential" and "supplemental" classes of training have proven difficult to achieve desired results.

"Training is command-driven"

"Thirty-seven point five days." Every senior artillery officer and Chief Warrant Officer (CWO) interviewed for research into this article, made the same inference. 37.5 days per soldier is what an ARes Commanding Officer (CO) receives for a pay budget every fiscal year. Within those 37.5 days, a CO and their staff must manage the budget to include:

- Individual and collective training within the unit;
- Training on National Defence policies, such as sexual harassment and workplace health and safety;
- Preparation of training course;
- Administration;
- Civic duties in the local community; and
- Ceremonial duties [8]

Some ARes units are making an effort to conduct some supplemental training, moving money around or relying on not every soldier being present at every training event in order to free up money. However, with 55 days of training missing from the GA training, with 30 of those days being at the GATS and GATSM level, where does a unit find the time and money to be able to train these deltas? Where is the command-driven push for remedies or mitigation, while this is being done at the ARes Regimental level? Furthermore, this training is sometimes difficult to organize and conduct, particularly in the 3rd Canadian Division. While in the 4th Canadian Division, all ARes units are relatively close together, or at least, are able to group for a weekend of training. The ARes artillery in Canada's west is spread out over more than 2,600 kilometers. How does the CA expect the units within a division that large to gather together over numerous weekends in order to pool resources and personnel to conduct supplemental training?

Both IT and CT training must be relevant, engaging, challenging, and needs to have a purpose. In the artillery, a purpose is achieving level 4 BTS to be prepared to support full spectrum operations. Training should also inspire confidence in both the trainees and the leadership to create a favourable learning environment. Without appropriate IT, the relevant and mandated CT is unable to be competently and safely executed.

Safety is a command responsibility. In its current state, the ARes artillery is suffering from a systemic issue of leadership by not having the requisite qualifications and experience to properly and safely run live level 4 training for Regimental fire missions and force protection. Furthermore, the ARes artillery is lacking leaders with the qualifications and experience to teach and mentor the next generation of soldiers who will run IT and CT. The role of a gunner is inherently dangerous; relaxing the amount of training required to get to various levels of leadership will only make it more unsafe.

Conclusion

A problem cannot be solved by simply throwing money at it, as the adage goes. One exception to this rule is training, and investing in it will eliminate, or at the very least alleviate, the other resource limitations. Money allows for the purchase of additional equipment as well as the maintenance of that equipment (or at the very least, the availability of serviceable spares in case of a breakdown). More training days can be paid for with money, which frees up more staff members to deliver competent instruction. In turn, this strengthens the training corps and furthermore permits the soldier to learn the skills and invest the time required to become proficient in them before they may deploy and be required to be a master of those skills.

It is time for the Royal Regiment of Canadian Artillery to re-evaluate the need for training deltas amongst the ARes and develop a training plan that is identical for both Regular and Reserve soldiers. Some recommendations to resolve the training disparity and train every gunner to their full competency are:

i) Increase funding to the ARes, providing additional training days throughout the year to complete supplemental training. Furthermore, qualifying the current training cadre first would be extremely beneficial;

ii) Increase the use of modular courses, both ARes and Reg F, and include what is currently supplemental training within each module;

iii) Increase the amount of Instructor-in-Gunnery and Assistant Instructor-in-Gunnery visits to ARes training, both CT and IT. Allow these visits to be long enough to provide meaningful mentorship to

the ARes units and appropriately evaluate the training state and competencies within the ARes RCA;

iv) Remove redundant training from courses which would reduce the amount of training days; and

v) When possible, train both elements together. This will not only ensure both elements are trained the same, but will increase available training resources and importantly, foster cohesion between those elements. Train as we fight – together;

The RCA prides itself in being "a Regiment of Regiments" under one cap badge. They are one family. By training everyone to one standard, it ensures the RCA remains one family, while enabling one team, one fight.

References

A. A-P9-002-ART/PG-B01 Qualification Standard and Training Plan (QS/TP), Rank Qualification – Artillery Detachment Member (Common) – Gunner

B. A-P9-021-DP1/PG-B01 QS/TP Gun Detachment Member

C. A-P9-021-S08/PC-B01 Qualification Standard (QS) – Artillery Command Post Technician

D. A-P9-021-S08/PH-B01 Training Plan (TP) – Artillery Command Post Technician

E. A-P2-002-GD2/PC-B01 QS – Gun Detachment Second-in-Command

F. A-P2-002-GD2/PH-B01 TP – Gun Detachment Second-in-Command

G. A-P2-002-GDC/PC-B01 QS – Gun Detachment Commander

H. A-P2-002-GDC/PH-B01 TP – Gun Detachment Commander

I. A-P2-002-GTS/PG-B01 QS/TP – Gun Area Technical Supervisor

J. A-P2-002-TSM/PG-B01 QS/TP – Gun Area Troop Sergeant Major (2018)

K. A-P9-021-S35/PH-B01 Training Plan Gun Area Troop Sergeant Major dated 18-06-2004

L. Canadian Army Op Plan FY 23/24 version 1

M. CAO 23-21 Canadian Army Collective Training Policy – Foundation Training

N. B-GL-383-002/FP-001 Battle Task Standards for Land Operations

O. B-GL-300-008/FP-001 Training for Land Operations

End Notes

[1] B-GL-300-008/FP-001 Training for Land Operations (2014-06-14) Chapter 1, Section 6

[2] Strong, Secure, Engaged – Canada's Defence Policy

[3] 2016 Spring Reports of the Auditor General of Canada, Report 5-Canadian Army Reserve-National Defence

[4] Strengthening the primary reserves – The Royal Canadian Artillery Perspective

Maj O.M. Wing and Capt N.E. Kaempffer

Canadian Army Journal 17.2 2017

[5] Chap 1, Para 13, A-P2-002-TSM/PG-B01 Qualification Standard and Training Plan Gun Area Troop Sergeant Major, approved 13 Jul 18, last modified 30 Oct 20

[6] 2016 Spring Reports of the Auditor General of Canada, Report 5-Canadian Army Reserve-National Defence, para 5.104

[7] B-GL-300-008/FP-001 Training for Land Operations (2014-06-14) Chapter 1, Section 6, Paragraph 10

[8] 2016 Spring Reports of the Auditor General of Canada, Report 5-Canadian Army Reserve-National Defence, para 5.77

Interviews conducted:

LCol P.J.E. Pitt, CO 56th Field Artillery Regiment, 27 January 2023

CWO D.R. Shaughnessy, RSM 56th Field Artillery Regiment, 28 January 2023

CWO C.E. Lelond, RSM 38 CBG ATG and ARes RSM RCA, 03 February 2023

LCol J.A. Phillips, Cmdt RCAS, Deputy Director RCA, 10 February 2023

LCol M.P.C. Bérubé, Deputy Director RCA (Reserve), 24 February 2023

LCol J.A. Causey, CO 33 CBG ATG and Senior Staff Officer-Artillery for 4th Canadian Division, email correspondence, 30 January 2023

Range Training Area Improvements

WO M.R. Chasse

Background

In the past, the Artillery has deployed in many areas that were unsuitable for vehicles and equipment currently in use. As such; we have caused unnecessary damage to our vehicles, equipment and caused injury to our personnel. All ranks of the Royal Canadian Artillery are responsible to ensure that training is conducted without impact to the environment. The common deployment areas that the artillery utilizes are generally properly maintained and proper range clearances are completed to ensure the longevity of the Range Training Areas (RTA). Base Commanders of the Canadian Armed Forces (CAF) have governing power over all maintenance in the RTA. They will, however, delegate this responsibility to the Range Training Area Management (RTAM) Team. These RTAMs are ultimately responsible for ensuring that all maintenance and development requests by units are properly planned out, cost estimates are conducted and prioritization of projects in order to facilitate the environmental and operational sustainability of the RTA. New technologies, training methodologies and weapon systems will continue to change as will the requirements that the Artillery must adhere to in order to operate within the RTAs. Proper planning and prioritization of projects will ensure the continued use and long-term sustainability for ranges and training areas. [1]The majority of Canada's infrastructure in the Range Training Areas were developed back in the 1940's and 1950's, and thus it brings into question the long-term availability and long-term use of Canada's RTAs.

Individuals Responsibilities

I would recommend that a form be created and made available for course programmers and command elements who deploy within the RTA (see Annex A). This form will allow units to identify deployment areas that require the attention of the RTAM after every exercise. The following information should be provided when filling out the form: location, deficiency observed and substantiation for the alterations.

Unit Responsibilities

Rather than a reactive approach to deficiencies found in our training areas, units should develop a team to have a more proactive approach to unsuitable training areas and infrastructure. In doing so, we would reduce the time required in having the desired maintenance, execute planned projects and facilitate the collection/distribution of other units upcoming projects in their respective operational areas that may affect our future training. This will allow units to plan out training without being negatively impacted by ongoing maintenance and projects in their training areas. The collection of RTA Deficiency and Development will allow organization and prioritization of all requests. This will ensure a more proactive approach in establishing a more desirable training environment which will ensure the safety of our troops, the serviceability of our vehicles and equipment, and therefore a more effective training environment for current and future operational requirements.

Unit RTA Management Team

The requirement for the gathering and distribution of information in regards to the suitability of deployment and impact areas for all streams of the artillery should be kept with their unit representative and their team. This team can be known as the Unit RTA Management (URTAM) Team. All requests could be recorded in order to ensure that they fall in line with environmental guidelines and unit training requirements. A monthly update to current and upcoming maintenance in the RTA should be distributed to the Command Teams of each Battery for further dissemination and allow for all command elements at the units to be well aware of all activities that may impede training and allow for the planning to mitigate any issues that can be forecasted. It is essential that all maintenance and new developments have justification, a general description of the work and the expected outcome. The substantiation should be based on the requirements for new equipment or new deployment types based on current or future threats (ie - decentralized gun posi-

tions). If the matter is of maintenance, the justification of why it is required, must be substantiated with its deficiency. All unit requests must be processed through the Unit Environmental Officer to ensure that they will not have a negative impact on the RTA environment and can be prioritized based on unit requirements and planned projects. All requests are to be clearly communicated and answer the question of why it is required. It is not suggested that the URTAM Team simply put in all requests immediately but rather submit all requests to be completed within 3-5 year period. This will allow other units to put in their requests without the artillery monopolizing training area projects on each respective base.

Unit Operations and Training

Unit operations can use this information to designate deployment locations in the RTA and submit requests to effectively plan out field training exercises. By putting in snow/ice clearing and vegetation overgrowth clearing requests in line with the national calendar to ensure a fluidity of operations on exercises. Once a memo is drafted and approved by the URTAM Team, it will require the commanding officer of the unit to approve the request, at which time it can be submitted higher. In the case of the Royal Canadian Artillery School, this approved/signed off memo would proceed to CTC HQ and if approved would be sent to Real Property Operations (RPO). RPO will conduct a cost estimate and submit the work request to have the project planned and executed. It is worth noting that all plans for RTA improvements are cost captured by the RPO and are covered by their budget and not by the requesting unit. These requests can be anything up to but not limited to winter snow and ice clearing requests, vegetation overgrowth clearance, and pest control for infrastructure in the RTA. All these requests can be planned in advance as they may be an annual requirement to ensure the success of training events as mentioned above with the unit operations.

Base RTAM Team

When discussing future development plans, the RTAM Team at each base is responsible to conduct initial project analysis and cost estimates for inclusion within the Base Development Plan. Units that are able to clearly indicate their intentions for maintenance and improvements will allow for a smooth transition to the base RTAM Teams in order to mitigate any push back and allow those teams to effectively implement these requests in a timely manner. Proactive requests that may be submitted annually can be prepared and submitted to the RTAM Team well in advance to reduce any negative impact to training.

Conclusion

As these Standard Operating Procedure (SOP) are implemented, units can continue to work towards developing them in order to meet current and future training requirements. Overall the implementation of URTAM SOPs will ensure that our soldiers are not being negatively impacted by unsuitable conditions that the unit can effectively control. Having ideal positions within the RTA may not be realistic, due to the fact that when units are deployed on operations, deployment areas will rarely be ideal. However, this allows for our members to develop their abilities and skills while reducing the risk of injury that could occur from mounted and dismounted training. Additionally, this will reduce the wear and tear on our vehicles which will reduce the Vehicles on Repair states, to include equipment in vehicles and towed equipment. This will ensure that the appropriate allocation of vehicles for training exercises are deployed which will enhance the training environment. Ultimately the implementation of these SOPs will help ensure the serviceability of our troops, vehicles and equipment, which will enhance our ability to deploy on operations. Furthermore, it will reduce the restrictions of vehicles and equipment to allow for maximum load on courses on a more regular basis and enhance the longevity of our training area. As we continue to develop and implement new initiatives, it is important to remain up to date on all new directives that may affect this process. Furthermore, as users of the RTA we must ensure we remain vigilant to changes that may impact or improve conditions in our training area and the processes for maintenance and future development.

References

[1] Audit of Range and Training Area Management - https://www.canada.ca/en/department-national-defence/corporate/reports-publications/audit-evaluation/audit-range-training-area-management.html

References: B-GL-381-001/TS-000 – Training Safety

B-GL-381-002/TS-000 – Range Maintenance and Construction

ARTILLERY SCHOOL STANDING OPERATING PROCEDURES RTA MAINTENANCE/DEVELOPMENT

References:

A. B-GL-381-001/TS-000

B. B-GL-381-002/TS-001

AIM

1. The aim of this SOP is to detail the duties and responsibilities of the Unit Range Training Area Management Team and the procedures to have maintenance and future development of the RTA.

GENERAL

2. Any deficiencies of AMA's that are found to negatively affect training shall be reported to the Unit RTA Management Team in order to have these rectified in a timely manner. If the intent is for future development, members can submit their request on the form in Annex A.

PROCEDURE

3. Deficiencies

a. When an area has been deemed unsuitable for use. It shall be recorded on the Annex provided. Details for the location, description of the deficiency, and the substantiation of why this is making the AMA unsuitable. The originator shall sign and date the form and submit it to the Unit RTA Management Team.

b. Once the Unit RTA Management Team has received a RCAS RTA Deficiency/Development Form, the team shall verify the information on the form, compare it to any legacy forms already submitted. A member will be required to visit the location specified and conduct an inspection of the deficiency. When the deficiency has been confirmed, the Unit RTA Management team will then make their recommendation on how to resolve the issue and include it in their RTA management plan.

Future Development

a. Ongoing development of the RTA is required in order to adapt to current and future threats, as well as requirement for new weapons and equipment procured by the CAF.

b. Any intent for development of new AMA's shall be recorded on the form in Annex below. The procedure is similar to the deficiencies reported, whereas the Unit RTA Management Team will confirm requirement for a new AMA, then deconflict with any ongoing development currently in progress with Base RTA Management. Once deconflicted, Unit RTA Management will confirm suitability of the proposed position and include it on the Unit RTA Management Plan. Once it has been checked for any environmental considerations, then a memo to the Cmdt can be drafted and once signed off, it can be pushed to the CTC HQ.

Unit RTA Management Plan

a. The RTA Management Plan will encompass a 5 year period. As new deficiencies and future development request are submitted and confirmed, they will be included on the RTA Management Plan. This plan will also house the annual maintenance requests for vegetation overgrowth control, pest control and SNIC. These can be planned out based on planned exercises on the RCAS Calendar.

ÉCOLE DE L'ARTILLERIE INSTRUCTIONS PERMANENTS D'OPÉRATIONS MAINTENANCE/ DÉVELOPMENT CTSE

Références :

A. B-GL-381-001/TS-000

B. B-GL-381-002/TS-001

BUT

1. Le but de cette IPO est de décrire les tâches et les responsabilités de l'équipe de gestion de la zone d'entraînement du champ de tir de l'unité et les procédures de maintenance et de développement futur des CTSE.

GÉNÉRALITÉS

2. Toutes les lacunes affectant négativement l'entrainement dans les ZMA devront être signalées à l'équipe de gestion des CTSE de l'unité afin qu'elles soient corrigées en temps opportun. Si l'intention est pour un développement futur, les membres peuvent soumettre leur demande remplissant le formulaire à l'annexe A.

PROCÉDURE

3. Défectuosité

a. Lorsqu'une zone a été jugée inutilisable, Il doit être consigné sur l'annexe fournie avec détails de l'emplacement, description de la lacune et justification de la raison pour laquelle cela rend la ZMA impraticable. L'auteur doit signer et dater le formulaire et le soumettre à l'équipe de gestion CTSE de l'unité.

b Une fois que l'équipe de gestion CTSE de l'unité a reçu un formulaire de défectuosité/développement ÉARC CTSE, l'équipe doit vérifier les informations sur le formulaire, les comparer à tous anciens formulaires déjà soumis. Un membre devra se rendre à l'endroit spécifié et procéder à une inspection de la défectuosité. Lorsque la

lacune a été confirmée, l'équipe de gestion CTSE de l'unité fera alors une recommandation sur la façon de résoudre le problème et l'inclura dans leur plan de gestion CTSE.

Développement Futur

a. Le développement continu du CTSE est nécessaire afin de s'adapter aux menaces actuelles et futures, ainsi qu'aux besoins en nouvelles armes et équipements achetés par les FAC.

b. Toutes intentions de développement de nouvelles ZMA doit être enregistrée sur le formulaire en annexe ci-dessous. La procédure est similaire aux défectuosités signalées, tandis que l'équipe de gestion CTSE de l'unité confirmera la nécessité d'une nouvelle ZMA, puis établira un plan en lien avec tout développement en cours par la gestion du CTSE avec la gestion CTSE de la base. Une fois le plan confirmé, la direction de l'unité CTSE confirmera l'utilisation adéquate de la position et l'inclura dans le plan de gestion de l'unité CTSE. Une fois que toutes les considérations environnementales ont été vérifiées, une note de service au Cmdt sera rédigée. Une fois signée, elle sera transmise au QG du CTC.

Plan de Gestion du CTSE de l'Unité

a. Le plan de gestion CTSE couvrira une période de 5 ans. Au fur et à mesure que de nouvelles défectuosités et de futures demandes de développement seront soumises et confirmées, elles seront incluses dans le plan de gestion du CTSE. Ce plan abritera également les demandes annuelles d'entretien pour le contrôle de la prolifération de la végétation, la lutte antiparasitaire et l'opération de neige et de glace. Ceux-ci peuvent être planifiés en fonction des exercices planifiés du calendrier l'ÉARC

RCAS RTA Deficiency/Development Form

Location (AMA or Grid Ref)	**Deficiency or proposed development**	**Substantiation**
Air Strip 3 AMA 203	Large Gravel Pile on lower Hardstand	No benefit of it being on AMA, it only impedes use of full AMA. Has been left on position for 8+ years untouched.
Location (AMA or Grid Ref)	**Deficiency or proposed development**	**Substantiation**
Hersey Bunker Gr 19T GL 105 766	Integrity of the Bunker to withstand a blast from a 105/155mm HE.	Many cracks in structure of bunker, cracked blast proof glass, general condition of interior of bunker requires attention.
Rank and Name	WO Name	**Date:** 27 Jan 2023

Inspected By:	**Reccomendation(s):**	**URTAM O approval:**
Capt Name	**-Submit request to Base RTAM for disposal of gravel from AirStrip 3.** **-Submit request to Base RTAM for a safety**	Maj Name
Date: **28 Jan 2023** **Signature:** **<SIGNED>**		**Date:** **29 Jan 2023** **Signature:** **<SIGNED>**

Divide to Unite.

An approach to Surveillance and Target Acquisition (STA) close support Unit Structure

WO J.D. Firmin

Forward

Firstly, I would like to acknowledge the input received from the Close Support Units (1 RCHA, 2 RCHA and 5 RALC), your responses provided much to consider and, in many cases, reframe the initial concept. Gratitude to the Drill Sergeant Major Royal of the Canadian Artillery School Master, Warrant Officer Munro for their insight on how this concept might affect/ impact the Military Employment Structure review within the artillery. Capt Larkin, for the discussions on this topic so many years ago and their framework support to this current product. Without this support, this idea may have remained just a thought. I would also like to highlight that the opinions and specific events in this article are based on personal experiences on Exercises (Ex) and Operations over the past 15 years as an STA soldier in the Artillery.

The aim of this paper is to highlight current perceived issues in the Close Support (CS) STA Batteries (Bty's) and propose structural changes that would seek to alleviate these issues. This path is fraught with pitfalls and the analysis must remain fair and honest in its examination of the problem space and at all times maintain realisms with those expectations. In order to shape the recommendation, the following are key areas that must be reviewed. Training, employment, impact on unit cohesion, Command (Comd) relationships, and finally, is this new structure achievable not only on paper but in practice on the ground.

Background

We will never find where we can go without understanding where we came from. STA in the modern Canadian context can be measured in time through the Land Force Intelligence Surveillance Target Acquisition and Reconnaissance project which began in 2003, and since has produced most of the STA assets and capabilities available to the artillery and the larger army as a whole. Although the equipment has been successful in its various roles whether domestic or through deployments (Afghanistan, Iraq, and Latvia), the issue lies with the value added employment out of the regiments. The problem space lies with their involvement throughout the regimental training year. Unit Commanding Officers (CO's), Regimental Command Post Officers and Operations Officers are, as a matter of necessity, more gun and Observation Post (OP) centric and as such the training and focus within CS regiments remains focused in that realm. Although STA subunits can make use of this focus to qualify candidates and exercise some of the capabilities, the priority of the regiment seems to rarely line up with the requirements of the STA call signs (C/S). How can this be mitigated?

In looking at the UK model for STA units, The British Army has an STA capability within the artillery, however unlike Canada, they have chosen to place both CS and General Support (GS) all housed at the Marne Barracks Catterick U.K within one Regt 5 Royal Artillery. This regiment consists of 4 STA Bty's, a Headquarters (HQ) Bty and a Special OP Bty known for their long-range STA patrol capability. This structure, although still under the Royal Corps of Artillery, facilitates STA focused training to be honed year round under a Comd whose interest is advancing the capability. Essentially there is a common focus amongst the regiment allowing for a common goal.

Context / Problem

In order to review the situation objectively, I've analyzed the following parameters which the conclusions will support my recommendations. Those chosen were;

1) Training - current situation versus foreseen improvements within the proposed recommended structure;
2) Employment - looking at Operations and how regimental assignments are selected compared to the proposed structure with widened deployment;
3) Impact on Unit cohesion - both for the individual and for Comd,
4) Comd relationships - options and selection criteria; and
5) Unit structure - a top-down overview training impacts / improvements.
In general, the exercises within a calendar year that affect the CS units are consistent.

Using 1 CMBG as an example, 1 RCHA has EX LIMBER GUNNER in the fall and EX FROZEN GUNNER in the winter. With virtual Brigade (Bde) exercises in between (EX VIRTUAL RAM in November, and EX UNIFIED RESOLVE in January). The year is finalized with the validation of the Bde during Ex MAPLE RESOLVE. STA has a role within each these exercises, and currently their participation in the training exercises is ordered by Comd staff of the regiment. This is loosely framed along the Battle Tasks Standards (BTS) for STA as currently understood. The question is how this affects the close support STA units?

In the regimental field Ex context in keeping the BTS required to be achieved, STA Bty's are largely left to their own devices to move about the training area and deploy in accordance with current Tactics Techniques and Procedures in order to detect and assess the information available from the firing units. This of course works well enough for the individual detachments, however the problem lies with the matter of direction and planning at the regimental level which often leaves STA Btys behind, in many cases an afterthought. Tactical scenarios pay little attention to the weight of influence STA sensors can bring to bear and when highlighted during the conduct are often paid lip service. So, why does this matter if we are achieving the required BTS? It goes to the morale and value of the individual soldiers when they watch the scenario and see that regardless of their input, it seems not to affect the movement of the exercise. There is often little opportunity for the counter battery aspect within the regimental context.

As it applies to the Surveillance and Target Acquisition Coordination Center (STACC), there is no place for training the individuals within the organization at the Bty or regimental level. Unfortunately, the members within the organization often end up playing a simple administrative role, this is owed to the fact that by nature of the STA it requires a Bde to be truly exercised. The regimental level simply cannot offer the required entities that are necessary to interact with.

The first opportunity for the STACC to be truly exercised, is during the virtual exercises of VIRTUAL RAM and to a greater extent during UNIFIED RESOLVE. This is the first time that the STACC has the occasion to link in with other Intelligence, Surveillance and Reconnaissance (ISR) providers and begin to see the actual scope of their tasks. However, it comes with its own set of problems. As mentioned in the background of this article, key planners and organizers within the CS Units are by necessity gun and OP centric and as such during the coordination and planning of large Bde exercises, the actual needs of the STACC for example often go unaddressed, in particular as it applies to Communications Infrastructure Systems (CIS). During UNIFIED RESOLVE 21, while employed as the STACC Warrant Officer, the STACC had not been allocated any LCIS terminals. It was observed that we needed at least two in order to do the tasks correctly. The error was in the assumption that STACC and Fire Support Coordination Center (FSCC) where co-located and essentially the same entity and therefore one terminal would suffice. This was a simple misconception that could have been easily identified and corrected if the STA had a larger presence in communication with Bde planning. This is a small isolated incident that is indicative of a larger issue. STA provides Bde capability's and as such should have a more direct connection with key stake holders vice going through the conduit of the CS Units which have plenty to coordinate alone.

Unit Structure

In order to address some of the issues identified in the earlier paragraphs, a restructuring of the current Artillery Corps is proposed. The process of moving troops from all over the country to one central location as a CS STA regiment would be costly and require new infrastructure, therefore this is perhaps not feasible, but the concept in general is a workable one.

The Comd element of the CS STA regiment could be held under 5 CCSB in Kingston and comprised of CO, Regimental Sergeant Major, Operations cell, Training Cell, and Joint Intelligence Surveillance and Reconnaissance (JISR) Cell with 3 Bde STACC's. The positions Yielded (PY) would be shifted out of the CS Units STACC's with the possible addition of 10 PYs to cover the difference. The remainder of the STA PY's would remain with the existing units.

Kingston was selected for its proximity to Canadian Forces School of Military Intelligence, Joint Signals Regiment, and 21 Electronic Warfare. All

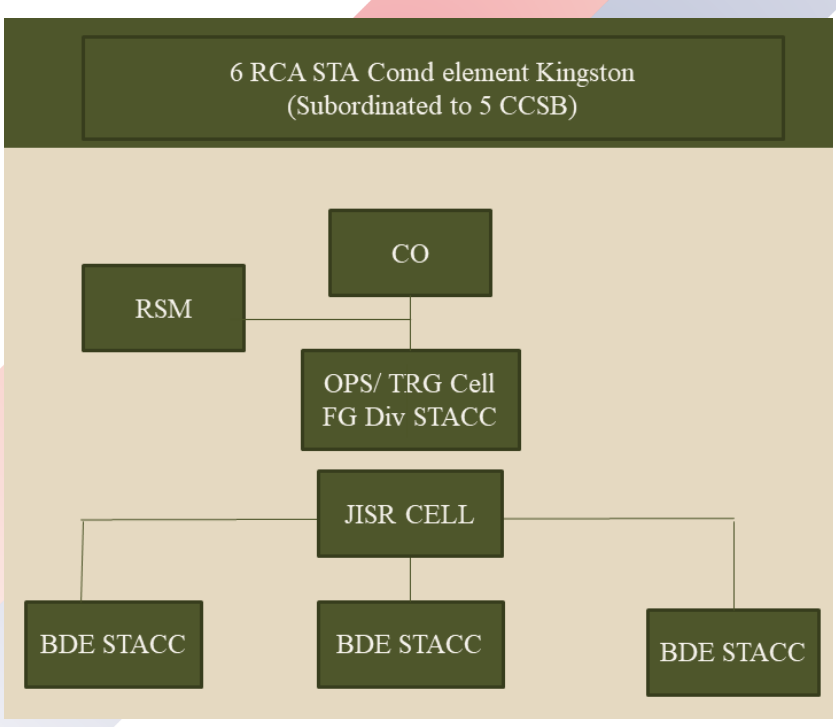


Fig 1.1 (CS Regt HQ Orbat)

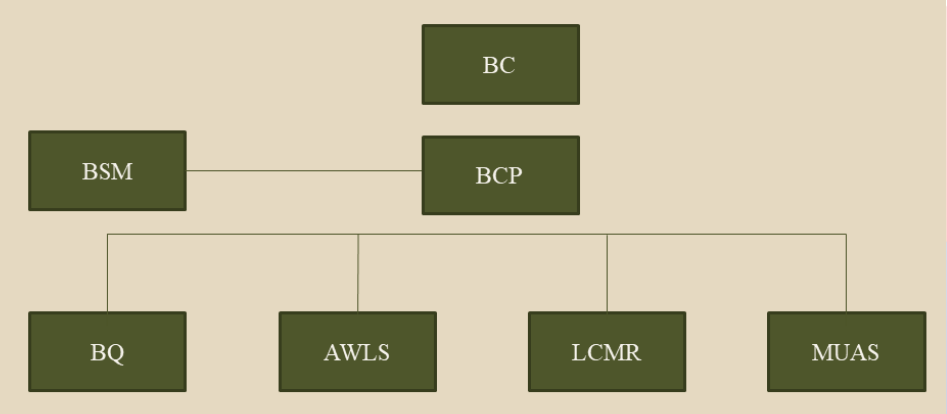


Fig 1.2 (CS Bty Orbat with in the Gun Regt)

elements that currently and particularly moving into the future which have a close battlefield relationship with the STACC and STA sensors. As we continue to refine the JISR process at Divisional and lower levels, having a cell within the CS regiment close to those elements who contribute significantly to the ISR plan therefore becomes invaluable from an ease of training standpoint.

The remaining elements of the STA Bty's, would remain in location with their current regiments across the country with albeit a slightly different organizational layout. We would see the Battery Command Post (BCP) holding the Bty level Operations and training positions that we currently see the STACC hold in garrison, with the Command Post Sergeant, Master Bombardier and Bombardiers holding the positions and then being employed as BCP in field operations. The remainder of the Bty would retain a troop structure comparable to the current layout.

By Virtue of the fact that the biggest hindrance to valuable training for the STACC is its lack of employability on the regimental level, this structure aims to solve this problem. All remaining elements of the STA Bty in the regiments would continue to have a role at the regimental level. BCP C/S 5 directs movement of the sensors in support of the Counter Battery (CB)/ ISR plan, reports directly to C/S 0 and maintains a link for CB fires. While the STACC elements can focus on their primary role of artillery intelligence support to operations and linking into the JISR planning. Further to this, STACC personnel can enhance their understanding of Future Operations (FUOPS), or in plain text the planning and the important role that sensors play into a larger space than just CB, something while recognized is not fully exploited.

Should the STACC's and Comd be held together, this would help to solve some of the training requirement deficiency as well as to see STA focused personnel responsible for coordination of Bde and higher training events. This could give perhaps a more vested interested in ensuring the resources required are allocated correctly. As we are aware, the military is moving more to a simulated training environment and with this proposed structure a dislocated STACC would not suffer a loss in training quality.

Comd Relationship

So, if we separate Comd elements from the body of Bty's, how do we ensure smart and accurate Command and Control (C2)? To address this, a similar approach that 4th Regt (GS) has with regards to the ASCC being TACON to each of the Bde's should be considered. In this scenario each of the STACC's in Kingston would be given a Tactical Control Relationship (TACON) to their respective Bde and in turn the Bty's physically housed with the CS Artillery units would be TACON to regiments. By virtue of this relationship, support can still be provided but as per the table below there be a level of oversight of the STA Bty's ensuring meaningful employment and training driven by the Comd element in Kingston, who would retain the ability to assign the specific missions and tasks.

(See Annex A on next page)

Impact on Unit cohesion

When disseminating this initial concept to units for feedback, concerns with potential impacts on unit cohesion and troop morale within the regiments were present. In a slightly biased view (as the idea is mine) the impact at the soldier level is minimal as there is still space for regimental identity. The 1 RCHA STA Gunners are still Gunners. However, after feedback from some Commanders, ideas not considered came to the surface. The idea of 'serving two superiors'' is one that is most pressing as there would be two chains of Command essentially that the Bty in the regiment would be responsive. The direct link within the regiment and then the eternal link to the STA Regiment. A clearly delineated Comd relationship would remedy this concern but understand that the concern exists. More pressing perhaps, is the ability of the individual soldier to move laterally within the Unit. Currently, the STA soldier can move from the Bty to perhaps to the regimental command post or transport. This is concerning because it represents a friction point for internal staffing purposes. On the Surface, the answer is posting troops in and out of Kingston to fill positions, but a working group would need to be established and tasked to pay careful attention to the solution to this. Although I do not have a direct solution to this problem, which is potentially a large one, I would be remised in not mentioning it.

Conclusion

The personal value of an individual cannot be gauged by money or respect although outwardly they may seem like the answer, they are merely surface level appeasements. The true self worth of someone is measured through satisfaction with life and in our society, work is life as you spend your life working. As an STA soldier feeling undervalued and ignored by those on the peripherals in the CS units, can be very difficult as experience shows. A new model must be adopted for the employment, training and development of the STA with in the Artillery as it is not going anywhere and conversely is becoming ever more important to the battlespace.

Although the answer is not known, what is perfectly clear is that the model from an STA perspective is not working. There are on the level, two options, continue with the Status Quo or push radical change as proposed and hopefully somewhere in the middle is the answer.

References

B-GL-373-001/FP001 Surveillance and Target Acquisition in Land Operations

B-GL-300-003/FP001 Command in Land operations

B-GL-352-001/FP001 Intelligence Surveillance Target acquisition and reconnaissance

1 CMBG Order 001 – Operating Plan 2021-2022

ANNEX A TO CHAPTER 3
COMMAND RELATIONSHIPS

	Full Command(1)	COMMAND(2)		CONTROL(5)		Planning Authority (7)
		Operational Command(1) (3)	Tactical Command (4)	Operational Control(6)	Tactical Control	
1. Assign Separate Employment of Components of Units/ Formations	X	X				
2. Assign Missions[8]	X	X		X		
3. Assign Tasks	X	X	X	X		
4. Delegate Command Authority:						
Delegate OPCOM	X	X				
Delegate TACOM	X	X	X			
Delegate OPCON	X	X		X		
Delegate TACON	X	X	X	X	X	
5. Coordination of Local Movement, Real Estate and Area Defence	X	X	X	X	X	
6. Planning coordination	X	X	X	X	X	X
7. Administrative Responsibility[9]	X					

(Picture From B-GL – 300-003/FP001 Command in Land operations)

Establishing a Naval Gunfire Cell at the RCAS

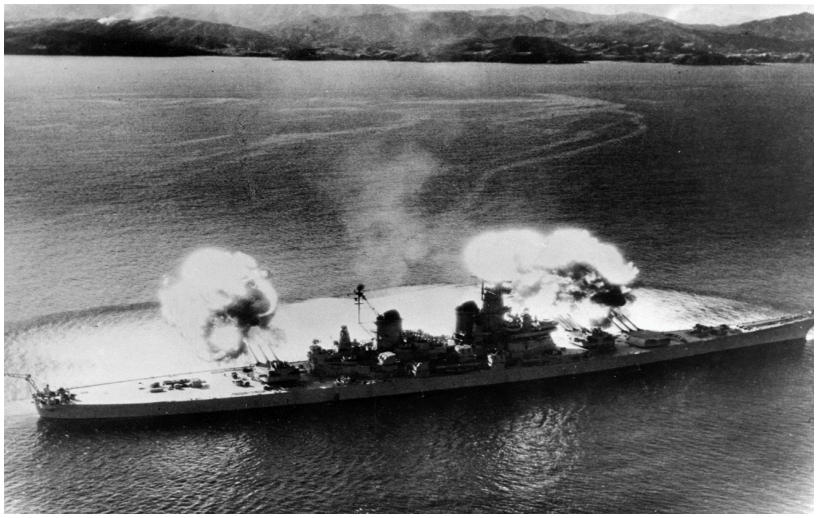
WO K.D. Vanderzwaag

Aim

The aim of this journal is to discuss the value of implementing a Naval Gunfire Support (NGS) cell within the Royal Canadian Artillery School (RCAS) in order to re-establish and maintain a capability that has slowly degraded through the years. The degradation of the Canadian Armed Forces (CAF) NGS can be attributed by many factors, but primarily due to many years without the Royal Canadian Navy (RCN) having the capability to provide surface fires has greatly declined this skillset and corporate knowledge. The RCN is currently in the process of modernizing its force, upgrading the HALIFAX class frigates to the Canadian Surface Combatants (CSC), which will be delivered with an enhanced capability of conducting surface fires in support of ground forces.

History

Naval Gunfire is defined as fire provided by the Navy surface gun, and missile systems in support of a unit or units, and has been used in conflicts all around the world dating back to the Siege of Calais in 1347. During the Crimean war, NGS was used by Franco-British ships in the battle of Petropavlovsk attempting to destroy the port. In the American civil war, NGS was used in multiple conflicts against Ports and Forts to help shape the victory for the Union. On April 25th 1915, the first major amphibious assault in the modern era occurred in the Gallipoli Peninsula with the use of NGS as preliminary bombardments. Although it was considered a failure, many lessons were learned. This would eventually help develop doctrine for future amphibious assaults. On August 19th 1942, during World War Two (WWII) the lack of NGS during the Dieppe Raid cost many lives. Even though NGS was initially planned for, there was not enough commitment of resources; and the execution of the fires left pillboxes and coastal defenses unscathed, leaving the landing force with minimal fire support. The casualties suffered by the Canadian military force in the Dieppe raid were extremely heavy. In all categories they totaled 3367 at all ranks. On June 6th 1944, which is now known as D-Day, the greatest amphibious assault in history took place in Normandy. As with any amphibious attacks, there is a lack of sufficient land-based artillery in the assault divisions and on D-Day, the Allies brought powerful naval artillery to Normandy. It was provided by seven battleships, twenty-three cruisers, ninety-three destroyers, two monitors, and two gunboats. Because most gunfire support ships could not see their targets, indirect fire was required. Some destroyers slid within a few hundred yards of their assigned beaches to support the army, and though communication problems frequently arose, the overall effect was largely beneficial. The chief of staff of the First Infantry Division Col. Stanhope B. Mason stated, “I am firmly convinced that our supporting naval fire got us in; that without the gunfire we positively could not have crossed the beaches.” This statement shows



https://www.history.navy.mil/our-collections/photography/us-navy-ships/battleships/new-jersey-bb-62/80-G-435681.html

that NGS was critical for the success of the invasion of Normandy, which ultimately was the beginning of the end of WWII. In 1945, during the Okinawa campaign, warships fired nearly 300,000 rounds of 5 inch or larger shells and on April 1st 1945, the United States (US) forces invaded Okinawa and was the last major amphibious assault of WWII. In the Vietnam War, between 1965 and 1972, the US had destroyers and cruisers stationed off the coast to provided NGS support to the US Army and Marines on shore. NGS helped save lives of ground troops that were being overran. The Falklands again illustrated the essential value of NGS. During the battle, 14 destroyers and frigates mounting a total of eighteen naval guns, the 4.5 inch guns fired roughly 7,900 rounds in support of the landings and subsequent land campaign. This fire supported friendly troops, suppressed enemy fire, destroyed enemy supplies and aircrafts on the ground, and seriously hurt the morale of the defenders. During operation Desert Storm, battleships Wisconsin and Missouri provided NGS for troops ashore. The two battleships delivered over 2.1 million pounds of ordnance. Battle damage assessment (BDA) was available for 41 of the 80 missions and indicated that 68% of the targets received heavy damage or worse from the naval support. More recently during the 2000's, NGS has been employed on different occasions. NGS was used in the 2003 Invasion of Iraq in support of operations on the Al-Faw Peninsula in the early stages of the war by the Royal Navy and Royal Australian Navy. In 2007, the destroyer USS Chafee fired the deck guns at two or three suspected "high-value terrorist targets" in the Puntland area along the northern coast of Somalia. Operation UNIFIED PROTECTOR in 2011 which occurred Libya, saw allied forces provide NGS support to rebel forces. The most recent use of NGS in conflict was Operation ODYSSEY LIGHTNING, the 22nd Marine Expeditionary Unit called in fires from the 5-inch gun aboard the Arleigh Burke-class destroyer Carney. In 2022, During OP REASSURANCE, a FOO party from 1 RCHA had the opportunity to conduct 15 fire missions with the HDMS Esbern Snare using their 127mm gun in Latvia. All these conflicts point out how valuable NGS has been in conflicts and how the lack of planning and execution of NGS can result in massive casualties.

https://www.military.com/history/why-50-year-old-battleships-were-critical-part-of-operation-desert-storm.html

https://www.cgai.ca/the_canadian_surface_combatant_capability_and_context

The Future

The RCN is converting its HALIFAX class frigates to the CSC, as was previously mentioned. The RCN's ability to support land operations will increase with the addition of these new ships. A Leonardo 127mm/64 Caliber Main Gun System will be installed on the CSC, offering a 450 round ammunition capacity along with conventional, ballistic, and guided long-range ammunition. The CSC will be outfitted with Surface-to-Surface Missiles, including two Kongsberg four-cell launchers, one of which will be on the port side of the ship and the other on the starboard side. Furthermore, a Mark 41 Vertical Launching System with 24 canisters that will be loaded with Raytheon Tactical Tomahawks. These will each have eight Kongsberg Naval Strike Missiles loaded onto them. The CSC's weapon system will significantly improve the CAF's capacity for amphibious operations and will significantly enhance the RCN's ability to support ground maneuver units in combat.

This article holds the opinion that the future of battles will take place in urban areas. Given that about 40% of the world's population currently lives within 100 kilometers of the coast, littoral operations will be an important factor in future conflicts. The RCAS needs to

have a solid working understanding of the process in order to be ready for

future battles because NGS is important to amphibious operations and joint fires incorporates naval components.

Discussion

Presently, Canada's ability to call in NGS without any prior training is limited. Currently the CAF nominates one to two members to attend the five -week Naval Gunfire Liaison Officer (NGLO) course in the US. Upon completion, these members are predominantly (though not exclusively) employed at the RCAS as Subject Matter Experts (SMEs) related to NGS. The NGLO course provides the necessary training required to perform NATO's NGS Call for Fire (CFF). The RCA core currently has under 20 qualified NGLO soldiers. The problem space stems from two issues. Firstly, the RCN has been unable to provide the capability and training opportunities related to NGS within the RCA. Secondly, is the lack of instruction currently in the RCAS courseware.

Establishing a NGS cell within the RCAS could benefit not only the RCA core, but the CAF concurrently. A NGS cell would be able to establish a working relationship with not only the RCN, but other NATO countries. Upon conversations with the United States Navy (USN), it was discovered there are opportunities to send personnel to the US and partake in live fire exercises. This is an opportunity that the RCA has not taken advantage of due to lack of a communication with our NATO counterparts. In establishing a permanent NGS cell within the RCAS, we could better manage the competencies of our gunners, exploit training opportunities, and safeguard this capability from skill fade and high turnover of staff.

https://www.janes.com/defence-news/news-detail/leonardo-to-supply-12764-lw-gun-systems-for-csc-frigate-programme

Developing Doctrine

The primary reason the RCAS should develop a NGS cell is to establish a working relationship with the RCN; together they could develop a doctrine based off ATP-4 doctrine and be better prepared for the arrival of the CSCs. One aspect that needs to be examined, is how do the CSC's plan on qualifying their ships NGS. Currently the RCN executes a tiered readiness program anywhere from 4-10 months prior to a deployment. It consists of Operations Team Training performing a simulated warfare, as well as one to two workup programs. These programs start with basic warfare, then evolves to damage control issues like flood or fire during battles at sea, then typically completing a live missile firing prior to or on route to the deployment theater. This could result in personnel being removed from post or from the team if not achieving the standards. With the workup training currently occurring, a NGS portion could be implemented into these programs in the future.

Looking at the USN doctrine for ship qualification of NGS, it states the following: Commanders are responsible for the qualification of ships in NGS. Qualification is determined by the evaluation of exercise firing reports by the commander's staff NGS training officer. All ships, regardless of equipment, are required to complete the same basic qualification. As stated above the evaluation is done by the NGS training officer. This is a task, which together with the RCN, could be established as part of the NGS cell to help facilitate the testing. Prior to deployments, the USN must qualify a NGS, and they accomplish by conducting exercises called FIREXs. The purpose of the FIREX is trying to accomplish the following;

1. Train the Combat Information Center (CIC) and gun weapons system personnel to deliver NGS to a landing force under simulated combat conditions,
2. Train CIC and gun weapons system personnel to extract applicable data from the naval gunfire plan and schedule of fires in support of the landing force, and
3. 3. Train CIC and gun weapons system personnel to respond to on-call fire missions from the

Shore Fire Control Party (SFCP) and aerial observers as required to support the landing force.

Prior to commencing a graded FIREX, a ship will be required to fire a Pre-action Calibration (PAC) for each gun mount. PAC fire can be observed by the spotter as a Call For Fire (CFF) (e.g., grid) mission. The spotter will give at least one large (greater than 300 meters) spot to test the ship's ability to safely apply spots. The ship will be afforded the opportunity to practice any desired missions prior to commencing the graded FIREX. The FIREX testing is done by the Expeditionary Warfare Training Group NGS Branch, which consists of both Navy and Marine personnel. The Navy personnel assess everything that happens aboard the ship, while the Marines assess everything from the SFCP. The FIREX is a 6-8 hour exercise in which the qualifying ship is tested on all the aspects of NSFS that could be expected to occur during an amphibious operation. The exercise will be scenario driven and the qualifying ship will respond to the various support missions as received from the Officer in Charge (OIC) of the SFCP. The sequence on the types of fire occurring during the scenario will vary but remain as realistic as possible with respect to the sequence of events anticipated during an opposed amphibious landing.

FIREX I will consist of 11 NGS missions, which must be completed with a score of 80 percent or greater. The ship is allowed to reattempt two of the mission types for passing score. The missions are; 4 Basic CFF, Schedule Target, Area Target, Re-fire, Danger Close, Counter-mechanized fire, Suppression of Enemy Air Defense (SEAD), and Coordinated Illumination. Once a ship has achieved initial NSFS qualification by conducting a FIREX I mission, maintenance of readiness standards is accomplished by conducting an abbreviated qualification which is completed by conducting FIREX II. FIREX II consists of the following 6 missions. Coordinated illumination, Danger Close, Counter-mechanized fire, SEAD, and a Re-fire of a previous target. The sixth mission is one chosen by the OIC SFCP.

By studying this publication and the way the USN currently qualifies and maintain their ships NGS readiness, is an aspect that the NGS cell could help derive the CAF testing requirements from. Having a NGS cell that works together with the RCN, could establish our own testing to fit the needs of the CAF.

Courseware

Another issue a NGS cell could repair, is the lack of NGS instruction that is mandated in the RCAS courseware. Currently the only instruction on NGS within all the RCAS Qualification Standard and Training Plans (QS/TPs) are as follows;

1. The Forward Observation Officer (FOO) course has two periods allocated to NGS in which the first period covers three teaching points, and the second period is in the Indirect Fire Trainer (IFT) conducting a practice mission,
2. The Observation Post Detachment Commander (OPDC) course has one period that describes Characteristics and Procedures for NGS, and
3. The Fire Support Coordination Center (FSCC) WO course has one period explaining the Planning Considerations for the Provision of Naval Fire Support.

https://www.baesystems.com/en-ca/article/-strong-canada-s-combat-ship-team--we-re-ready-on-day-one--strong-

All these classes are instructed by the aforementioned RCAS SMEs. The time allocated on NGS throughout these courses alone is not adequate for any RCAS member to perform a CFF with a ship without some sort of training prior to going live. The lack of instruction of NGS in our courseware is apparent and needs to be addressed. Establishing a NGS cell would be a two-fold system. The first aspect of the cell would be looking at our courseware and secondly updating the NGS portion. The USN NGLO course is broken into two parts: the first part is the spotting aspect of NGS, and the second is the NGLO portion. As OPDC's and FOO's, we are already proficient at CFF's, so the spotting portion can be addressed in multiple different ways. Looking through the NGLO TP, the following three Course of Actions (COA) could possibly solve the issue with the lack of NGS training in our courseware.

COA 1. Involves not creating a NGS cell and therefore there will involve little changes to our current ways of operating of sending one or two personnel down to the NGLO course and have the USN qualify future SMEs. The only change that should be implemented is to have the SMEs go to field force units once a year to provide them with knowledge on NGS and provide FOO/OPDC some practice in the IFTs. The advantages that come with this, is there is no need to change anything, training requirements all stay status quo, and the field force units get a little more exposure to NGS with SME involvement.

The problems that occur with this are; very limited numbers of personnel become qualified, it doesn't establish the ability to qualify our own spotters, and when the CSC arrive, the ability to execute NGS in any operation will still be lacking.

The following two recommendations, involve the creation of a NGS cell.

COA 2. Add training days to the current OPDC and FOO courses to incorporate more define NGS material to give the basic understanding of NGS as spotters. Reviewing the USN NGLO course and taking the knowledge the OPDC and FOO candidates already possess, it could be assessed that we would need approximately 24 periods to cover the NATO CFF and all the missions that can be incorporated into NGS. Which would also include IFT practice time. The other lessons that would need to be covered in another 24 + periods would be Communication with UHF and HF radios, Reports, and Amphibious task force Organization. Lastly there would be eight periods which will cover all testing, including written and practical assessments. Upon completing this portion of the OPDC/FOO course, it is possible they could be qualified as a NGS Spotter. This COA would still have the RCAS sending a limited number of personnel to the USN NGLO course to ensure that

capability is still acquired. The advantages of this COA are; all OPDC and FOO could be qualified with basic knowledge of NGS. This would greatly enhance the RCA core in NGS capability.

Some of the disadvantages includes; courses would have to be lengthen to get the appropriate amount of training days, the IFT operators would need to receive in depth training on NGS, and still, the NGLO portion is not taught by the RCAS.

COA 3a. Instead of lengthening the current OPDC/FOO courses, the NGS cell could conduct a basic NGS course. It would be run like the USN NGLO course with the basic course including the following: an Intro to NGS, history of NGS, NGS ordnance, The NATO CFF, all the different missions, Communications with UHF and HF, and reports. This would take approximately five days to complete. This NGS course would dive deeper into each of the subjects to give the students a vast knowledge of NGS. This COA would still have the RCAS sending limited number of personnel to the USN NGLO course to ensure that capability is still acquired.

COA 3b. RCAS would organize a basic and advanced NGS course. The basic course would be the same as COA 3a and be supplemented by the advanced courses. That course would cover amphibious task force organization, Amphibious Operations, NGS support planning and the NGLO portion which would take approximately eight days to complete. This could all be designed as one course or be broken down into two separate courses depending on the requirements. The advantages of this COA are; RCAS could qualify multiple personnel per serial and run multiple serials a year.

The Disadvantages includes not all OPDC/FOO in the core would get qualified. A whole new course would need to be designed from scratch. IFT operators would need to receive in depth training on NGS.

https://defbrief.com/2021/04/22/canadian-surface-combatants-getting-leonardos-vulcano-lw-guns/

Recommendation

This article recommendation is that the RCAS add one or two personal to the FSCC cell and make a NGS cell as a component. The NGS cell should investigate receiving augmentees from the RCN, and the possibility of sending a Liaison Officer to Halifax to keep establishing that relationship with the RCN. To maintain continuity and the relationships that will be formed, the cell's posting should be for a minimum of two years. By establishing this cell, it would look to address some NGS training-related problems we currently encounter and begin formulating doctrine to establish a plan for the future. The article's recommendation in regards to the COAs that deal with courseware, is to have COA 3a which has a basic NGS course while continuing to send personnel to the USN to take the NGLO course in order to maintain a working relationship with them.

Conclusion

As this article has pointed out, NGS is a capability that Canada will soon be acquiring, and steps need to be taken to help establish this new ability. These steps should be taken prior to receiving the capability so that when it does arrive, the RCAS and RCN are readily prepared. Establishing a Cell at the RCAS is the first step that should be taken and COAs should be examined to help accomplish this. The CAF currently has a lack of knowledge on this capability. With the future equipment and capability that is being acquired by the RCN, all attempts should be taken to remediate the current deficiency.

References

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Forward Observation Officer QS/TP

ATP-4

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USN NGLO Student Handout Book

https://www.canada.ca/content/dam/rcn-mrc/documents/ships/csc-factsheet-2022-2.pdf

"This is how we do it back home" – A foreigner's take on RCAS Coursing

Capt T.P. Murgatroyd

Aim

Military exchange programs are often undertaken with an aim to "[Get] after it."[1] with little to no understanding of what 'it' is, or where 'it' might be found. This poorly defined intent is often given to the individual who is on the exchange and in turn, obtaining lessons learnt is seldom conducted in a deliberate or objective fashion. This issue is compounded by both the exchange officer and the host nation often being hamstrung by confirmation bias and (other than specific course related outcomes) little productive learning occurs.[2] This is primarily due to no tangible, actionable end states being set at the beginning of the exchange. Through the forum of the long course journal, there is the opportunity to diverge from this trend and for an objective, outside and deliberately developed perspective to provide commentary on some key areas in the RCA Officer Model.

These key areas of the RCA Officer Model, leadership and tactics training, have been identified for differing reasons. Leadership training has been addressed as the revision of the RCA Officer Model has allowed for its inclusion on the DP1.2 course, whereas previously it had not been included at all.[3] In the revised career model, four days of the DP1.2 course are allocated to leadership training; while this is a positive move, it is simply not enough time for effective leadership development. The second area of RCA officer training that has been assessed within this paper is deliberate individual tactics training. The current training approach does provide courses intended to train students for specific roles and does follow the RCA officer career path, however in doing so it transitions directly from Combat Team (CT)[4,5] to Brigade level[6] operations.

The aim of this paper is to analyze areas of the RCA Officer Model that can be enhanced by implementing approaches taken by the NZDF in its officer progression model, acknowledging that the NZDF (as a smaller and therefore more agile organization) is able to identify potential changes to be made and to implement them.

It should be stressed at this point that initially this paper may sound very much "well this is how we do it back home", which will deter some readers. Those of you who do persist will see that the recommendations are all based on RCA observation of Royal New Zealand Artillery (RNZA)/ NZ Army practices with the final product being CAF led application of any changes.

Method

The start state for this paper is the revised RCA Officer model; that is to say, a DP 1.2 course including four days of training and officers coursing moving straight from CT to Bde level. From this start state there are two areas to be analyzed; whether or not four days provides sufficient time to not only educate, but also train leadership and, what, if anything needs to be done to bridge the gap from CT to Bde level in RCA officer training.

The sharing of ideas between the CAF and NZDF with regards to leadership, ethos and how our personnel act is nothing new. 'Trusted to Serve' cites the NZ Army 'Way of the New Zealand Warrior' as one of its primary references.[7,8] This paper has used the relationship between those two documents to frame its discussion around leadership training. This relationship between RCA and RNZA individual training programs will be the focus of this paper as leadership training aimed at the individual is considered by industry experts as the most appropriate way to develop leaders. [9]

An analysis of the tactics training included in artillery officer coursing will

be conducted and any areas that could be improved will be identified. This examination will base its assessment on maneuver tactics training from CT to Bde level. The analysis contained in this paper will stop at the commencement of AOC as at this point, officers have been exposed to brigade operations from both and artillery and an all-corps perspective and as such, no meaningful comparison can be gained for the purposes of this paper. As a result, the BC course will also be outside the scope of this paper.

Finally, this paper will not use any anecdotal evidence or feedback from individuals relating to what they have been taught ad hoc or any teaching beyond what is prescribed in TPs to avoid diminishing any area of interest on account of overly motivated or proactive instructors. If it is identified that any courses routinely cover either tactical or leadership training beyond what is addressed in the TP, then the actionable recommendation is to realign the TP with common practice.

Discussion

Leadership Training in the RCA Officer Model

The RCA Officer model is being redeveloped and one significant new inclusion is leadership training on the DP1.2 course. [10] The addition of leadership training for junior officers is important as conducting it early can prevent the development of bad habits or the potential for individuals to act in such a way as to adversely affect their own career early. This paper agrees that this is an important improvement, however the four days of training[11] outlined in the RCA Officer Model can still be built upon.

Very little time is allocated to leadership development in the career pathway of an RCA Officer in the pre-revision model, with less than six days allocated to leadership development, almost all of which comes in the form of Distance Learning packages.[12,13] These are broken down between; (ATOC) Lead Subordinates – 0.5 Days training allocated to this,[14] split between CAF ethics and warrior ethos (net is a quarter of a day on leadership), with no direct assessment being conducted, (BMOQ) PO99 - there is no formal PC for this PO;[15] observed non-compliance with the standard will constitute a failure of this PO, (AJOSQ) PO 201 – 8 hours total (DL packages).[16] Across these courses, all the prescribed leadership development is detailed as a combination of lessons, distance packages and guided discussion. While this does provide a useful base for leadership development, this paper will show that work must be done to ensure it is in keeping with the CAF overall direction on leadership development.

It is an expectation within the CAF that the leaders themselves are developed, not merely educated on leadership as a process or personal quality. [17] This requires an individual being developed through leadership training, over and above leadership education; the former takes significantly more time and is beyond that which IGs and AIGs are resourced to provide.[18,19,20] This expectation stems from the CAF's most prominent policy and guidance on leadership and values – 'Trusted To Serve'; which states that "Military leaders are developed through education, training, employment experience and self-development."[21] Leadership training is the component of this which has been neglected, as the other three are either currently conducted, happen naturally or are the responsibility of the individual. Together leadership education with subsequent training prepares officers sufficiently to undergo the next phase of their leadership development, that being gaining experience through doing their job. Leadership development as a whole, requires an experiential component (i.e. training), with feedback attached to the individual's performance in response to discreet training events.

In contrast to this, RNZA Officers (as a part of their All- Corps coursing) undergo progressive, deliberate training at all significant career gateways; during their commissioning course, as a 2Lt and prior to promotion to major. This takes the form of classroom and small group based activities and discussions around leadership and ethics, taking place over five training days.[22] This is followed by a Hogan's[23] personality assessment and an Experiential Leadership Development Activity (ELDA);[24] the Hogan's assessment predicts an individual's likely actions or reactions to situations and is a useful tool for demonstrating a gap between self-perception and perception by others. The second component (ELDA) puts leaders outside their comfort zone undertaking activities such as sport climbing or white water kayaking in order to highlight the impact of certain behavior traits on how an individual is likely to handle stressful and challenging situations. As a complete package, this allows the individual to understand the theory of leadership (i.e. what is expected of a leader in the organization), appreciate its importance and link it to their own situation through enhanced self-perception.

There already exists a large leadership training industry with significant research behind its application and organizations often leverage this academic understanding to create effective training programs intended to prepare individuals for leadership in large, professional organizations (e.g. for contexts such as a Fortune 500 company).[25]

With the inclusion of four training days for leadership development, the RCA model sits at 80% of the training

time allocated to theoretical leadership training the RNZA officers experience. Accepting a 20% difference as being sufficiently similar, there remains a difference of a one-week leadership training package; this is component of the training that is based on personality testing and experiential learning in order to develop self-awareness. This paper suggests that addressing this difference would offer benefits to officers in the RCA. Overall, good leaders will be good leaders and bad leaders will be bad leaders. However, leadership training can make good leaders better and mitigate bad leadership.

Conclusion

The inclusion of leadership training is a good step forward for the development of RCA officers. At this stage it is a place holder until meaningful leadership education is developed; or less desirably, until a leadership PO is developed that is 'sufficient' appears. Using a start state that another country's armed forces have successfully employed for nearly a decade may not be directly or immediately employable by the CAF or RCA; however, any deliberately developed start state is better than no start state.

Recommendation

This paper recommends that an RCA representative spends time with the NZDF Army Leadership Centre (ALC) to observe or even take part in an appropriate level of leadership training with a view to employ a similar method in the RCA Officer Model. Employment of the approach developed by the NZDF is recommended as a pilot program to allow it to fit within the revised DP 1.2 course with a view to expand it after a period of successful employment.

The primary area of the NZDF Army Leadership framework that is recommended for employment in the RCA officer model is personality testing (e.g. Hogan's testing).[26] This can be outsourced, takes very little time for the impact it can have and has a proven history of helping to develop leaders. Therefore, it is able to be directly implemented within the time allowed for leadership training on the revised DP1.2 course.

Experiential learning[27] is also recommended for inclusion in the RCA model, however it comes with a caveat. Experiential learning is critical for leadership training, however, cannot be effectively implemented within the time allowed. Overall, this paper recommends that additional analysis of RCA officer coursing be done in order to identify three training days to be allocated to experiential leadership development. Because ultimately, technical skills will allow a young officer to get by, but leadership skills will enable them to thrive throughout their career.

Tactics Training in the RCA Officer Model

Functioning effectively as a part of staff at any level requires Artillery officers to be educated in two areas; technical artillery, and tactics. Technical artillery training enables an officer to plan and coordinate fires at various levels. Tactical training allows artillery concepts and procedures to be effectively employed within an All Corps environment. Currently a gap exists in the RCA individual training system at the BG level, with regards to overall battle group tactics. This paper provides an overview of the relevant TPs that comprise the RCA Officer Model with respect to this and a way to bridge this gap.

Analysis of the TP for ATOC outlines a course designed to "train junior officers to perform command and staff functions to support sub-unit combined arms operations,"[28] the POs and their subordinate EOs all align to describe a course that meets that intent. The ATOC TP contains 27 references to 'Battle Groups,' most of those being BG orders to provide context for subunit operations. The few EOs directed at BGs, cover BG structures and capabilities (one day of training) and BG CSS considerations (two days of training).[29]

During the Forward Observation Officer Course, artillery planning at battle group level is addressed to an extent.[30] The approved lesson plans covering this subject matter are primarily focused on battle group HQ composition, artillery coordination, artillery tactical tasks and command relationships.[31,32] This course, appropriately for where it lies in the RCA officer model and for the aim of the course, does not address BG tactics.

The next step in the RCA Officer Model is where the tactics disconnect occurs, that being DP2 Artillery Operations. The aim of this course is to "allow personnel to be capable of planning Artillery Operations and to supervise a Fire Support Coordination Centre (FSCC), or a Surveillance and Target Acquisition Coordination Centre (STACC) or an Air Space Coordination Centre ASCC) at brigade and higher." [33] This disconnect is the jump from combat team operations to brigade operations.

The repercussion of this gap is that RCA Captains have not received any specific training at the BG or Bde level prior to being employed in a Bde context, this all corps tactics training forms a vital stepping stone in preparing officers for roles in Bde HQs and higher. In short, it is not in keeping with the 'progressive' approach to training, as stipulated in Trusted to Serve.[34] Overall, officers enter the DP2 Artillery Operations course with CT level tactics training and left to pair this with the structure of a Bde, without an assessed understanding of how a Bde or the BGs that comprise it function in warfare.

The Officer Career Model in the NZ Army, by contrast, leverages Corps specific and All-Corps coursing to create a progressive tactics training environment. An officer in the RNZA, for example, will undergo tactics training up to PI level in detail and an introduction to Company level training during their commissioning course.[35] Once commissioned they will complete DP1.1 and 1.2 equivalent courses during their time on the weapon line and around the five years post commissioning will complete the Joint Fires Team Commander Course (JFT Comd course, the RNZA equivalent of the FOO Course). The JFT Comd course covers combat team tactics in offensive and defensive operations with a week-long TEWT package at the beginning of the course, focusing on maneuver tactics.[36] Naturally, the remainder of the course takes place in a combat team environment, focusing on fires and their supporting role. At this stage of a RNZA Officers' career, they have been exposed to platoon maneuver tactics for a significant amount of time and combat team tactics to a level where they are able to support general planning and to provide fires advice and support.

Recently, the JFT Commanders Course has been modified twice; firstly, to include a three-week BG FSCC package, and secondly to restyle this as a standalone course (named S03 Fires) which is now open to OP streamed RNZA SSgts and WO2s (equivalent to a CAF Warrant Officer).[37]

The final gateway for promotion to Capt for any Officer in the NZ Army is the Grade Three Staff and Tactics Course. This course occurs almost exclusively (aside from one initial combat team level TEWT)[38] at the BG level and covers offensive, defensive and stability operations with sustainment TEWTs taking place for each phase of war as well. It is six weeks long and each phase of war split between theory (one day) staff planning (three days), execution of the plan (one day) and individual TEWTs (two TEWTs across two days).[39] At the conclusion of the course, officers are eligible to be promoted to captain with an assessed ability to work within any functional area of a BG HQ.

Conclusion

This paper does not seek to recommend changes to Canadian Army All-Corps Officer career progression and acknowledges that the above system is not directly applicable in the RCA context. The main element of the above approach that merits consideration is the placement of BG level tactics training into an officer's career; this would bridge the gap between ATOC and the FOO Course (at combat team) and Artillery Operations (at Bde level) to achieve a progressive training model with respect to maneuver tactics. Overall, this would provide an effective tactics 'steppingstone' to the Bde level.

Recommendation

This paper recommends that, in conjunction with observing NZ Army leadership training practices, a CAF Officer (AOC qualified would provide sufficient tactical training to engage fully) observes the NZ Army Tactics training model. This individual could visit three training establishments in NZ where they would be exposed to platoon, combat team and battle group level tactics training. This exposure is designed to demonstrate the method by which tactics training is conducted throughout an RNZA officer's career.

This paper recommends that the results of this exposure are used to develop a three-day BG and Bde level tactics training package to be implemented during the opening two weeks of DP 2 Artillery Operations. This would serve to prepare officers to operate more effectively as a staff member in a Bde context, armed with an understanding of how BGs and Bdes fight.

Summary

As a complete package, this paper has sought to identify areas of RCA training that could benefit from some scrutiny, leveraging the opportunities experienced by officers in another army. As it stands, the RCA IT systems spends little time developing leaders and has a tactics training progression that jumps from combat team, to brigade, then back to battle group. Recommendations about developing a way forward have been provided, largely involving observation of some well-established leadership and tactics training and some training that has recently been developed (S03 Fires coursing). This is by no means designed to imply that the RCA should do things the RNZA/ NZ Army way, rather this paper seeks to demonstrate opportunities to learn from one another. Even if the level, type or scope of training that is observed within the NZ Army is considered insufficient or inappropriate, then you will be appreciative of these recommendations as you experience up to 15,000km of pristine NZ beaches on your time off.

Footnotes

1. Excerpt from a larger quote: "…there's no real plan there, just "getting after it". Don't know what "it" is though, and I would suggest no one else really does either."
2. Hugo Mercier, Confirmation Bias – Myside Bias, Cognitive Illusions : Intriguing Phenomena in Judgement, Thinking and Memory, Routledge, NY, 2017
3. Revised Officer Model
4. Land Force Training and Doctrine System, Training Plan

ARMY TACTICAL OPERATIONS COURSE (ATOC), AITIS, RCAS, 2022

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Assimilation of Digital Fires into the RCA

Capt S.W. Northcott

Train as we fight is an idiom that is at the forefront of any planner designing an exercise to ensure effort is not wasted and to ensure that the necessary lessons learned are achieved in the target audience. This is the main effort when considering new equipment, techniques and technologies, which will be adopted by both the Royal Canadian Artillery (RCA) and the wider CAF as a whole. Therefore, it is important to keep in mind where Canada sits within the larger picture as a fighting force. When we train in both simulation and in real time and step up to divisional level training, we start to rely on the support of our allied partners. This indicates that even in invented scenarios, we still consider a divisional level force to consist of ABCANZ or NATO partners. This is the context in which we will examine the incorporation of Canadian digital fires into our current training system and our cooperation with allied partners to better communicate and fight with them. The future of the digital fires system will allow the CAF to improve the speed and efficacy of our call for fire (CFF), while improving gun line security by reducing radio emission and potentially shrinking the physical footprint of the battery. Employing digital fires into phase training of future gunners forthwith, is the requisite method for the RCA to train and establish new methods of utilizing modern systems, thus building institutional knowledge to standardize its use.

The way forward to adapt digital fires soonest, follows the trends of our allies in both ABCANZ and NATO. The only alternative to this step is a far more tenuous avenue which would see the RCA remain reliant on older technology, more readily hacked, spoofed and retired; falling further behind our allies and partners already operating with digital platforms. The integration of digital fires would support interoperability with our partners in safer less detectable ways; the rapid adaptation of a digital fires system is therefore imperative to building modern systems and control structures. We in the artillery already operate with an advantage towards this change: much of our communication and data transfer can be just as easily, and sometimes more efficiently transmitted through data as opposed to voice. The fundamental shift away from a voice control structure is one that has been long coming and will undoubtedly take a great deal of time and effort to properly employ. Prior to discussing the adaptation of such a system, a summary of ongoing projects should provide clarity on proposed capabilities of future digital fires suites.

Indirect fire control software suite (IFCSS)/Fires automation and targeted effects system (FATES)

FATES, formally IFCSS is a project within Baseline 2021, a larger project aimed at delivering improved digital capabilities to the Canadian Army to endow commanders at all levels with on the move information exchange (Capabilities Highlight Document, 2020). In its completed state this new suite will provide accurate tracking of friendly units and vehicles, enabling better informed planning and decision making with a minimum of delay. FATES, the artillery's planned piece of the puzzle, is a collection of software applications within the larger JFM hardware designed to enable the rapid reaction of indirect fire capabilities in response to call for fire (CFF) utilizing digital transmission of information. Once completed and integrated into the larger JFM network, FATES will connect Observer, Gun line, Sensors, FSCC, ASCC and JTACs in a common network link, readily sharing information and targeting data rapidly (DLR 2020). In its current form, the capabilities allow communication from sensor to shoot-

er link, as well as communications with most NATO and ABCANZ partners. However, it should be noted that one current issue with the system is the inability to be used in a dismounted observer role.

Joint Fires Modernization (JFM) Project

The JFM project is designed in response to the 2017 policy of *Strong Secure Engaged* which requires interoperability of effects within the Canadian Army to the entire CAF as a whole. This improvement requires synchronicity of Air, Land, Sea, Cyber and Space elements to include those of our coalition partners in order to improve efficacy, speed, and decision making clarity with respect to battlefield effects. JFM aims to acquire modern equipment and software to improve all levels of joint fires coordination. With respect to the RCA, there is a particular emphasis placed on minimizing the potential for latency and human error to the sensor/shooter link. In regard to Joint effects, this project intends on producing a system capable of sharing targets, effects and most importantly, battlefield information across all levels and with coalition partners (Parent 2022).

However, given that interoperability with JFM is an essential and pressing matter, it is worth noting that FATES is not the only means by which this integration can be achieved. There are other more widely used systems, for example; the US Advanced Field Artillery Tactical Data System (AFATDS), which although would not provide the Canadian CFF format, it may offer a more complete off the shelf system. It is however important to note that while JFM covers a much larger part of updating the Joint Effects capabilities and information passage, the current projects do not directly overlap.

Voice to Digital Transmission

Moving from voice to digital fires is a shift in technology and procedures, which will affect all levels of the artillery command structure. The importance of this change, and ultimately its implementation, is a tremendous undertaking, which would not be as simple as adopting a new firing platform or retraining on a computing device. Systems and software acquired by JFM may require the RCA to reconsider the location and core function of several of its positions. JFM will require a change in what information is taught to gunners in both Officer and NCM streams. There are several potential outcomes with this systems adaptation, an example being: the prospective for battery coordination without the Command Post (CP), and having firing data transmitted directly to each firing call sign from a sensor, without the need for calculation of data for individual missions on site. These major changes will likely change the employment of key battery elements, such as Recce parties or the location of the echelon with the gun line. Currently our best method for determining the changes in operation to the battery function and overall artillery picture, is with the earliest adaptation of a form of digital fires. We have these systems currently and are able to deploy them, what we require is the will to work with these systems to improve our own acumen with the equipment we have.

With the larger overall changes required, adaptation of a system such as FATES is not a wasted effort; even if FATES were to be replaced within the next few years. The action of transferring from voice procedure to digital fires requires more than reequipping batteries or retraining soldiers. The process will require establishment of institutional knowledge; answering questions as simple as, 'what will a battery look like once digital fires are the primary means of conducting missions?' Adopting any system soonest, which perhaps may not fill our future requirements early, would still allow us to work on those problems on the ground where methods can be stress tested to determine their efficacy. When a digital fires system is fully adopted, it will allow the RCA to consider our future processes and work to shape our fires systems to be more readily adaptive to a digital platform.

Currently, FATES has a limited working system capable of transmitting firing data from sensor to shooter through EPLRS radios; the system is awaiting hardware upgrade to improve its capabilities while regularly receiving software updates. There are some considerations to take into account when discussing what will be used for our future digital fire control system; ensuring not just that our fire control system allows us to communicate effectively with ourselves, but also our partners. Based on the JFM project, the primary and secondary high level mandatory requirement (HLMR) of the system to be acquired is: technical and operational interoperability, respectively (Parent 2022). JFM intends to acquire a system enabling the fires-decision action cycle, giving weight to the efficacy of FATES, which is based on our own fire discipline and would allow a smoother transition for the RCA. In this context, a tailor-made Canadian fires system is ideal internally, though not in a wider context currently. However, going forward, as long as FATES is able to communicate with digital fire control systems of other nations and provide a familiar platform to conduct our own fires on, there is no reason it would not meet the overall requirements to mesh with the JFM project. Familiarity does not diminish the requirement of training on a digital fires system at the earliest opportunity, it also requires building institutional knowledge, technical familiarity and digital support systems.

Proposed Training COAs Going Forward

Looking specifically at the Officer training model, there are two COAs which will more readily allow a transition to the RCA utilizing digital fires as our modus operandi. Based on a survey taken to establish priorities of future officer training models, a lack of training of digital systems was identified as a problem which needed to be addressed (Haug 2022). Looking at voice procedure, similarly to Manual Artillery Plotting System (MAPS) as a historical example, we see how a system was phased out but remained a piece of mandatory instruction in a limited sense in case of complete failure of the IFCCS computer. IFCCS provided faster more accurate calculation of firing data for the CP to send; MAPS however provided a base understanding of how ballistic data is calculated. MAPS is still taught to all new artillery officers during phase training. Regardless of the method of institutional knowledge, MAPS was maintained for emergency use and in the event of complete system failure; the same principals may be prudent when redesigning the employment of digital fires in phase training.

The following are two potential methods which may be employed for the future digital fires suite:

COA 1 Supplemental

Supplemental training on digital fires is reminiscent of how MAPS is still taught on Phase training; Though MAPS is forecast to cease being taught on phase training by 2024, for now, it will still provide a useful comparison. Voice procedure is taught in its entirety so that students are capable of receiving, calculating, and issuing data to the guns prior to proper training on the subsequent digital system. This ensures that the institutional knowledge is maintained with voice procedure enabling its use in the event of a failure on the digital system. This training option is seemingly the most logical as it allows the RCA to both train new officers on the most advanced systems in use today, while maintaining the backup capabilities with the tried and true voice procedure method, should the digital method fail for whatever reason. Keeping an alternative method for fires that may be employed with decades of reliability behind it is no wasted effort.

Supplemental training of voice procedure will enable the RCA to remain well practiced at its voice procedure and fire discipline as it stands now, ensuring the knowledge remains readily accessible to the field force. It is important to acknowledge that familiarization and operation of digital fires have been included in several courses; however, weighing digital over voice the same way we weigh IFCCS over MAP is not yet our way forward. This comes at a cost of time invested in training, as teaching and practicing two separate methods of CFF takes time, especially as new hardware is adopted by the RCA training on this equipment at least at a rudimentary level will also be required.

COA 2 Replacement

Replacement completely of the voice procedure method is a more direct approach to the institutional change and would bring with it a series of knock on effects. Primarily, it would require retraining of members who still function within the artillery framework who are not used to the new methods being used by new officers at regiment, though it could be argued that regardless of which method is adopted this is a requirement. Replacement could potentially save effort in the long run, ensuring that the procedures taught are the most updated and current means of responding to a CFF and firing on a target. Fire discipline is direct in its meaning by design; its design however, was put in place by gunners whose method of passing information was through voice only. What potential changes may effect fire discipline without spoken work required for a fire mission? With a dispersed gun line? There will be a new complexity to maintaining the institutional knowledge and capabilities of voice procedure as it will require its own separate suite of equipment and a distinctly different method of instruction.

The replacement method would however have the added benefit of a reduction in training time, not having to teach new students both methods of CFF by voice as well as the basics in a separate suite of equipment. This plan also comes with the caveat that whichever system is used in the future, comes a fully usable set of equipment; if however the suite is received piecemeal, it will be a far longer process to transfer over to a newer system. Gradually replacing the current system would make it far more difficult to measure when exactly the RCA has switched to a digital platform, as it makes legacy usage of voice procedure over digital a problem we currently find ourselves in already. We have the capacity to shoot with a digital fires system currently, perhaps a more dramatic shift in training, like replacement, would hasten the transfer to more readily adopting available systems.

Applicable to Both

Both of these options are just simply suggestions - there is likely a compromise between the two - the efficacy of which would be the best overall option. The option of unit led deployment of these systems however, is certainly the least likely system to be effective, which we can draw on historical examples for by looking at the rollout of the EPLRS system several years ago. While only able to draw

from first hand experiences with this system; the term 'going digital' became shorthand for attempting to use a system understood in part to transmit data from the CP directly to the guns on exercise. It was treated as an experiment, as opposed to its intended purpose: our future communications suite. This is why this must be an institutional effort, if we are to build the requisite institutional knowledge and become a faster more effective system. This will lead to a transitory period, which makes the immediate training of FATES all the more important.

Looking at the speed at which modern technology and capabilities effect the battlefield in Eastern Europe today, underlines the importance of handling the transitory period and rolling out the digital fires suite deliberately as it is released to us today; with FATES and portions of JFM that will affect us in the future. Regardless of which system is ultimately employed, there will need to be a period of retraining and familiarization for members in the regiment that have been trained with voice procedure. As the Royal Canadian Artillery School (RCAS) sets the training standards at which members must be trained on these systems, it seems reasonable that supplemental lessons are provided to units to ensure efficacy and swift employment of new systems. An example of which could be a breakdown of high level and low level usage of the systems, essentially officers, FSCC staff and those involved with planning, taught separately from those with arty comms, CP tech and those recently off Officer DP1.1 and DP1.2 training. Something along these lines would confirm members at all levels have the tools they require to become effective on these new systems, and could regularly be repeated as problems arise; IG assist visits like these to use digital fires systems are commonplace today and should remain so as long as they are needed.

The future of the artillery is digital, and employing training on these systems soonest is the most optimal way we can ensure that the transition to modern systems is standardized and deliberate. There is uncertainty as to which these systems will be adopted in the long run, however, the best method to ensure that we are prepared for whatever outcome is early formation of digital procedures and an understanding of the new requirements these systems will involve. If we are to continue to *Train as We Fight* then we must make bold and rapid decisions in how we adapt and take advantage of new equipment and opportunities to make us a more effective fighting force.

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INTEROPERABILITY & TACTICS, TECHNIQUES & PROCEDURES

CHAPTER 2

INTEROPÉRABILITÉ ET TACTIQUES, TECHNIQUES ET PROCÉDURES

Adapting Doctrine to Modern Warfare

WO J.M.J.F. Boucher

Introduction

Our Canadian Armed Forces (CAF) must be equipped with the necessary artillery training to repel any assaults. The military's primary objective is to protect Canada, its allies, and its interests; as a result, it is necessary to update our current doctrine considering the challenges from modern warfare in order to increase survivability. This article will focus on threats and lessons learned from the Ukrainian conflict, as well as suggested scenarios where the doctrine may be strengthened as a result. According to our training, we must be able to withstand enemy action at least until allied help is available. It is important to realise that the aim of this journal is not to undermine our doctrine, but rather to strengthen and modernize it based on new facts and data from ongoing wars. Future ideas could be taken and structured in such a way that the current baseline capabilities born of the doctrine are preserved. This essay will demonstrate how giving all levels of leadership more freedom over decisions and actions can strengthen our ability to combat peer and near-peer enemies. It will demonstrate and explain where emphasis should be placed, as well as how the artillery can still benefit from slightly altering its usual practices.

Current Threats and Capabilities emerging from the Ukraine Conflict

The Ukraine war is a complex conflict that has been characterized by a variety of weapons and tactics employed by both the Russian and Ukrainian sides. Unsurprisingly, artillery has been one of the most commonly used weapons by both sides of the conflict. As a result, the artillery relies less on firepower to complement manoeuvres, but alternatively setting the conditions for successful manoeuvres therefore enhancing survivability. This shift demonstrates that a new approach to our artillery training must be at the very least considered. Adaptation of potential new artillery tactics and drills will be influenced by some of the modern-day threats discussed below.

Counter-battery fire is an important tactic in neutralizing enemy artillery positions to reduce their effectiveness on the battlefield, by employing radars and acoustic sensors to track the incoming projectiles all the way back to their points of origin. Therefore, counter-battery fire defences need to be continuously upgraded due to the development of new artillery systems and tactics by the enemy. After months of firing close to 20,000 rounds a day, Russia changed up their strategy by using counter-battery radars, drones, and their range advantages and precision guided weapons to hit precisely selected targets. To avoid detection, the Ukraine Armed Forces (UAF) moved regularly after a short sequence of firing artillery at their opponent and using camouflage and concealment in hides to minimize risks. It has been observed that UAF conducted engagements on 2S19 Howitzers with Excalibur munitions. As a result, there were fewer engagements overall, but they were more accurate, which gave the opportunity to increase dispersion while reducing the enemy's capacity to respond. Both sides used drones as their primary method of targeting and to quicken the counter fire exchange.

Intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) were already more comprehensive and effective than previously experienced (or trained against). Russian Unmanned Aerial System (UAS) could be leveraged to bring artillery fire to bear

rapidly. They had the ability to locate and comprehend subsequent moves. According to open sources, there were over a hundred reconnaissance and assault drones flying over Ukraine every day. These devices are currently perceived as being much more dangerous than counter-battery fires. These domestically built drones, such as the lancet loitering munitions family (Kamikaze drones), have also proven their effectiveness by damaging or destroying a significant number of artillery systems supplied by the west. The concept of dispersion has been at the forefront of Ukraine in the initial stages of the war. Their ability to hide their positions from UAS observation and foundational soldiering skills assisted greatly. To successfully conceal and camouflage their assets, they had to make efforts like removing vehicle tracks when approaching a hide and setting up dummy positions. Camouflage netting or wiring enclosures were also valuable resources. The UAF artillery detachments were particularly affected by what is called "the paradox of survivability" related to surveillance drones and by using a "shoot and move" approach increases their risks of being discovered. As a result, it became necessary to pick an advantageous moment for mobility action to improve survivability.

Current RCA Doctrine and TTPs

The threats mentioned above are all part of our doctrine, but unfortunately not suited to combat against an overwhelming enemy possessing higher number of personnel and materiel. Our doctrine dictates to use troop dispersed deployment in areas of 1000 m x 1000 m with the echelon. These types of deployments are appropriate for certain operations especially when time is available but not against a superior army. This would prevent our forces from having the flexibility to immediately deploy after being discovered. This would also put at risk the destruction of an entire battery and their immediate line of supplies. Hides are another type of deployment that will be key to dispersion. This should be the main focus in our training considering the threats discussed earlier. UAF were able to survive by having their guns operating from conceal areas, and then moving quickly to an area from which to engage and return to the hide. It was observed that their guns would operate often autonomously or in pairs most of the time to avoid detection. For enhanced concealment and protection, their echelon would likewise be dispersed around the area of operations. The Russian army had a 12:1 artillery advantage in early summer 2022; as a result, the UAF needed to fiercely defend its resources and select the opportune moment for strategic battles that would impact the outcome of the war. This author sees similarities between the threats that the UAF is currently facing and what Canada could be encountering in the future. Which is why, the requirement to concentrate on hides will therefore improve our capacity to fend against any dangers. It is now more important than ever to fully utilise the employment of UAS throughout the preparation stages of the battle more than ever before. Reports from our allies and other military institutions all agree that the need to avoid detections from UAS and limit our emissions should be considered a priority. Supplementary rehearsal of hide disposition and more day for night deployments should be integrated in training. Furthermore, having all elements of the battery (gun, command post and echelon) in different location will ensure a better chance of deception. In general, the future threats will expect their rivals to react on short notice due to fires being initiated rapidly and at scale. Therefore, we need an artillery that move and engages extremely fast. Quick action is another drill that requires modification with the purpose to provide fire and avoid counter- battery attacks by using our hides and dispersion instead of being on the move and receiving a call for fire. The guns would remain concealed and move rapidly with speed to a predetermine location to fire at the enemy and redeploy as quickly as possible after completion of the mission. This type of actions were observed by many reporters of war witnessing self-propelled guns. For example, the 2S1 Howitzer were oriented quickly by aiming circle, firing a few rounds, and departing immediately. Obviously other guns (Howitzer) could use their digital system if available and this would mostly result in more accurate fire and speed.

Since the war in Ukraine, there are a few reports of Russia using electronic warfare systems to great effect. Ukrainians have applied the idea of decentralized command and control in several respects. For instance, their anti-armor weapons are deployed in dispersed groups who stages ambushes in a hit-and-run attacks fashion on incoming mechanized Russian forces. Instead of fighting in large formations or having every movement orchestrated from one central command, Ukrainian soldiers leverage the element of surprise while making themselves smaller targets from Russian attackers. NATO is analyzing these facts and has concluded that our survivability depends on dispersion. This supports the requirement to change our training's starting point so as to develop experience using our resources more independently. Seeing that we cannot afford to lose our limited resources, we must modify our doctrine by emphasizing on dispersed hides and quick action.

Recommended solution

The author believes that the Royal Canadian Artillery (RCA) could overcome those threats by updating their Field Artillery Doctrine publication by having the hides, fire points, quick actions and manoeuvre deployment redefined. These types of deployments are key to dispersion for the gun line and their echelon. Our Training, Tactic and Procedures (TTPs) for candidates on the Artillery Troop Commander courses requires to shift their evaluation criteria to recce hides (gun and echelon) and position of fire. Local defence assessment should be emphasised versus performing the role of the Gun Position Officer for open actions. It would challenge them to make the right decisions to minimize encounters with enemies and detection. The doctrine of conventional deployment of dispersed gun batteries was adequate many decades ago. They were adapted during the conflict in Afghanistan, but returned to their initial operations which, in light of today's dangers, are no longer feasible.

Presently, our junior officers within the RCA are becoming technically proficient within the command post and reconnaissance however, attempts should be made to provide training that would prepare them in leading an actual fight. It was directed that more imaginative training should be delivered with the intention to increase the proficiency of their abilities to lead a battle. The first step ought to be to solidify our TTPs, so that they are better prepared to deal with current threats. As it was already specified for the doctrinal publications, the TTPs for the Artillery Troop Commander courses requires emphasis to be placed on hides, manoeuvre deployment, firing points and quick actions. Due to their dynamic nature these alterations would initially be difficult in training, but they should provide junior officers and NCMs more autonomy as they learn how to conduct battles. By exercising dispersion deployment, soldiers will be held more accountable by establishing their basic soldier skill and leadership capabilities.

Conclusion

The CAF must carefully manage and preserve their limited resources and choose opportune moments to defend against counter battery fire. To be successful, we will have to inflict significant enemy artillery losses throughout their depth and degrade their ability to fight. Survivability in the early stages of a conflict is dependent on the ability to hide our position from UAS observation and by using smaller groups for deployment. The fundamentals of soldering, the proper drill within a hide, the creation of dummy positions, and camouflage/concealment will be key elements of modern warfare. Future conflicts/wars will demand to preserve the strength of our artillery creating the need to balance ammunition availability properly, conceal and dispersion of gun positions. Additionally, we will need to prosecute any counter-battery missions with speed and aggression. In conclusion, the status quo would only restrain us from progressing and battle strongly against future enemies. It is acknowledged that it will be difficult and that all players must participate. This will require more coordination and the engagements of more resources. We will utilize more Petroleum Oil and Lubricants but reduce our usage of ammunition, as we will strike targets with minimal ammunition but move more frequently to new locations. To achieve positive results, we will need to modify our existing doctrine using the lessons learned from current conflicts and applying them accordingly during domestic and international operations with other NATO nations.

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Antiquated Drills Impeding the Digital Fires

WO B.R. Chow

Introduction

The aim of this paper is to identify deficiencies in current training plans (TP's) with regards to digital fires and explore a possible way forward to facilitate training reflective of a digital first mentality. With the inevitable modernization of the battlespace, the Canadian Army must ensure that it is capable of delivering a product that meets this change. The Royal Canadian Artillery School (RCAS) must embrace this change and develop training that is suited to the current and future equipment. The capability to deliver digital fires is being delayed not only by the equipment, but also the knowledge and training. If digital fires are to be at the forefront of the artillery, individual training conducted at all levels across the RCAS must be reflective of such and older drills must be removed (or amended) from TP's and digital packages inserted. With the advancement of equipment and software, outdated drills do not meet the requirement for speed and accuracy let alone further development of digital drills. Furthermore, digital fires enhance the survivability of the gun line, while still being able to conduct fire missions, by enabling various deployment methods such as firing points and manoeuver deployments. Without formalized training, much of the "experts" become familiar with the equipment and software through trial and error. Only through a personal vested interest in current in-service digital equipment do members of the Royal Canadian Artillery (RCA) become more proficient in enabling digital fires. Exposure to digital fires starting earlier in a soldier's career, such as Developmental Period (DP) 1, could facilitate building a strong foundation to further develop the digital skillset of the gunner. Prior to reviewing junior level courses, I had consulted with a Training Development Officer to ensure Training Plan Change Requests (TPCR) had not yet been actioned. Currently there are no TPCR's or writing boards submitted to facilitate digital packages. Lack of a formal TPCR only delays such change and should be expedited. By not enabling programmers and candidates of courses to fully understand the intricacies of digital fires, results in personal development sessions being added during or after courses. The expectancy of a member completing a course is to be employed within that role and capable of setting up and troubleshooting of networks, producing/sending information relating to fire missions and providing reports/returns. Currently, the following courses do not meet these requirements as TPs are becoming vastly outdated.

Past Experiences

Looking back as a young gunner/bombardier, I spent much of my time as a gun detachment member and technician within the battery command post (BCP). My first exposure to digital fires was over a decade ago, with network cabling running from the M777 Enhanced Position Location Reporting System (EPLRS) radio to the command post in a similar manner as the Field Artillery Battery Communication System (FABCS). Often times the digital firing data was not being transmitted properly and troubleshooting would not resolve such issues, thus resulting in reverting back to analog firing. As Command Post Supervisors (CPS) that were more familiar with a digitized gun line were relocated away from their units, the capability to provide digital fires was essentially non-existent. Born out of my own personal interest in digital fires and EPLRS, I began collecting information from the subject matter experts (SME's), testing through trial and error until I felt I had a strong enough foundation to be confident in deploying a fully digitized Command Post (CP). The Battery Commander and Battery Sergeant Major were supportive of such an endeavor and allotted time for the BCP to troubleshoot any issue that arose throughout exercises. The embracing nature of the command team helped grow my understanding of the capabilities, limitations, and ways forward in providing digital fires. Often times my peers within different batteries would discuss more proficient ways of employing the digitized CP and assisted each other with troubleshooting or any issues that arose. The lack of training on digital fires most often fell to the individual battery CPS to familiarize Command Post Officers and Safety Officers. With the current tempo for units, this training must be conducted prior to members being em-

ployed in certain positions. With the next generation of soldiers who are more technically proficient, the ability for the gunner and junior officers in the field force units to understand the capabilities and drills is not the concern. Training plans throughout Non-Commissioned Members and Officers require a more digital focus as opposed to antiquated drills and use of such equipment. Course programmers at 1 RCHA ensure a digital familiarization is provided to the candidates. This sentiment is mirrored at 2 RCHA, where observations in the fall of 2022 suggested that CP technicians' courses have EPLRS/digital lessons incorporated into the TP to train and teach how the engagement of targets to new CP technicians are facilitated.

The Army Tactical Basic Mounted Communicator (ATBMC)

This course currently has Enabling Objective (EO) 001.02 – Prepare the vehicle mounted communications suite. Within this EO, various teaching points detail the preparation, installation/removal of in-service radios as well as programming radios for a total of 12 periods of instruction. Much of the focus is on the Combat Net Radio Enhanced (CNRE) and the ancillary equipment that relates to this. This could be reduced in order to allow more time to focus on the EPLRS radio or any future iteration of a digital system. With the complexity of establishing and maintaining a network such as the EPLRS, the TP should be amended to provide junior soldiers the knowledge and capability to perform duties related to the equipment and networking. Due to the ownership of radios belonging to the Signals Corps and the employment of digital applications related to fires is held solely within the RCA, there is a training gap between the understanding of the functionality of the radio and the use of the applications within the Indirect Fire Control Software Suite (IFCSS) relevant to the members' stream. The instructor pool for this course should be assigned with a member of the RCA in concert with the signalers to assist in bridging this training gap.

Army Tactical Artillery Communicator Course (ATACC)

If the aforementioned changes are not a feasible option, then a TPCR should be submitted for the ATACC. This would provide the gunner knowledge of the radio (to include networking, troubleshooting and maintenance) as well as the artillery voice procedure that would be expected of an artillery signaler. Performance Objective (PO) 001 – Operate the Field Artillery Battery Communication System (FABCS) should be rebranded as Operate the Current In-Service Gunline Communication System (GLCS) to include the Fire Support Speak (FSSpeak) application currently in use at the field force units. The previously mentioned changes would result in all streams benefiting from the digital package. Often times the lack of knowledge of digital fires results in members that are in leadership roles not trusting the system or user. This is most relevant in the Observation Post (OP) stream where OP detachment members are not currently being formally trained on digital fires. With the lack of training in EPLRS within the aforementioned communications courses, an OP party generally has troubles maintaining connectivity with their battery unless a member within the party has taken an interest in learning more than what is required on course.

Observation Post Detachment Member (OP Det Mbr)

The TP for the OP Det Mbr course contains PO 008 – Conduct Basic Fire Missions which has a written fire discipline test as well as a practical test conducting fire missions. A change in the TP should include conducting a digital fire mission, which would be tested in the same manner as conducting analog fire missions. In concert with these changes, the references should include the IFCSS Observer (OBS) Precis. This publication is specific to the OP stream members who would use the OBS application to communicate and send digital information as part of multicast group. Building a strong digital foundation at the lower level would allow further development of training and drills related to providing digital fires as well as establishing trust within our users and applications.

Artillery Command Post Technician Course (Arty CP Tech)

The final TP that I have reviewed was the Arty CP Tech course. This course would benefit the most from a TPCR that is reflective of providing digital fires. The current TP lacks a complete digital package, when day one, as a CP tech, they are expected to be capable of performing the technical duties within a digitized CP. PO 405 – Produce Firing Data Using the Mortar Plotter Board is currently irrelevant as the 81mm mortar was handed over for the infantry to employ. Removal of this PO (or reduction of training periods) would allow a digital package to be inserted without overly extending the length of the course and providing baseline knowledge of production of digital firing data. PO 401 – Produce Firing Data Using the Manual Artillery Plotting System (MAPS) could also be reduced. With current modern advances in technology, the requirement for manual calculations of firing data is slowly becoming less relevant. This would also allow capable instructor to teach the "tricks of the trade" with regards to digital fires as coined by many of the field force units. Command Post Exercise (CPX) 3 could then be conducted as a digital CPX in which candidates would be assessed in acting as a CP technician on a digitized gunline. This would not only include the production of firing data but sending and receiving reports and returns digitally vice voice.

Conclusion

All of the previously discussed changes to TP's have testable material that must be assessed in order to ensure junior members are digitally sound for future improvement on drills and software. With the artillery emphasizing more on the implementation of digital fires, this would accelerate the future development of digital fires. Change requests and implementation of TP's that are digitally focused will be im-

paired by our current lack of dissemination of digital knowledge and current capable instructor group. If the RCA is to provide the field force units with an instructor cadre that is able to deliver digital material and training to junior level courses, we must first produce SMEs at the RCAS. I believe a digital package should be delivered to the instruction cell at the RCAS in order to allow course programmers at the field force units capable of facilitating the implementation of changes within TP's. Delivering a more comprehensive digital package to courses such as Gun Area Technical Supervisor (GATS) course would in turn decentralize the digital knowledge at the RCAS and allow open dialogue to further develop digital drills and TTP's for future in-service digital equipment. This package would be readily available to all units (including reservist units) and easily amended to reflect changes with the modernization of future equipment. The package should not only include equipment but more technical information. Further discussion between units and RCAS about digital lessons learned would serve to further develop the RCA's digital capabilities. The Regimental Leadership Conference (RLC) is critical to professional development of junior officers and leaders. A forum such as the RLC would serve as a face-to-face open discussion on how each unit has observed proficiencies and deficiencies in drills, equipment, and training. In order for the RCA to further develop our own digital fires, antiquated drills and equipment must be removed from TPs in order to develop training that is reflective of the current modern-day equipment. TPCRs must be actioned without delay to allow programmers and instructors sufficient time to train junior soldiers that are expected to be employed within a digital battery. With the next generation of tech-savvy soldiers, building a strong foundational knowledge on all subjects digital earlier on in a soldiers' career, allows for more growth when the member is employed in a more senior position. The reliance of analog shooting methods should remain but not be the main focus throughout multiple courses conducted at all levels across the RCAS. Leaders and instructors must embrace this change as the modernization of the battlespace will only increase.

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Decentralization of the Artillery Battery

WO J.F.J.L. Picard

Introduction

Since the beginning of Canadian artillery, the artillery guns in the battery have always been arranged in a linear fashion and located in the same place with the command post (CP). This approach has been proven in the past to provide good command and control, better local defense, simplified calculation of fire data and good communication within the battery. However, in today's world, threats have changed and evolved simultaneously with new technologies and capabilities such as uncrewed aircraft systems (UAS) detections, rapid target acquisition leading to counter-battery fire, UAS with striking capabilities, and loitering munitions (suicide drones). In the current conflicts, such as the one between Russia and Ukraine, these are among the greatest threats on the ground. Coupled with a counter-battery response time of three to six minutes, dispersion and rapid redeployment should be the main focus for the Canadian artillery. An adaptation of deployment methods and local defense against the enemy should be made to increase our survivability on the battlefield.

Intention

In order to increase survivability and attempt to counter the real threats as mentioned above, one of the means that presented will be to disperse the artillery guns of a battery individually instead of having them all together in the same position as dictated in our Canadian doctrine. In concrete terms, the general idea would be to leave the command post, as well as the echelon, in the background and to send the guns independently to different coordinates to allow dispersion and rapid disengagement following the firing. While remaining within firing range of the target, the guns would continue to fire under the control of the CP to obtain the effects desired by firing in battery. Following the firing and depending on the need, each gun would move inside a maneuver box to support any new firing missions or simply go back into a hide to wait for the next opportunity of fire. This dispersal of guns would increase the chances of survival by avoiding detection of the entire battery by an aerial observer, radar or acoustic locating system which are the main systems that compose the Intelligence Surveillance Reconnaissance (ISR). This would become cumbersome for the enemy, since one gun is much less obvious to find than a battery. This would also allow for greater speed of redeployment from the battery by moving only one gun and not the entire battery, thus decreasing the chances of being hit by counter-battery fire. However, in order to implement this new type of deployment, there are several elements to consider, such as dispersal method, protection of our forces, communication, type of deployment, and logistical support.

Dispersion

Based on the current conflict between Russia and Ukraine, drones have been effective on both sides in locating and guiding artillery fire on enemy targets. To avoid these types of attacks, it would be necessary to maintain a distance of at least 1 Km between each gun to avoid multiple detection and thereby decrease the footprint size on the ground. As soon as an enemy target is detected by a Russian drone, they can engage with their artillery in only three to five minutes. Therefore, by having such a dispersion with quick redeployment, it would be harder for the enemy to engage multiple targets with the same firepower.

In addition, a longer-range achievability would allow for better dispersion and protection. Currently, according to the firing tables and the type of projectile used, the maximum effective range of the M777 howitzer is between 18.7 and 30 km. By choosing a projectile with a longer range, the dispersion of the guns would naturally be maximized. Then, to optimize the engagement of enemy targets, a circular or oval type of dispersion would allow the guns located at the extremities to still reach the target without being at their maximum range. On the other hand, it should also be considered that when the guns engage at a distance close to their maximum range, the accuracy is diminished due to the probable error in range and direction. The ideal combination would be to equip the chosen projectile with a precision guided kit (PGK) fuse to max-

imize the range while ensuring better accuracy.

Protection

Furthermore, the greater the dispersal distance, the more complex individual troop security, communications, and supplies become. A detachment cannot adequately defend itself with only the gun tow vehicle and the troop carrier. Additional firepower and personnel would be required to secure their movements and thus be able to establish a good local defense, once in position, even if it is only temporary. For individual protection, each of the guns should move with the support of a light armored vehicle (LAV) or a tactical armored patrol vehicle (TAPV) at the very least. Additional personnel should also be added to the detachments to ensure a good local defense is established with supporting weapons. This same process should be in place when returning to the hide. In addition, hides would need to be dug out to provide better protection in the event of detection.

Communication

In terms of communications, the firing data would need to remain digital to allow the guns to receive real-time data as the field changes and to transmit the exact position of the guns to the CP. However, the Enhanced Position Location Reporting System, better known as EPLRS, is not really suitable for this type of deployment. It must create a local area network and the systems must be in line of sight of each other in order to function. Therefore, the parts would need to have a communication system that allows them to communicate, regardless of their location, and receive the data to make engagements. The battery would also have to ensure proper control of movement and transmit information of the location of the guns to other units to avoid confusion. Currently, according to trials conducted by the 5e Régiment d'Artillerie Légère du Canada (5 RALC), MANET-type MPU 5 radios are working very well and allows fire missions to be sent digitally directly from the forward observer officer to the CP and so forth to the guns. Another solution would be the Satellite-on-the-Move (SOTM) allowing satellite communication during movement. In addition, this communication system indicates the location of friendly forces, which would facilitate the movement of six independent artillery guns in the field.

Type of Deployment

To counteract counter-battery fire, it would be necessary to avoid being static for too long in one position to of course avoid detection. To prevent remaining static, the use of maneuver boxes seems to be the best method. This allows our troops to be in continuous movement as soon as the firing mission is over. In order to ensure the guns of an artillery battery can efficiently come out-of-action, the drills for coming into-action need to be revised. When setting up into-action, by deploying only the necessary equipment, with a good preparatory ammunition order and a slight modification of the set-up sequence, we can reduce the time considerably and leave the position quickly to avoid counter-battery fire as much as possible. (See article by WO G.A. Smith in this same journal)

The situation is more complicated for reconnaissance. A reconnaissance team for each position or maneuver box would be ideal, but unfortunately would require a considerable increase in personnel and vehicles. On the other hand, the degree of preparation would have to be minimal to ensure speed. The solution would be to use one or more UAVs to perform reconnaissance from the air. Perhaps we should even consider combining them with our reconnaissance elements. One thing is certain, this type of deployment requires greater synchronization of capabilities at the brigade level.

Logistics

Another aspect to consider is the logistical support. Depending on the tactical situation, supplies must be properly planned and adapted to all types of condition. The best distribution method chosen should maximize speed and minimize targeting by enemy forces. An accurate status of food, fuel, and ammunition count of the guns would need to be constantly updated by the detachment commanders (Det Comds) and sent directly to the CP to adjust supplies. Also, since a maximum load of ammunition for each detachment is not ideal for speed of deployment, a smaller, lighter load would be required. Even when dispersed and far from the echelon, resupply should not be a problem if the chosen distribution method is battery managed. So, the two options would be to either use different Resupply Points (RP) or have a Forward Support Group (FSG) that would be deployed as needed. For the first option, it would be ideal to use several different RPs to prevent the enemy from quickly detecting and identifying parts. This would reduce the chances that the enemy would anticipate the guns to regroup at that point to strike with a single blow. Finally, if we keep in mind that one of the objectives is to improve accuracy as much as possible, as mentioned above with the PGK fuse, this would result in less usage of ammunition and resupply requirements.

Det Comds would also be given more responsibility, as there would no longer be a Troop Sergeant Major (TSM) to supervise. Among other things, they would be responsible for navigation, local defense, ammunition count, casualties, and minor repairs on the howitzer. This should result in more rigorous training for Det Comds and revised training to better enable them to train for this type of deployment.

Lastly, a change in artillery tactics, techniques and procedures would need to occur to standardize these new proposed disciplines. Artillery software would also need to be updated to allow for data calculation. The Indirect Fire Control Computer Software (IFCCS) would need to be modified to separate the guns individually and use the position of the gun sent digitally to the CP as the battery center. If this modification is not developed, the CP would have to have the same number of computers as there are guns, which would not facilitate the management of fire missions at all.

Proposal

While current equipment and technology allows our military to accomplish this type of deployment, the increase in equipment and personnel that it would require makes it unrealistic, at least with Canada's current re-

sources. However, by slightly modifying the idea and sending the guns in troops of two instead of one, it becomes possible. Therefore, by deploying three two-gun troops, this would allow for better dispersion while maintaining an ideal range of fire even when using a linear dispersion. It would also allow for better protection during convoy or local defense and decrease the footprint compared to a full battery. The use of the TSMs would remain valid but would require one per troop and the same for the security officers. Indeed, when training, the data would always have to be verified by a security officer and sent digitally. On the other hand, it cannot handle the calculation of six firing trajectories from six positions and be efficient. In using only three troops, the number of safety officers would be limited to three and this task could even be filled by the TSMs once they are qualified. The high number of positions required can make training difficult for some training areas. Moving in troops would decrease the demands on training areas and lower the number of firing positions required. As for reconnaissance, it could be limited to three positions or maneuver boxes instead of six. A relief would also be created at the CP for the management of firing missions by having only three positions to calculate.

Conclusion

In conclusion, keeping the same intent of decentralizing the artillery battery, but changing the idea slightly, this type of deployment would increase survivability and help counter real threats such as counter-battery attacks, UAS, and loitering munitions. The current conflict in Ukraine confirms that these threats are real in modern conventional warfare and that Canadian artillery must adapt quickly to survive and be effective on the battlefield. Dispersal improves survivability while reducing the risk of detection by any ISR and casualties in providing fewer targets. We could even add a counter-UAS defense system to each troop as a local defense. In addition, by improving our speed of redeployment by slightly changing our procedures, this would decrease our exposure. A more drastic solution would be to replace our M777 howitzers with a self-propelled system, some of which need less than 30 seconds to fire and only another 30 seconds to redeploy elsewhere. In the end, this type of deployment can help us immediately on the battlefield with current CAF equipment, as opposed to waiting for a gun or equipment we don't have that can only help us in the future. Also, international exchanges on these types of deployment with other countries could be beneficial in collecting their point of view and opinions on the relevance of adapting and developing a new doctrine. Some countries, such as France and Slovakia, already use this type of deployment. An exchange between these countries would give Canada the opportunity to compare their techniques and adapt them to our current equipment.

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A Deadly Game of Cat and Mouse: The Modernization of the Royal Canadian Artillery (RCA) Gun Platform

WO G.A. Smith

Foreword

Throughout Canadian history, Gunners have provided the battlefields firepower, produced effects that have defined battles, demoralized the enemy, created courage amongst allies, and ultimately decided the fate of armies. Gunners would manoeuvre their cannons through the absolute worst of terrain. As they brought their weapons into action, they would offload stores and equipment essential to bring fire upon their enemies. Afterwards, they would pack up their stores with speed and purpose, keep pace with the movement of the battlefield, and remain prepared to do it all over again. These actions continued until Gunners were relieved from their post, or the battle was won. Gunners are ever mindful that the deadly actions they provided may eventually cause them the same fate they were imposing on their enemy. The risk of detection, and the delivery of counter-fires upon our forces is higher now than it has ever been in recent memory. Methods of detecting an adversary's artillery has been developed and honed by weapon developers across the world for decades, dating all the way back to World War I with the concept of artillery sound ranging and flash spotting. Acoustic Weapon Locating Systems (AWLS), Weapon Locating Radar (WLR), Electronic Warfare (EW), Uncrewed Aerial Systems (UAS), and the physical presence of the enemy themselves are examples of a few of the tools at the modern armies' disposal to be able to readily detect hostile battery activity. As Gunners, we must now develop Tactics, Techniques, and Procedures (TTPs) that will assist in overcoming the dangers of these detections. Gunners must come to terms and understand that detection will occur during conflict on the modern battlefield, and it is the ability to remain mobile enough to avoid acquisition from these detections that will be paramount in keeping them safe, and ultimately, having the ability to deliver effects on the battlefields of the future.

Canada's current artillery 155mm Howitzer, the M777 Light Weight Towed Howitzer (LWTH) was initially procured in early 2006. The "LWTH Project" further developed in 2008 to bring the fleet of twelve operational M777's to a total of thirty-seven. In the Statement of Operational Requirement (SOR) for this project, it was identified that a response time of less than three minutes to come out of action was required. Canada's prime mover for the M777 is currently the Medium Support Vehicle System, Standard Military Pattern Gun Tractor (MSVS SMP) and comes equipped with a set of storage racks meant to be lifted from the rear or sides of the vehicle by an integral crane designated the Load Handling System (LHS). The utilisation of these racks requires set-up of the LHS and its out-riggers, while members of the detachment operate and oversee its use. The LHS can lower one bin down at a time, repeating this procedure until each of the four bins has been deployed. The operation of the LHS takes extensive time to use in both the initial deployment of the howitzer, and its subsequent redeployment. Detachments deploy with the majority of it's Equipment Issued Stores (EIS) at every position. Additionally, Gunner's offload ammunition at every position, with each projectile of High Explosive ammunition alone weighing forty-five kilograms, or approximately ninety-nine pounds. Furthermore, with the offloaded projectiles, the total weight of the propellant and fuse needed to fire generates another fifty-three and a half pounds for a Modular Artillery Charge System (MACS) high canister and their M739 disruptive fuses. Each of these are required during a fire mission, and if they are not consumed, are repacked, and reloaded on the MSVS SMP. Doing

so increases the time required to redeploy the howitzer. Each item increases the amount of time needed to redeploy and could increase detachment member fatigue. These become compounding factor against meeting the crucial 3-minute benchmark stipulated in the SOR. Current gun drill does not allow for rapid movement of the gun either, as it keeps the M777 prepared to engage in frequent fire missions from a single gun platform. Moving howitzers from one gun position to another has been extensively practiced during exercises and operations. This process could be made more effective by proactively securing the travelling parts of the howitzer once a fire mission has concluded. This would change the tactical employment of the M777 but would reduce redeployment time. It would also still allow the gun to re-engage from its current position if required, as it will not be taken out of action.

The detection of a hostile artillery's presence most commonly occurs at the moment the howitzer fires its initial round. While this is not always the case, and ground-based intelligence may indicate that it occurs earlier, specifically for detection by EW; The TTPs developed should be based on the overall benchmark of achieving "fire and movement" of the M777 in five to seven minutes from the onset of perceived detection. This would allow for a few minutes of sustained firing, the conduct of bringing the gun out of action, and time to vacate the area. While Canadian targeting practices don't indicate a concrete duration from the moment of detection to the delivery of effects on target, we understand this to be a truncating window and will only get smaller as technology and tactics evolve.

Research

Gun Area Troop Sergeants Major (GATSM) candidates attending courses in Gagetown, NB, were requested to take part in a guided discussion regarding artillery procedures and gun drills. While they all acknowledged the basic standards of drills, it became evident that each Regiment has developed procedures that deviate from our current drills. They were asked to discuss what additional changes could be made to the kit and equipment utilized on the gunline, and how modifications to specific drills for the movement of the guns could be altered to enhance the Battery's survivability. For the most part, Gunners are already conducting drills and procedures that increase the chances of survival. Unfortunately, members from the 1st Regiment, Royal Canadian Horse Artillery (1RCHA) were not able to be present at the discussions due to operational tempo. The leadership of 1RCHA were sent a thorough set of minutes, and after a careful review, they agreed with the points brought forward. 1RCHA also pointed out that much of the suggested changes were already put into practice during operations, most recently on OPERATION REASSURANCE in the fall of 2022.

One of the main topics of discussion was the location of the MSVS SMP and the use of wagon lines. The MSVS SMP should be placed as close to the howitzer as possible, which all units agreed. As a result, it is possible to move quickly and unexpectedly, access tools and ammunition, and use the vehicle's power to keep the Digital Gun Management System (DGMS) charged. Gunners weighed the pros and cons of having the vehicles close, and noted the immediate availability of the ammunition and EIS outweighed the tactical disadvantage of a potential detection by means of an adversary's UAS or other air assets. This disadvantage is further mitigated when allied forces have air superiority/supremacy. Another issue affecting speed, spoken about at length was the MSVS SMP's LHS and equipment storage racks specific to the gun tractor variant of the vehicle. While some units are finding success with the ammunition racks for maintaining their organization of projectiles, none of the regiments have found success in the equipment storage racks, as the time it takes to deploy EIS in this fashion takes too much time to redeploy when required.

Next, the discussion shifted to how a standard gun platform is deployed, and how it could be altered to improve speed and efficiency. The use of standard Gun Aiming Points (GAPs) such as collimators and aiming posts, was weighed against the use of close and distant GAPs. The primary method of orientation of the M777 is the three ring laser gyros and three accelerometers of the DGMS's Inertial Navigation Unit (INU). Data produced by this instrument is displayed on the Gun Laying Unit (GLU). if there is a mechanical or electronic failure of the DGMS, the gun detachment will revert to using the panoramic telescope along with GAPs as prescribed in the M777 gun drill manual. The advantage of not having the presence of physical GAP equipment on the gun platform and utilizing distant objects instead, outweighed the risk for a small loss of accuracy due to the use of a less accurate GAP. This loss in accuracy can be calculated using trigonometry, measuring the distance the howitzer displaces once it has fired, and dividing it by the range to the GAP in use. The requirement of the panoramic sight to be affixed to the gun was challenged as well. Ultimately, a consensus was reached with the thought that the panoramic telescope need only be used while the howitzer is being recorded, and stowed on the gun tractor once complete, unless required due to a failure check in the DGMS. As well, the standard gun box, a large and often heavy metal box used to store various tools and equipment, was still being deployed across all units, de-

spite no longer being issued as part of the M777's EIS. Further analysis with the GATSM candidates revealed that a smaller and simple container, large enough to contain the Portable Induction Artillery Fuze Setter (PIAFS) and the primer magazines would sufficiently replace the need for any gun box on the platform in its normal role. In fact, most units have already begun this practise, such as by utilizing a repurposed fuse canister for this function. 2.4-Kilowatt direct current generators for the M777 were procured in 2007 and were largely dismissed as not used and normally stowed away, due to mechanical failures in old equipment. The integral ability to charge the gun via the MSVS SMP was now exclusively used in its stead. The Centre of Arc (COA) Marker, a roughly six-foot-tall metal spike that is placed in front of the howitzer to assist the Detachment Commanders (Det Comd) and GATSM to maintain parallelism was determined to be another item referenced in the gun drill manual that was not common practice any longer. The drill of marking the COA on the course bearing scale on the M777 is still employed.

Ammunition requirements were also discussed, and while each Regiment seemed to have a slightly different idea of what constituted the correct amount of ammunition to be readied upon deployment, but all the units agreed that a compulsory ammunition preparation order from the command post (CP) with every mission, would allow Det Comd to better manage their ammunition during engagements. It was noted that excess ammunition could be packed away earlier, and that if the MSVS SMP was kept within a functional distance to the gun platform, the effort and speed needed to offload extra ammunition would be negligible.

Finally, the order "Prepare to Move" was discussed, which was expressed as a desire to modify the current M777 gun drill manual. As a warning order for movement, certain preparations shall be made for movement, including the repacking of ammunition and stores not required for the immediate service of the howitzer. Various M777 EIS items used on standard gun platforms and their necessity to be called "immediate stores" were debated. They concluded that the following kit was required: The J-Bar; PIAFS; Primer Magazine storage box; Det Comd Data Terminal (DCDT); and Lanyard. A consensus was agreed upon that the order should also trigger actions on the gun itself to prepare it for movement. A key discussion point was that at no time should the howitzer itself be brought out of action by these actions, which remains in line with current gun drill.

Trials

The Gun Area students of the Assistant Instructor-in-Gunnery course organised a series of timed trials to test some of the proposed changes and noticed remarkable improvements in redeployment times. Canadian Forces Base Gagetown hosted the test runs and although the icy conditions of the paved surface made running by detachment members less safe, the weather remained above freezing throughout the trial day. To simulate battlefield conditions, the howitzer was brought into action and the spades dropped prior to the gun being lowered on every run. This simulated the spades being dug in, and unable to be lifted prior to the gun being raised. The MSVS Military Commercial Off-the-Shelf (MilCOTS) was used in place of an MSVS SMP because an MSVS SMP wasn't accessible for these trials. The MSVS SMP ammunition and equipment storage racks weren't used because they weren't accessible during these tests. Each trial utilized a Det Comd along with seven detachment members, and drills were conducted in accordance with the M777 Gun drill manual, with the No. 2, conducting the drills of the No. 4, and the No. 7 conducting the drills of the No. 8. The decision to use an eight-person gun detachment rather than the standard ten was made to reflect the realistic circumstances affecting detachments in operation and in training, such as assisting the battery reconnaissance party with force protection or standing guard as part of the local defense plan. The MSVS MilCOTS remained perpendicular to, and within a functional distance to the howitzer and remained running throughout each timed serial. Commencement of each serial began upon the order "Cease Firing" and concluded once the howitzer was hooked to the MSVS MilCOTS, and the wheels began to roll forward. The mounting of the detachment onto a separate vehicle was not considered for this trial.

The first of five trials served as the "time to beat" and each subsequent trial raised the bar further. All routine gun stores were deployed including a pallet of eight dummy projectiles and simulated propellant and fuses to match. The panoramic telescope remained mounted on the howitzer, and one collimator was deployed as a GAP. As the trial simulated coming out of action immediately after engagement, the camouflage cover was not draped over the howitzer, but remained deployed on the right side of the gun. Once the trial commenced, it took the detachment a total of five minutes and five seconds to redeploy the howitzer.

The second trial repeated this procedure, with the exception that all ammunition was removed prior to commencing. It was concluded that an effective ammunition preparation order given from the CP to the guns would allow sufficient time for the guns to pack away unnecessary ammunition during the conduct of a mission, and therefore should not hinder the redeployment times. Once the

trial commenced, it took the detachment a total of two minutes and fifty-five seconds to redeploy the howitzer.

Routine stores that were stowed for the third trial included the generator, sight box, gun box, and gun camouflage cover. Due to their size and weight, these items require multiple personnel to lift them to the load bed height of one and a half metres with the drop sides in their open position, meaning the prime mover cannot manoeuvre to hook-in the howitzer until this process is completed. Once the MSVS SMP is situated in front of the M777 for the purpose of hooking in, these stores also create a safety concern for loading due to the distance to be carried and the additional height required to be lifted. These modifications allowed the MSVS SMP to be quickly repositioned, allowing the remaining kit to be loaded while the howitzer was concurrently hooked in. Once the trial commenced, it took the detachment a total of two minutes and twenty-one seconds to redeploy the howitzer.

Essential stores for firing and movement were solely employed during the fourth trial. Once the trial commenced, it took the detachment a total of one minute and thirty-six seconds to redeploy the howitzer.

The fifth and final trial kept the deployed essential stores for the firing and movement of the howitzer. Additionally, modifications to the "Prepare to Move" Drill, along with the drills on the M777 were conducted. The chart below details how changes to the current drill were utilized. Once the trial commenced, it took the detachment a total of one minute and sixteen seconds to redeploy the howitzer.

Current M777 Gun Drill Manual for orders for coming out of action.	**Proposed Revision to M777 Gun Drill Manual for orders for coming out of action.**
The order "CEASE FIRING" will be preceded by the order "VERIFY GUN EMPTY". Upon receiving this order, the No 1 will look down the bore to ensure it is empty and reports "NUMBER ___ EMPTY". The howitzers must be empty before "CEASE FIRING" is ordered. ***Drill*** *No 1 ensures his bore is clear and orders CEASE FIRING.* *No 3 assists the No 2 in locking the traversing mechanism.* *No 5 removes and hands the primer magazine to No 10. No 10 secures the primer magazine.* *Nos 4 and 5, assisted by the No 2, secure the travel locks.* *No 2 removes the direct fire telescope and stores it in the container.* *No 3 removes the panoramic telescope from the mount and stores it in the container.* *No 5 closes the breech and installs the PFM cover.* *Nos 4 and 5 raise the suspension system. As soon as the howitzer is hooked to the vehicle, the No 10 will order "RELEASE BRAKES". Nos 4 and 5 release the brakes and continue raising until the ride height indicators are aligned for the travelling positions.* *Nos 6 and 7 raise the trail arms to the stowed position.* *Nos 8 and 10 assist in raising the platform by pushing down on the muzzle of the howitzer and securing the muzzle to the towing pintle as soon as possible.* *No 8 replaces the trident bar and No 10 replaces the muzzle plug.* *Nos 4 and 5, once the platform is raised and the wheel assembly is locked, stow the stabilizer arms ensuring they are secured.* *m. The detachment mounts under direction from the No 1.*	**On the Order "Prepare to Move"** *No. 3 assists the No. 2 in locking the traversing mechanism.* *No. 5 removes and hands the primer magazine to No. 10. No 10 secures the primer magazine.* *Nos. 4 and 5, assisted by the No. 2, secure the travel locks.* *No. 2 removes the direct fire telescope and stores it in the container. (**DFT was stowed for the duration of the trial as it is not common practice to have mounted on the howitzer)*** *No. 3 removes the panoramic telescope from the mount and stores it in the container. **(Panoramic Telescope will already be stowed, as per suggested changes in Trial 3)*** **On the Order "Verify Guns Empty"** *No 1 will look down the bore to ensure it is empty and reports "NUMBER ___ EMPTY".* *No. 5 closes the breech and installs the PFM Cover.* *No. 10 replaces the muzzle plug.* **On receipt of the order "Cease Firing". (Trial commenced at this phase)** *Nos. 4 and 5 raise the suspension system.* *Nos. 8 and 10 assist in raising the platform by pushing down on the muzzle of the howitzer and securing the muzzle to the towing pintle as soon as possible. As soon as the howitzer is hooked to the vehicle, the No. 10 will order "RELEASE BRAKES". Nos. 4 and 5 release the brakes and continue raising until the ride height indicators are aligned for the travelling positions.* *Nos. 6 and 7 raise the trail arms to the stowed position.* *Nos. 4 and 5, once the platform is raised and the wheel assembly is locked, stow the stabilizer arms ensuring they are secured.* *No. 10 supervises the mounting of the detachment under direction from the No. 1.* *No. 1 Performs a check on all parts of the howitzer to ensure it is secure and safe to transport.*

Recommendation

On completion of the trials, and in concurrence with the discussions with members across the Royal Regiment, the following changes to the deployment of the M777 and to the classification of gun stores is recommended. Gun stores should be categorized under three sub-headings for all weapon systems across the RCA and are listed below. Not only will this alleviate any doubt as to when each item should be used, but it will also provide guidance and direction for the deployment of gun stores to battery leadership. This alteration should be included in the Close Support Field Artillery Regiment in Battle publication immediately. Each gun drill manual should also be altered to include a list that reflect its own unique set of gun stores. For the M777, the recommended itemized list has been included.

Gun Stores

Essential stores for firing and moving - These stores are essential for the immediate use and firing of the howitzer upon every deployment. Additionally, these stores are kept on every platform and are used during every tactical movement of the howitzer.

Routine Stores - These stores are utilized for routine maintenance and occasional use on the howitzer. These will remain stowed at the discretion of the Det Comd, and only ordered to be offloaded upon the order of the Det Comd or Gun Position Officer (GPO).

Periodic Stores - These stores are utilized less often than routine stores and should only be ordered to be offloaded for immediate use by the gun detachment, or under the direction of the GPO.

The MSVS SMP Ammunition and Storage Racks should only be used when the howitzers are in a static position and the tactical situation dictates that the guns are not expected to move. Even without being a part of the timed trial, it is obvious that these racks are associated with longer redeployment times. The RCA should acquire and standardize the use of a smaller, lighter box that only contains essential firing stores to replace the outdated gun box. The main function of the MSVS SMP is to be able to rapidly hook up and move the M777. It should be positioned adjacent to, and within a functional distance to the howitzer whenever possible during deployments. This maximizes its functionality both as an ammunition limber, an equipment hauler, and as a power source.

Ammunition management should be heavily controlled by the CP under the advisement of the Fire Support Coordination Centre (FSCC) and monitored by the GATSM. The amount removed from the MSVS SMP should no longer be a standard number. Instead, a calculated amount based on the threat and expected engagement should be ordered on every movement. When conducting either firing point or manoeuvre positions, it should be mandatory for the CP to issue ammunition preparation orders to the guns to allow for rapid repacking of ammunition by the gun crew during the conduct of the mission if necessary. For static gun positions, where the MSVS SMP may not be within a functional distance to the gun, a greater amount of ammunition may be ordered to be removed.

The Panoramic Telescope should be deployed and used to pick up a GAP upon the deployment of the howitzer whenever DMGS is in use. Once completed, the sight box along with the panoramic telescope should be stowed in the MSVS SMP unless required. The determination of the GAP should remain a Det Comd decision, and the priority for selection of GAP's during the daytime should be altered to prioritize distant GAPs while the DGMS is in use. Collimators and aiming posts should remain stowed unless ordered due to the lack of a sufficient GAP being located.

The CoA marker should be eliminated from the M777 Gun Drill manual in its next revision. Recording drills for the M777 should simply state "As soon as all records have been completed, the No. 1 will mark of CoA on the course azimuth scale (on the body). The No 1 will report to the GPO, NUMBER ___ RECORDED".

A Chief Instructor in Gunnery (CIG) directive to overhaul the "Prepare to Move" drill should also be developed. The changes outlined in trial five should be put in place immediately. Gun detachments recognize the impact of reducing redeployment times and are very interested in creating efficient remedy. This CIG directive should remain in place until the current gun drill manuals can be updated to reflect accordingly. All modifications outlined above maintain the tactical footprint on the ground and allow the battery to re-engage without delay, as it is never brought out of action.

M777 Equipment

Gun Stores	Qty	E	R	P
Spare Ammo Can to Include				
- Magazine Assembly	3	x		
- M18 Fuze Setter	1	x		
- Firing Mechanism	2	x		
- Digital Thermometer	1	x		
- Primer Vent Cleaning Brush	1	x		
- Lanyard 6'	1	x		
PIAFS	1	x		
Rammer, Artillery Loading (J Bar)	1	x		
DCDT Complete	1	x		
DCDT Carrying Case	1	x		
DCDT Stand with Amp and Loudspeaker	1	x		
Slave to RJB Cable	1	x		
Umbillical Cable	1	x		
DCDT Cable Assy	1	x		
Platform Integration Kit (PIK)				x
Muzzle Plug	1	x		
Access Cover	1	x		
PFM Cover	1	x		
Sight Cover	2	x		
Collimator	1		x	
Aiming Post with Bag	2		x	
Rubberized Aiming Post Bag	1		x	
Aiming Post Light	4		x	
Gun Box	1		x	
M34 Fuze Setter	1		x	
M27 Fuze Setter	1		x	
M35 Fuze Setter	1		x	
PIAFS Power Cable	1		x	
Cleaning Brush (toothbrush Style)	1		x	
Vent, Cleaning Tool	1		x	
Hand Reamer	1		x	
Spanner Wrench	1		x	
Tire Iron, Spoon, 24" L	1		x	
Tire Iron, 33" L	1		x	
Primer Extractor	1		x	
Bore Sight Pouch	1		x	
Bore Sight Muzzle Disk	1		x	
Bore Sight Breech Disk	1		x	
Combination Breach Wrench	1		x	
Lanyard 25'	1		x	
Thermometor	1		x	
Box, Stowage Accessories (to include)	1		x	
-Firing Pin	2		x	
-Retaining Clip	1		x	
-Connecting Link	1		x	
-Firing Pin Spring	1		x	
-Coupler, Dog	1		x	
Obturator Ring	1			x
Stop Cartridge	1		x	
Flyers Bag Complete	1			x
Jack Hammer with Bits	1			x
Cut off Machine	1			x
2.4KW Generator	1		x	

Gun Stores	Qty	E	R	P
Optical Instrument Case	1		x	
Panoramic Sight	1		x	
Elbow Telescope	1		x	
Alignment Device	1		x	
Gunners Quadrant	1		x	
Wheel, Pneumatic	1			x
Cleaning Stave	9		x	
Protective Cap, Dust and Moisture	1		x	
Bore Cleaning Brush with Bag	1		x	
Bell Cone	1		x	
155mm Swab Holder	1		x	
Chamber Swab	1		x	
Fast Bar	1		x	
Projectile Extractor	1			x
Packing Box for Extractor	1			x
Trident Bar	1		x	
Shim Assortment	1		x	
Castor, Swivel	1			x
Breech Stool	1		x	
Muzzle Cover	1		x	
Breech Cover	1		x	
Taillight Assy	1			x
Safety Chains (Set)	1		x	
Tarp 12x12'	2		x	
Jack, Planer	1		x	
Utility Pail	1		x	
Slave to BPM Cable	1		x	
AC Power Supply	1		x	
Gun Cam Net	1		x	
Tool Bag	1			x
Hammer with Removable Heads	1			x
Hammer insert (Soft)	2			x
Hammer Inssert (Hard)	2			x
3/4" Drive Ratchet	1			x
1/2" Drive Ratchet	1			x
Socket Extension 3/4" Drive 16" L	1			x
Socket Extension 1/2" Drive 4" L	1			x
Adjustable Wrench 12" L	1			x
Socket 11mm	1			x
Socket 24mm	1			x
Socket 33mm	1			x
Socket 16mm	1			x
Hand File 4"	1			x
Valve Stem Removing Tool	1			x
Tire Pressure Guage	1			x
Lens Cleaning Brush	1			x
Hand Oiler	1			x
Grease Gun	1		x	
Sledge Hammer	1		x	
Long Handled Shovel	4		x	
Axe	1		x	
Pick Handle	2		x	
Mattock Head	2		x	

Conclusion

Despite improvements in gunline concealment techniques, artillery systems will continue to be detected due to their acoustic signatures and possible electromagnetic emissions. The suggested changes, however, will be crucial in lowering the acquisition of the gun battery once it has been discovered thanks to drills that keep detachments proactive and engaged throughout the deployment. The ability to keep our howitzers moving and stay ahead of enemy counterfires will allow gunners to continue reshaping the battlefield and engaging our enemies whenever necessary, and with the minimum of delay.

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Enabling Indirect Fires at the Battalion Level: The Field Artillery and 81mm Mortars

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Aim

The purpose of this journal article is to examine the current infantry mortar integration construct at the Battle Group (BG)/ Battalion (Bn) level. This will be achieved through a review of allied doctrine in order to determine a framework through which to effectively enable the employment and integration of infantry mortars at the Bn level. Specifically, this paper will examine the infantry-artillery framework that the United Kingdom (UK) and United States (US) employ as well as models that were trialed by Canadian Battery Commanders (BC) whilst conducting training with light battalions at the Joint Readiness Training Centre (JRTC) in Fort Polk, Louisiana. As an end state, this journal article will seek to provide a realistic recommendation for the integration of infantry mortars into Canadian artillery doctrine with the aim of resolving friction points between the two branches of the Canadian Army (CA) with a straightforward framework that keeps the sensor to shooter link as short as possible. It is assumed that the reader of this paper has some knowledge of Canadian artillery doctrine. Furthermore, it is not within the scope of this article to comment on training being conducted by the Canadian Infantry School, nor will it recommend changes to any infantry owned doctrine.

Background

The dismounted 81mm mortar was, up until 2002, employed as organic infantry fire support at the Bn level. Between 2002 and 2018, the Royal Canadian Artillery (RCA) employed the weapon system within its Field Regiments and force generated personnel to operate it. It was given back to the infantry for their use as organic fire support in 2018, with the aim of having a weapon system owned by the infantry that could better enable their movement with fires without having to leverage the fire support of an external agency. However, due to the amount of time that had passed since the infantry divested the 81mm mortar and 2018, a capability gap was born out of the simple lack of corporate knowledge. Now, instead of basing the force employment structure for the 81mm off historical Tactics, Techniques and Procedures (TTPs), the infantry is re-learning how to best employ the traditionally infantry owned weapon.

The same learning curve is occurring within the RCA; TTPs and Standard Operating Procedures (SOPs) that normally accounted for the planning of mortar employment are having to be re-thought or re-approached to incorporate an outside entity in the planning process. The result is a friction space where the doctrine is unclear as to where the hand-off occurs when it comes to advising indirect fire support and owning the deconfliction.

This friction space is aggravated by several complicating factors. The first is that although Canadian artillery doctrine does not on paper employ a standalone Fire Support Coordination

Centre (FSCC) at Bn level, as it is traditionally the BC's party operating out of the BC's vehicle that fills this role, we are increasingly employing them across all levels of combined arms training. Training events such as the Unified Resolve series (UR), JRTC, and Maple Resolve (MR) call for, or at least set the conditions for, an FSCC at Bn level to be employed. This is due (at least in part) to a trend of growing unit level Headquarters (HQs). Unit HQs are swelling and growing away from their doctrinal size as a result of an increasing number of sensors and enablers being made available to unit commanders. With more sensors and capabilities being injected into units, the need to synthesize and analyse the information in a timely manner to inform commanders' decisions arises and thus the need for bigger and more staff heavy HQs has been created.

Additionally, the lack of a doctrinal Fire Support Coordination Centre Officer (FSCCO) at the Bn level, despite it becoming increasingly the norm to employ one, and the presence of the newly force generated Mortar Platoon Commander, has contributed to the friction between the infantry and the artillery because it calls into question *who* should act as the FSCCO at Bn level as it has not been previously codified. On top of the friction caused by the employment of an FSCCO at Bn level without such a need being captured by existing doctrine; the RCAS is currently conducting training that treats mortar call-signs as if they are gun call-signs. This can be seen both on the DP 2 Forward Observation Officer (FOO) course and on the Instructor-in-Gunnery (IG) course. This is a disservice to both trades as it reinforces old TTPs within the artillery as well as strengthens the practice of simply defaulting to treating mortar call-signs like gun call-signs.

Finally, the problem becomes further complicated in a multi-national context. Given that UR, MR, and JRTC serve to validate units prior to deployment, and that the Enhanced Forward Protection Group (eFP) Latvia employs an FSCCO for what is on paper, only a Bn HQ, the issue of how mortars are integrated, controlled, and employed alongside field artillery gains another of complexity.

Review of United States Mortar Doctrine

The United States Army as well as the United States Marine Corps (USMC) both employ mortars within their respective organizations. Both institutions employ mortar systems as organic fire support integral to the infantry. It is important to note that the US (like most other NATO countries) employ a centralized model for the delivery of fires and weapons effects. This is different from the largely decentralized model employed by most commonwealth armies.

United States Army

American Army doctrine, like Canadian doctrine, is tiered into Capstone, Keystone and supporting documents. Army Doctrine Publications (ADPs) are capstone documents, and as such, this review will begin with an ADP in order to examine how the United States Army employs their various mortar platforms, and what command and control relationships exist within their organizations.

The first piece of doctrine to be examined is ADP 3-09, entitled *Fires* initially, and has since been renamed *Fire Support*. Within this publication, it is indicated that one must look to Army Doctrine Reference Publication (ADRP) 3-09 for information on the Fires Warfighting Function.

ADRP 3-09 outlines "the roles, core competencies, critical capabilities, characteristics, and principals of fires, as well as fires in support of unified land operations, and decisive action." Additionally, it speaks to "the various fires organizations, and lists key fires personnel with their duties and responsibilities." Within this publication, the Fire Support Team (FiST) is defined as "a field artillery team organic to each maneuver battalion and selected units to plan and coordinate all available company supporting fires, including mortars, field artillery, naval surface fire support, and close air support integration." ADRP 3-09, as well as several other publications of American army doctrine, outline that FiST's are employed at both the Bn and Company (Coy) level. The Coy level FiST has the responsibility of controlling Forward Observation (FO) parties that are allocated to the platoon level, in addition to collating information as well as ensuring a cogent observation plan is in place. The Coy level FiST is subordinate to the Bn FiST. In both cases, the FiST comes from the DS artillery battalion that is a part of the Brigade Combat Team (BCT).

The United States military has three different classes of BCTs: Armored Brigade Combat Teams (ABCTs, sometimes referred to as HBCTs for "heavy" in lieu of "armored"), Infantry Brigade Combat Teams (IBCTs) and Stryker Brigade Combat Teams (SBCT). All three variants of BCTs employ the 60, 81, and 120mm mortars from platoon to Bn level. With respect to all three BCTs, it is made clear through American doctrine that the mortars belong to the Bn, however, the Fire Support Officer (FSO) from the direct support artillery battalion employed at both Coy and Bn level are the principle adviser on fires, including mortars, to the supported arms commander. The doctrine does stipulate that the FSO may even be allowed to position the Bn mortars, but permission must be given from the commander to the FSO prior to doing so.

United States Marine Corps

In addition to the BCTs, the USMC also employs mortars. While the BCT's reflect what we might colloquially refer to as the "Green Army" construct, as they are comparable to Canadian Mechanized Brigade Groups (CMBGs), it is still useful to examine the USMC construct as they employ a decentralized construct for effects delivery. The Marine Corps, while still operating within the doctrinal context that includes the possibility of having a Direct Support (DS) artillery unit, is designed to operate independently (albeit as part of the Department of the Navy). The USMC task-tailors Marine Air-Ground Task Forces (MAGTFs) of varying sizes as their baseline grouping. All MAGTFs have command, ground, air and logistic combat elements, but only the MAGTF as a whole can seize and hold ground (vice the ground combat element alone).

The USMC does have artillery units integral to their organizations that can be organized under the ground combat element (GCE), which would provide their own observers to the MAGTF. However, due to the joint nature of the MAGTF organization and the level of Air-Ground cooperation required not only within the MAGTF but also with flanking units, the USMC houses the Air Naval Gunfire Liaison Company (ANGLICO) which force generates observer teams that serve the purpose of:

> *provid[ing] the MAGTF commander a liaison capability to plan, coordinate, and conduct the terminal control of fires in support of joint and multinational forces operating within or adjacent to the MAGTF battlespace. Each ANGLICO contains Marine and Navy personnel qualified to plan, coordinate, and integrate all fire support assets available to the MAGTF, as well as joint and multinational forces.*

As a result of their independent force structure, they employ an FSCC at Bn level instead of a FiST. The FSCC is commanded by the officer-commanding (OC) of the weapons company within the Bn as part of the GCE. At Regimental level, an FSCC is still employed but it is formed and led by the commanding officer of the artillery battalion in DS. Of note, within the USMC Bn level FSCC, the DS artillery battalion and the mortar platoon both send representatives to sit in the FSCC and work under the direction of OC weapons coy.

Doctrine Common to Both the United States Army and the United States Marine Corps

In addition to the doctrine that belongs specifically to each of the US Army and the USMC, there exists publications that are dual purpose and serve both organizations, such as the Army Techniques Publication (ATP) 3-21.90 *Tactical Employment of Mortars* which also doubles as the Marine Corps Tactical Publication (MCTP) 3-01D and as such is a piece of doctrine common to the two branches.

This publication illustrates that although both the US Army and the USMC employ mortars in a similar, but not –identical fashion, the differences are negligible at Bn level and below. That is not to say that the two organizations do not have different command structures implemented to facilitate fires, but that with respect to how mortars interact with the Bn HQ for firing, it is negligible. Chapter 2 discusses Fire Support Operations in which it states "[t]he mortar element leader and FSO (or in the case of the USMC Fires Support Coordinator (FSC)) have a close professional relationship. They must understand the maneuver commander's intent for fires and work closely to ensure it is properly executed." It continues in saying that:

> *The mortar element is a delivery platform that the FSO includes in the planning process. The mortar element leader is present during the planning process to advise on the capabilities of the mortar element systems, fire direction and communication equipment, personnel, and how best to employ the mortar element to execute the fire support plan within the maneuver commander's intent.*

Importantly however, this document does not shy away from making it clear that the various mortar platforms belong to the Bn (and where applicable, Coy) commander(s). This is in keeping with FM 3-09.31 *Tactics, Techniques, and Procedures for Fire Support for the Combined Arms Commander,* which as previously stated indicates that the Bn FSO can be granted permission to control the mortars directly, but it is an authority granted by the Bn commander.

Discussion

When reviewing the referenced pieces of American doctrine, similarities between American and Canadian force employment constructs arise, despite what one might initially think. Both the US Army and the USMC employ similar personnel at Bn and Coy level with similar functions in order to effectively coordinate fire support. The only real difference that exists between the two organizations is that the Bn Fire Support Coordinator (FSC) within the USMC is the Weapons Coy OC and similarly at the company level, the Coy FSC is a Weapons Coy platoon commander. Within the US Army, this function, although referred to as the FSO, is filled by a designated Field Artillery Captain at Bn level and a Field Artillery 1st Lieutenant at Coy level, both from the DS artillery battalion. The distinction between the USMC's FSCC (vice the US Army's FiST) being led by an in-

fanteer who is referred to as a "coordinator" of fires, reflects a decentralized fires delivery construct as effects are being "coordinated" vice commanded by a FSO.

Within Canadian doctrine, the Bn FSO equivalent is a BC from the DS battery that is to support the Bn in question. The Coy FSO can be thought of as a FOO. A major difference between the two doctrines is that Canadian doctrine does not specifically allocate observers to each platoon within a Coy, instead, the FOO has the freedom to split their resources as they see fit in a task-tailored manner. However, at Bn level there is only one FSO that advises the Commanding officer of the maneuver force, irrespective of the fact that in the case of the USMC that person is an infanteer by trade. This is common between both nations.

In sum, while the US Army and the USMC both employ mortars as integral infantry support weapons, the Army relies on the DS artillery battalion to coordinate and synchronize fires from a multitude of resources so as to achieve the BCT's Fire Support Tasks. This is reflective of a centralized fires and effects delivery construct. Conversely, the USMC tends towards a more decentralized model facilitated by an FSC, due to the task-tailored nature in which they fight and work within larger joint and multinational roles. In both cases, the mortar platoon leaders advise their respective FSOs (or FSCs) on the capabilities and limitations they possess, but the FSO (FSC) remains the primary adviser on all things fire support. Finally, in both cases, the mortar platoon commander does not have a requirement to be in the Tactical Operations Centre (TOC) or Tactical HQ (Tac).

Review of United Kingdom Mortar Doctrine

Like the US, the UK also employs several mortar platforms, both mounted and dismounted. A worthwhile place to begin this portion of the doctrine review is with *Artillery Training Volume III: Close Support Organization, Deployment and Operating Procedures (CS ODOPS) – Book 2, Army Code No. 71373.* This document is similar to the Canadian publications BGL 371-004 and 371-002 combined. It specifies that, like with Canadian doctrine, the BC of the battery tasked to support a Bn is the primary fire support advisor to the Bn Commander. The BC establishes the Joint Fires Cell (JFC) in the Bn HQ and commands it. In the absence of the BC, the JFC is commanded by an artillery staff sergeant. This document however, stipulates that an artillery captain may also be established as a member of the JFC to command it in the absence of the BC if the mission requires it.

Moreover, in the publication *Army Field Manual Volume 1 Combined Arms Operations, Part 2: Battle Group Tactics* the exact layout of a Bn HQ is depicted along with the roles and responsibilities of key staff. In this document, the duties of the BC reflect those outlined in CS ODOPS. In addition however, the mortar platoon commander has a dedicated seat in the JFC and has a codified role within the Bn HQ. This piece of British doctrine specifies that the mortar platoon representative within the Bn HQ has the responsibility of advising the BC on mortar resources and must assist the BC during the planning phase in addition to attending all orders and tracking the battle during the execution phase. This document stipulates, like in CS ODOPS, that the Staff Sergeant (or Captain as laid out in CS ODOPS) from the BC's organization commands the JFC in their absence.

In terms of UK doctrine that pertains specifically to the employment of mortars, there is: *Dismounted Close Combat (DCC) Tactical Doctrine Volume 2: The Tactical Employment of Infantry Weapons and Systems (IWS) Pamphlet No. 2 The Medium Mortar — 81 mm L16*. This piece of doctrine is similar to the American publication (and can be viewed as its counterpart in American doctrine) ATP 3-21.90 *Tactical Employment of Mortars* in the sense that they serve the same purpose in what information they contain. This pamphlet, as the name suggests, outlines in depth how the dismounted 81mm operates within an infantry battalion as well as how it interacts with supporters from field artillery regiments. Unlike ATP 3-21.90, this publication goes so far as to prescribe that the Mortar Officer specifically will be in the Fire Planning Cell (FPC—to be interpreted as the same cell that *CS OPODS* and *Battle Group Tactics* calls the JFC) and that they will move with the Tac HQ should it ever split from the main HQ alongside the BC. In such a case, the FPC in the Main HQ would remain to be commanded by the BC's assistant (BC's Tech) or Artillery Captain should one be employed. The Mortar Warrant Officer would also remain with the Main HQ.

Every battalion would normally be supported by 9 tubes divided into 3 sections of 3 tubes each. Each section would have their own Command Post (CP) to issue data to the tubes in response to fire orders. The platoon 2nd in command (2IC), the Mortar Warrant Officer, is seated in the Main HQ (Bn TOC) and is responsible for tracking ammunition and engagements so as to direct which mortar CP will respond to calls for fire (CFF) on mortar platoon net coming from the Mortar Fire Controllers (MFCs). Every company is allocated an MFC party and a FOO party, and independ of the MFCs sending CFF on their net, FOO

parties are also free to send CFF on their battery net.

Discussion

With respect to the differences between British doctrine and Canadian doctrine, it is no surprise that the doctrine surrounding the relationship between the field artillery and manoeuvre forces is extremely similar; as a former British colony and a current member of the British Commonwealth. However, a major difference is illustrated in the interaction between the mortar platoon and the field artillery within the Bn TOC. Both the mortar platoon and the field artillery DS battery enact decentralized effects delivery systems, however due to the constructs' inability to deconflict mortar and field artillery fire support at the Forward Line of Own Troops (FLOT), the whole systems becomes centralized and beholden to deconfliction between either the FSCCO and the Mortar PL 2IC or within the CO's Tac between the BC and the mortar platoon commander.

US Army vs UK Army Mortar Employment: Key Takeaways

To begin, there are a few key differences between British doctrine and American doctrine that are worth examining. While both nations outline constructs wherein the mortar platoon is integral to a given manoeuvre Bn and has representation in the Bn HQ fires cell (whether they be the mortar officer accompanied by their platoon Warrant Officer, or simply a member of the mortar platoon tasked to act as a liaison in the Bn HQ), the implied locus of control represented by the presence of the mortar platoon commander themselves is evidently different between both countries.

Under the British construct, the mortar platoon commander themselves assists the BC in the JFC, in addition to travelling in the CO's Tac alongside the BC. This is not the case with American doctrine. As was examined in the previous section, the FiST at Bn level is led by the FSO who fulfills the same role as the BC in all fashions less travelling with the CO in their Tac; a job notably also not filled by anyone from the mortar platoon. The lack of a mortar officer in the Bn HQ under US doctrine speaks to the level of control placed in the hands of the FSO. While it is made clear that integral mortars, under US doctrine, belong to their Bn and not to the Field Artillery FSO who is tasked to support a given Bn, they are often granted control of them in an effort to streamline a cogent fire support plan. This is not the case under British doctrine, where the presence of the mortar platoon officer in the JFC and alongside the CO in their Tac necessarily implies that control of the mortars in the battlespace would not under normal circumstances be granted to the BC or their assistant.

This key distinction is likely a symptom of having multiple mortar platforms operating within an infantry battalion under US Doctrine (the 60, 81 and 120mm mortars). If all the platoon commanders associated with these platforms, or even just the platoons associated with Bn fire support vice company level weapons, were to become a part of the Bn HQ and even the CO's Tac, there would simply be too many personnel. Not to mention the fact that there would be too many command elements trying to synthesize information into one plan. Placing the Bn FSO in charge of being the singular person to advise the commander on how to integrate all the indirect fire within the Bn streamlines the process of planning and executing effective fire support, thereby contributing to a faster planning cycle.

The drawback of this model is that no fire support adviser travels with the CO through the battlespace, which makes the FSO heavily dependent on reports and returns from sensors, thereby slowing the reaction time of fire support assets and ultimately removing any semblance of mission command from the application of fire support. This construct can be thought of as extremely centralized fire support whereas commonwealth countries tend to leverage decentralized fire support structures which tend to increase the overall agility of the network.

That being said, as was discussed in the review of UK Mortar doctrine, it appears that the British Infantry and the Royal Artillery both implement decentralized fires delivery structures with no interoperability component built in to allow for the overall combined fires delivery systems to remain decentralized. Since all the deconfliction between mortar fires and gun fires must happen in either the TOC or the Tac, the product of the interaction between the mortar fires delivery system and the gun fires delivery system, unfortunately and most likely, unintentionally, becomes centralized.

Canadian Light Battalions and JRTC

As was touched upon in Section 2 of this article, the Background, the CA has employed the 81mm mortar as an organic infantry support weapon since it was returned to the infantry in 2018. While the doctrine surrounding the finer points of the integration at Bn level is in need of finessing, the CA has been pressing onwards with its tasks nonetheless. As a result, anecdotal experiences of RCA ATGs forming FSCCs at Bn level wherein infantry mortars are being employed exist and have been trialed. This section will discuss models that have been employed by the Field Regimentals of the RCA with their supported light battalions at the Joint Readiness Training Centre, a level 7 training exercise held in the US. During this

training event, one Canadian light battalion each year integrates into an American brigade for a force-on-force exercise followed by live ranges. This training event serves to validate the light battalion that belongs to the brigade being validated each training cycle (under the Canadian Managed Readiness Plan), as the light battalion cannot be validated as part of MR, due to the remainder of the brigade being a mechanized force.

When deploying to the US in support of the 3rd Battalion, Royal Canadian Regiment (3 RCR), 2nd Regiment Royal Canadian Horse Artillery (2 RCHA) employed different constructs over the years with respect to the structure of the FSCC provided to 3 RCR for the conduct of the exercise. This variance in construct is both a reflection of the decision space afforded to BCs with respect to their ATG and how they choose to employ their personnel; and also of the relative grey area surrounding the Bn FSCC and what it should look like given the factors previously discussed in Section 2: Background.

In 2020 Y Battery, 2 RCHA deployed to JRTC with two FOO parties and an FSCC that did not include an FSCCO. To this end, the mortar platoon commander was employed in the FSCC alongside the FSCC WO to act on behalf of the BC in the TOC. With the mortar platoon commander in the TOC and the mortars being the only fire support asset organic to 3 RCR, the Command and Control (C2) construct was naturally streamlined. However, complications arose from the employment of a Captain in a coordination center that would normally be run by the FSCC WO in the BC's absence. In 2022 however, the ATG that accompanied 3 RCR to Fort Polk, Louisiana had an FSCC with an FSCCO as well as two complete FOO parties.

On both rotations, Canadian guns did not support 3 RCR alongside the associated ATG. Y Battery opted to have the mortar platoon join Bn Fires net (battery net), in order to keep the sensor to shooter link as short as possible. The follow-on effect of having the mortar platoon on battery net, along with the BC, FOO parties and MUAS Det was that the mortar platoon commander did not have to be in the TOC, as fire orders as well as movement orders could be sent from the FSCC direct to the tubes. The mortar platoon commander, however, did integrate into the FSCC nonetheless for professional development purposes. When the mortars ran out of ammunition and the battalion defensive position was being overrun, the platoon commander had to quickly re-orient and return to their tube line in order to perform their secondary task, and baseline job, as a rifle platoon commander.

In 2023, 5ième Régiment D'artillerie Légere du Canada (5 RALC) participated in JRTC with 3ième Royal Vingt -Deuxième Régiment (3 R22R) and their associated mortar platoon. In keeping with the trend, 5 RALC reported having the same frictions between their ATG and the mortar platoon integral to 3 R22R. The 3 R22R mortar platoon began the exercise working completely separately from the BC which led to two separate fires delivery systems that had no central command or control, thereby hindering the fires system as a whole. By the end of the exercise, 5 RALC opted to employ the FSCC as both an FSCC and also a centralized command post. This saw the 5 RALC FSCC doubling as an RCP for the observers on mortar platoon net as well as the FOOs on battery net.

Lastly, 1st Regiment Royal Canadian Horse Artillery (1 RCHA) participated in JRTC with 3rd Battalion, Princess Patricia's Canadian Light Infantry (3 PPCLI) in 2021. This anecdote provided by 1 RCHA is included for posterity insofar as input was received from all Field Regiments within the RCA as they did not have participation from the Battalion's integral mortars. However, it was reported by members of their regiment that the decentralized fires delivery system employed by the US Army was a challenging construct to work within given the decentralized nature in which Canada's fires delivery system functions.

Discussion

The 2022 solution of having the mortars on battery net, with an FSCCO in the TOC vice just an FSCC WO did work and did serve the purpose of keeping the C2 structure as simple as possible, and under the control of the BC throughout. This is preferable for any commander in challenging and complex conditions. However, having the mortar platoon join battery net at the Bn level is a task tailored solution that would not have worked as smoothly had a Canadian gun battery been in direct support to 3 RCR and on battery net as well. 5 RALC's solution reflects a construct that not only works in a manner that allows the BC to have complete situational awareness (SA) on the engagements of all firing units but also parallels the already employed construct of an RCP in a Regimental/ Brigade context.

In a scenario where a mortar platoon and a firing battery are both tasked to support a Bn, two separate nets would need to be employed and the Bn FSCC would have to act in both the traditional FSCC role as well as an RCPO. The nature of that deconfliction is outside of the scope of this article, however it is worth nothing that the vehicle normally assigned to be the FSCC (LAV 6.0) cannot monitor four nets. Given that the BC will always have to be on Bn Comd Net as well as one of battery net or regimental command net, there is no bandwidth for the BC/ their FSCC to monitor the second firing net that would be mortar net. This makes intuitive sense, a ship in Direct Support

would have a Liaison Officer (LO) in the TOC ready to pass information to the ship in question on their own integral communication network. Similarly, a JTAC serves the same function in the same manner when communicating with aircraft.

Nonetheless, there are risks associated with simply solving the integration issue by allowing the mortars to be treated as another gun call sign. The primary risk is that this would not be affording the infantry mortars the ability to build their own employment construct, as the RCA would be effectively hand cuffing them to a specific employment construct. Additionally, it's worth noting that given the high level of doctrinal overlap between the UK and Canadian field artillery; if the solution was to simply dictate to the infantry that they must conduct themselves as if they are gun call signs, why is that not the case in the UK?

Summary

Overall, this article has reviewed both US Army and USMC mortar employment, as well as UK mortar employment and present day integration models within the Canadian Army. Through the examination of relevant doctrine and the extrapolation of pertinent implications that arose from the allied employment models; it is clear that every organization has applied a different construct in an effort to synthesize organic battalion fires with the fires provided by DS Artillery Regiments/ Battalions.

The US Army employs a completely centralized system, this is in keeping with what one might expect from a resource heavy organization that does not operate under the assumption they will always be employed in a multi-national context. Further, it is evident that when multiple organic indirect fire support assets are employed within a battalion, one centralized node for command and control is preferred over a decentralized model. This allows not only for an organized and synchronized response to various inputs from sensors in the battlespace, but also facilitates a more centralized artillery command structure commonly employed by the Americans, in so far as the Bn FiST acts as the singular fires point of contact for the Bde FSCC and that the fires delivery system is based off of calls for effects, and FSOs respond with the appropriate munitions.

Conversely, the USMC employs a decentralized model both within the Bn level FSCC as well as with respect to its fires delivery system. This is likely a symptom of having less fires delivery systems available as well as having an overall effects construct that sees their sensors ordering the resources they need to achieve an effect in the moment, vice solely requesting an effect and being issued a resource from a C2 node. Observers call for the munitions they want in order to achieve an effect, and firing units respond in kind, with FSCCs deconflicting where needed.

The UK employs two decentralized models whose combination results in a centralized system. Their Mortar Platoon Commander integrates into the JFC at Bn level as a subordinate officer to the BC of the DS firing unit. However, the mortar platoon commander is tasked to travel with the unit CO throughout the battle alongside the BC. A mortar net and a battery net run in parallel to each other in the Bn Area of Operations (AO) with the senior call sign on each net (the Mortar Platoon commander and the BC) co-located with the CO of the supported unit. Firing call-signs respond to CFFs from their own observers and any relevant deconfliction happens in the TOC or the Tac. This makes it clear that although the overall fire support plan belongs to the BC, the mortar platoon is controlled by the mortar platoon commander on behalf of the CO of the unit. The end state is a fire support plan that is rigid in nature due to an inability for any one personnel to have complete situational awareness of engagements at one time.

Recommendation and Conclusion

This article set out with an aim to examine the doctrine of allied nations that employ mortar platforms as organic infantry support weapons so as to recommend a way forward for the CA. Given the findings, it is the recommendation that the CA employ blended US/UK approach to mortar integration at the Bn level.

This would see a mortar liaison detachment being employed in the FSCC that would be stood up by the ATG attached to a given Bn (ideally two personnel max so as not to over crowd the FSCC). This would allow the FSCCO/ FSCC WO (depending on the construct employed by the BC and the amount of officers available to them) to have a direct means of communication to the mortar line, without having to staff additional artillery communicators from the FSCC/ DS Battery. The mortar platoon commander themselves could fill this role, or they are free to remain on the tube line, or wherever else they see fit in order to best support the battle. Under this construct, the mortar platoon commander is afforded the decision space to place themselves in the most opportune position to command their platoon while simultaneously influencing the battle.

Furthermore, a mortar LO team in the FSCC would establish the stand-off necessary between the artillery and the infantry so as to not afford any stakeholders in the FSCC the opportunity to conflate the mortars as an artillery weapons system. This in turn, would likely set the necessary conditions for the Canadian Infantry as a

whole to begin to grow and create new corporate knowledge on how to employ this weapon system independent of artillery TTPs. This recommendation also alleviates the responsibility for the ATG to provide a net for the mortars to operate on, in addition to managing the complications that could arise from having a mortar platoon on a battery net with a gun battery.

Finally, this model would provide a start state that is more in line with other enablers that could be integrated into the FSCC such as a JTAC. If operating in accordance with this recommendation, all calls for fire would be sent to the FSCC on Bn fires net (battery net). OP parties and MFCs alike would monitor Bn fires and their associated Company Net. The Mortar CP would monitor Mortar Platoon net and Bn Comd as they normally would. As CFF come over battery net, the FSCC would read back all fire orders in lieu of the Gun CP or the mortar CP with all observes and the BC listening in. The FSCC and/or the BC (if they deem it necessary) will issue a Message to Observer to the observer that sent the CFF if necessary and direct them to the net they are to carry out their mission on.

This solution allows for the BC to remain in the loop, along with all the observers and the FSCC as to what targets are being engaged, and what firing unit is to respond. Additionally, it allows for the mortar platoon commander to position themselves where they feel is best based on the tactical scenario. Finally, it allows for the artillery to retain control over the indirect fire plan as a whole, integrating all relevant systems in accordance with our training and provide a complete, synchronized effects plan that reflects the expertise the RCA brings to the table.

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Countering the UAS Menace: Finding an Uncommon Solution to a Common Problem

Capt P.R.N. Vendette

Introduction

With the emergence of militarized and commercial off-the-shelf drones (COTS) in recent conflicts, there is an operational need for the Canadian Armed Forces (CAF) and the Royal Canadian Artillery (RCA) to explore options to mitigate Class I-III Uncrewed Aircraft System (UAS) in order to increase the survivability of artillery positions. The purpose of this journal article is to discuss the survivability of artillery positions against emerging drone threats (armed, commercial (ISR), loitering drones) and propose solutions to increase it. It will examine the current threat posed by class I-III UAS, and the potential enemy Counter-Battery (CB) response times as a result. It will also discuss current Canadian Counter-Uncrewed Aerial System (CUAS) doctrine and All-Arms Air Defense (AAAD) and identify what Tactics, Techniques and Procedures (TTPs) and emerging technologies the RCA might adopt to increase its effectiveness on the battlefield. Having thoroughly explored the contemporary UAS and associated CB threat to current artillery TTPs, this article will provide recommendations on characteristics required to satisfy the Urgent Operational Requirement (UOR) when looking for a Counter-Uncrewed Aerial System.

Background

Over the last two decades, the pace with which drones of all natures have proliferated the battlespace has increased exponentially. COTS drones have been utilized in warfare due to their accessibility, price and constant technological evolution providing greater efficiency. Initially employed for agricultural purposes such as autonomous crop spraying or in the film/photo industry with cameras that provide images in 4K, the technology currently offered on the market is constantly evolving and the options on how to employ such technology is limitless. As improvised explosive devices (IEDs) were a serious and ever-evolving threat during the War in Afghanistan, so has the threat of COTS drones being armed with explosives increased in popularity. In the past, the employment of drones was reserved by nation states with significant technological advantages over their adversaries. However, in the span of a few years, the employment of drones has evolved to the point where irregular forces have gained parity due to the access to COTS drones at a drastic cost reduction. Current and past conflicts around the World such as the Second Nagorno-Karabakh War, the defeat of Daesh in Iraq and Syria or the Ukraine-Russia War are examples.

Since 2014, many nations have deployed combat forces to the Middle East in support of Operation INHERENT RESOLVE (OIR). In the past decade, the amount of attacks originating from armed, commercial (ISR), loitering drones have increased significantly. Despite Indirect Fire being the main threat to allied forces throughout the Area of Operation (AO), advanced conventional weapons (ACW) threat remained the most deadly. This includes one-way UAS. The same issue was observed in Nagorno-Karabakh where Azerbaijani Armed Forces' widespread use of drones was seen as a major factor contributing to their defeat of the Armenian military. Due to this evolving threat, many countries are currently looking into acquiring or developing a system that can defeat these threats. The CAF are participating, alongside their NATO allies, in a multitude of working groups and project development to come up with a solution that will answer the troops' needs.

Discussion

Currently, the Functional Centre of Excellence (FCoE) for CUAS has not been identified, or at the very least

agreed upon. While Class II and III UAVs will be dealt, in majority, by ground-based air defence (GBAD) assets, Class I UAVs remain the responsibility of ground forces. As stated in the All Arms Air Defence Training Manual, "all elements of the army must be capable of self-defense against the air threat, particularly against the armed helicopter." This definition ought to be updated in order to include class one UAVs. Soldiers and units operating in close proximity to adversarial forces should assume that they are being observed and are not under the protection of GBAD and/or EW elements. Sensors, including long-range and short-range radars, optical devices and audible alert systems, face challenges in detecting the Class I UAS at sufficient ranges to mitigate effects.

In addition to the TTPs already developed and outlined in the Canadian CUAS doctrine manual, the employment of MANPADS and the addition of service crew weapons dedicated to the defeat of Class I UAVs are fundamental to increasing survivability against Micro, Mini and Small (MMN) UAVs. What the Ukrainian Armed Forces (UAF) have learned through experience in their fight against Russia, the CAF should modify in advance of future conflicts by their TTPs and disperse MANPADS to the ground forces rather than dedicated air defense capabilities. Furthermore, all elements of the army should acquire crew-served weapons dedicated to the defeat of Class I UAVs. The employment of non-kinetic or directed -energy weapons to defend airspace against UAS, such as quadcopters and hexacopters, operate without compromising safety or risking collateral damage and is easy to use. The concept of "air sentry" was reinvigorated in the Canadian CUAS Doctrine. In Platoon-size elements, soldiers would have secondary duties and act as air sentry just like they would as a C6 gunner. In order to achieve this, new Individual Battle Task Standards would need to be implemented. The creation of CUAS ranges will be necessary in order to qualify these individuals. Examples could be drawn from the US Army where CUAS courses and demonstrations are given to individuals being deployed in operations (i.e. Op OIR) where Class I UAVs are a threat. CUAS IBTS would include both practical (TOETs and PWTs) and knowledge-based requirements. Knowledge-based requirements could include online classes (i.e. perform visual aircraft recognition training, Camouflage and Concealment, etc.) paired with confirmatory testing to assess their knowledge. Similar to the standard for personnel designated as primary or alternate C6 gunner, personnel designated as air sentry would be required to maintain currency on the non-kinetic crew served weapon's handling tests as well as PWT 1 through 3 depending on Individual Standard (IS) requirements related to their trade. As it will not be considered a personal weapon, not all combat arms personnel will be required to maintain currency on the weapon handling test. Although, it is recommended that the knowledge-based portion be mandatory for all Combat Arms personnel.

As a result of these new IBTS coupled with new data on adversary UAS, it would be wise to revisit our weapon control orders. At present, the common practice of AAAD against UAS is to have troops at Weapons Tight, whereby weapons may fire only at aircraft identified as being hostile. In an environment where Identification Friendly Foe (IFF) might only be possible by human recognition and where the time period allocated for decision making is limited, weapon control orders should be broken down by UAV classes and subclasses. This way, SUAS would remain as Weapons Tight but MUAS and Micro UAS could be under Weapons Free. This would significantly increase the speed of engagement and therefore, the survivability of troops on the ground. In the event that the targeted UAS was friendly, the owner could identify themselves following the contact report pushed by the ground force elements that engaged it.

The Ukraine-Russia War demonstrated that the use of UAVs in the battle space continues to evolve as a force multiplier for artillery reconnaissance and observation and engagement of high pay-off targets. An encounter with a Class I UAS does not necessarily mean that the soldier or unit is at risk or under attack. However, an unidentified Class I UAS operating in close proximity may be a precursor to an attack - or, at a minimum, may be an information-gathering operation by the adversary. It is therefore imperative for ground force elements, such as artillery positions, to negate the enemy of such capabilities. By jamming enemy UAVs, it denies the enemy of potential for intelligence and information gathering and their ability to conduct call for fire from air observers. Effective and rapid interceptions of enemy UAVs would greatly increase the survivability of gun positions as it would inhibit the enemy from providing directing fires without boots on the ground.

Urgent Operational Requirements

After the invasion of Ukraine by Russian Forces in early 2022, CJOC has identified an urgent operational requirement (UOR) for a CUAS capability in support of Op REASSURANCE. The preferred option during the selection process would provide integrated CUAS sensors to DETECT, IDENTIFY and TRACK Class 1 UAS. In addition, it will include Soft-Kill Effectors designed to TARGET, ENGAGE and DEFEAT Class 1 UAS along with missiles. The CUAS soft-kill/missiles

equipped capability will be vehicle mounted on an existing Canadian Army (CA) vehicle fleet or a new vehicle platform that will have the capability to sense and effect Class I UAS. Having a vehicle mounted capability is a great way to increase the survivability of artillery positions such as gun platforms as it would be mobile and would not require to be dismounted in order to set up or tear down the equipment. In the event that the system be mounted on an existing CA vehicle fleet, it would also facilitate the introduction into the RCA. In order to answer the DETECT, IDENTIFY and TRACK, the system will be equipped with a Radar that will provide early warning for both enemy artillery as well as Class I UAS as per requirements as well as a Radio frequency (RF) detector. An Electronic Attack (EA) system, along with the sense assets, would then provide the soft-kill DEFEAT aspect. EA systems are an effective way to defeat UAVs due to their lack of ammunition requirement. Not only is it easier on the logistical side of the house, it also greatly reduces the potential for collateral damage, a potential results of typical munition. It also allows for the collection of the intercepted UAVs, permitting intelligence entities to gather information about its source. Also mounted on the CUAS platform should be any form of kinetic energy weapon in order to DEFEAT RF-hardened UAVs. An important consideration for kinetic energy weapons is the employment of proximity munitions. Throughout the history of Air Defense, it was proven that a direct hit or impact is not necessary to neutralize the target. The blast from the impact of proximity rounds is often enough to affect its target or take it off its course (in the case of one-way UAS or UAVs modified to deliver munitions). In most cases of Class I UAVs, the device fragile and its integrity can easily be affected by the shock of energy created by proximity rounds. Infrared homing or heat seeking missiles are also an option when it comes to kinetic energy. The only caveat is that this type of munition is a lot more expensive than the first option. It is important to remember that, in most cases, the enemy is using COTS UAVs which are pretty inexpensive and easily accessible. It may not be feasible to fire expensive munitions at inexpensive threats, unless absolutely necessary. Doing so would cost significantly more than proximity rounds and the enemy could use it against us by swarming us with cheap targets resulting in budgetary concerns which would result in the system being cost ineffective.

Conclusion

The constant and rapid evolution in drone technology makes it impossible to develop a perfect system to counter it. This presents a dilemma to defence procurement organizations the globe over. One thing in the future is certain: UAVs will be prevalent throughout the contemporary operating environment and CUAS must be a high priority consideration for commanders at all levels. They need to acknowledge and accept the fact that they will most likely be “behind the ball” but doesn’t justify complacency in countering this potent threat. Going “back to basics” with the adoption of timeless principles and TTPs like proper camouflage and concealment, light and noise discipline, and dispersing one’s forces are all valuable risk mitigation strategies and will remain effective. The inclusion of new technology such as directed-energy weapons and CUAS systems will help in the defeat of this new threat that terrorize the battlefield.

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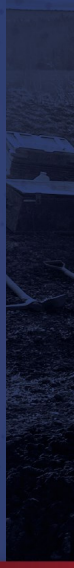


CAPABILITY DEVELOPMENT
CHAPTER 3
DÉVELOPPEMENT DE CAPACITÉS

Loitering Ammunition

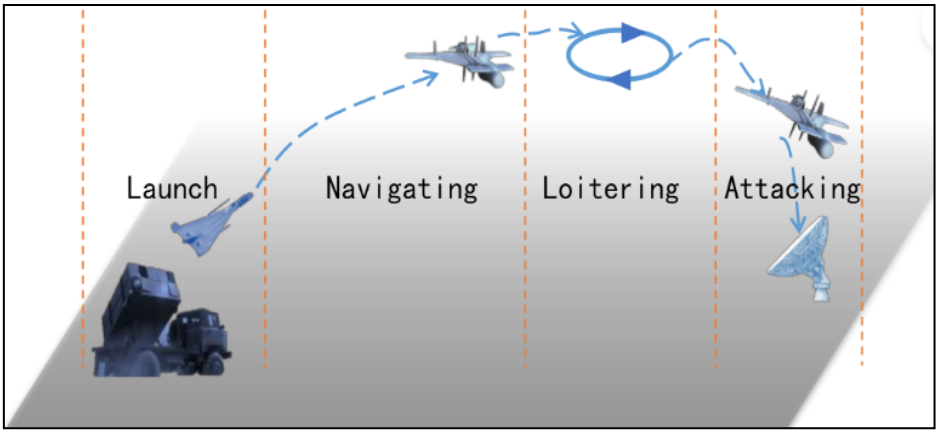
WO L. Doucet

Background

"Rounds are in the air, where do you want them?" This is a statement that is well-known by all Artillery personnel. This sarcastic comment is often mentioned when referring to and highlighting the bitterness surrounding the lack of control that an Artillery member has on the round after it leaves the barrel of the Howitzer. Despite the comment being 'loaded' with malevolence, I suspect that even those individuals would never have expected that it would one day become reality. Loitering Munition is a great example of the foreshadowing in the previous statement. It is a device that has the same capabilities of an Artillery round but is controlled from launch to target by an operator. It can achieve different effects depending on the needs on the battlefield. Loitering munitions purchase is a market that has built up quickly with the wake of the Ukraine conflict but has also evolved rapidly as the global demand for bigger, faster, and longer reach has significantly grown. When planning for conflict, there is a need to analyze those demands while keeping in mind that "every action has an equal and opposite reaction" which might not always meet the original intent and may potentially have catastrophic effects when looking on a global scale. Here are some factors that should be taken into consideration if Canada should purchase loitering munitions in the future, depending on the needs on the battlefield.

Launching Methods

Guns (C3/LG1/M777) and Mortars, have one way to fire projectiles and they include many factors like mathematical calculations, ballistics, charges, and fuses to name a few. Loitering munitions, depending on the size of the device, can be launched by a single member or with mechanical equipment. The following are examples of loitering munitions that can be launched by a single person within minutes from a single canister launcher. The HERO-20 weighing 1.8 Kg, the SWITCHBLADE 300 weighing 2.5 Kg and the HERO-30 weighing 3 Kg. Their compact container allows a single member to carry the loitering munition in a backpack and can be deployed almost anywhere.



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SWITCHBLADE 300 single canister launcher

UVISION Single Canister launcher

UVISION Vehicle Platform Launcher (Rail)

Harpy Loitering Munition being launched (Multi-canister)

The HERO series also has desirable capabilities such as, pneumatic launch, low noise, low thermal and acoustic signature, which helps to enable silent operations.

As for the other extreme, other options like the HERO-900 weighing 97 Kg, the HERO-1250 weighing 125 Kg and the HARPY weighing 135 Kg are also available. These are larger known loitering munition and requires mechanical equipment to launch the devices. They are similar to the Unmanned Aerial Vehicle (UAV) by rails, or a multi-canister launcher mounted on land, air or sea vehicles which enables the launching of multiple munitions in quick succession. When the multi-canister launchers are mounted on a vehicle, it can be deployed faster, however it also becomes a high valued target for opposing forces. In any conflict, one key factor is that the bigger footprint you make on the ground, the easier you are to be found.

Explosive Charge

The size of the device is relative to the explosive charge it carries. These charges are often filled in the fuselage of the device which is connected to a detonator that can detonate on contact or by demand of the originator. When comparing the HERO-20 and the HERO-1250 variant, it is easy to relate both of their characteristics and their use on the battlefield. The HERO-20 has a warhead of 0.2 Kg which would be used against dismounted troops, in urban areas or on light vehicles. The HERO-1250, with a warhead of 30 Kg, could act as a significant weapon in military strategy against larger high valued targets. Any other loitering munition between these warhead sizes could be used against armored vehicles, buildings and/or boats for example. When taking into the consideration of the size of the warhead, the device needed, and the launching method to be used, it really does make you reflect on all aspects of conflict and the controversial effects of such ammunition. However, that's only the tip of the iceberg.

Effects

The controlling station can choose a target of opportunity either as an onsite location or based on a predetermined target. Additionally, the controlling station also has the capability to cancel the attack if it is deemed unsuitable for any reason. The amount of explosive charge needed can vary significantly depending on the ammunition used on the ground. Naturally, tanks will take a larger charge than dismounted patrols or dug in personnel. Loitering munition has a big advantage over Artillery rounds. Whether they are used in the battlefield or in Urban battles, it minimizes collateral damage considerably. It does this by enabling increased maneuverability and pinpoint strike capability against moving or stationary targets. The HERO-350 for example, features high speed transit, and low detection signatures in the acoustic, visual, radar and thermal fields. It is also equipped with a significant warhead to counter high value and fortified targets. It is designed to locate, track and strike hidden or moving objects. The warhead carried by the HERO series is activated by a tri-mode fuse with proximity, point detonation and delay modes. Therefore, all the capabilities of a High Explosive (HE) Artillery round can be matched by the loitering munition and achieved with more control on a wider variety of targets.

HERO family Loitering Munition System developed by UVISION

The HERO-120SF hits one of the assigned targets during testing.

Flight time

Isaac Newton explained that “What goes up must come down”. The Canadian Artillery has an approximate maximum firing range of 40 Km with an Excalibur round that can have a flight time between 2 to 3 minutes. Investigating into different options for this weapon to increase its range capabilities also comes with an inflation in cost. Loitering Munition have fluctuating flight times depending on which type is utilized. For example, the flight times can be between 15 minutes when using the SWITCHBLADE 300 to as much as, but not limited to 7 hours when using the HERO-900. The interesting and enticing thing with the HERO loitering munition, is their unique ability to transfer the control between different units and forces on the battlefield during flight. The HERO series allows the modern soldier to utilize the advantages of the entire line of munition at their will.

Recovery Methods

Most loitering munition are a one-time use only. The SWITCHBLADE, for example, can be launched when a target has been located to accomplish its task. If changes in a situation causes a strike to be cancelled, the operator can call off the SWITCHBLADE and/or redirect it to a new target. Otherwise, it will auto-destruct as most of them cannot be recovered for second usage.

There are other types of recovery options used by different types of loitering munitions. The Orbiter 1K uses a parachute and airbag recovery system or a net landing approach on a vessel. (1) The HERO series can loiter and be re-targeted if needed. If no target of opportunity is discovered for the HERO, it can return to the recovery area and use a parachute system. This recovery method makes the recovery search area significantly smaller as compared to other UAV systems which facilitates the recovery in dense wooded areas. For the HERO, it can be recovered, the parachute re-packed and employ the device as desired.

1 -Launching the Orbiter 1K from Land.

Countermeasures

The HE Artillery shell has no way to be stopped after it leaves the muzzles of a Howitzer. However, weapons like the Excalibur uses a guidance system dependent on Global Positioning System (GPS). This dependency makes it vulnerable to signal jamming, thus interfering with its target objective. There has been claims by the Russians Air Defense that on November 27th 2022, of intercepting an M-982 Excalibur but didn’t specify what air defense system was used to destroy it or providing footage of the interception. (2)

When taking loitering munitions into consideration, there are some concerns with the devices. However, they also have a tactical advantage which would significantly help outweigh some of the negative aspects of the weaponry system. They can be discovered, tracked, and intercepted by radar systems or fighter jets because of the advancements in today’s technology. Nonetheless, the tactical advantage is that there is a considerably low plausibility that any military section would send a fighter jet to engage a 3 Kg loitering munition. Realistically, if it was destroyed, the cost comparison for a 3 Kg loitering munition as compared to the operational cost of a fighter jet is heavily skewed. Basically, troops could easily continue to send rounds after rounds until the desired result is achieved despite the speed and agility of a fighter jet. There are so many variants of loitering munition that it is almost impossible to stop all of them. With size comes deployment speed limitations as it gives the enemy time to intercept and strike prior to target acquisition. As previously stated, their detection can be achieved either by airplane or electronic warfare technology. Even with a long reach capability, it is imperative to use loitering munition smartly and take into consideration the enemy’s air superiority. Lastly, it needs to be determined if you require a high volume of fire over precision fire based on the overall objective. All these points need to be considered to make the use of this ammunition as effective as possible by the operator.

HERO-20

Guns Vs Surveillance Target Acquisition (STA)

If the Canadian Armed Forces (CAF) were to receive some type of loitering munition soon, the author would be inclined to have it reside within the STA stream and mirror the organization in place for the Raven’s UAV sys-

The HERO Family

tem. Separate branches can provide courses on the system, but to be qualified, a member would initially need to be evaluated by subject matter expert from the Royal Canadian Artillery School (RCAS). Since the UAV systems are comparable to loitering munition, the STA branch personnel already have a considerable amount of experience flying air assets. They already have flight time drills established and exposure to the Pod/camera system on UAV's. It would take less time for them to be fully operational with those type of devices versus a soldier without any training in similar systems. They could be re-enforced by gun detachment members as the guns could potentially become obsolete as time goes on. Eventually, more people would be trained in different trades throughout the forces enabling them to carry a single tube launcher per soldier. These advances are a major step towards the way of the future.

Conclusion

Loitering munition can be used in many ways depending on the intention of the originator. Taking into consideration the situation within the battle and throughout strategic, opportunistic decision making, I believe loitering munition can be an asset to the CAF. The HERO series has many different types with a multitude of capabilities that can cover a range of specific needs with explicit reference to close combat, long distance, and precision targeting. The HERO loitering systems were developed by UVision who then provided the specific loitering munition technology. A signed partnership with Rheinmetall then occurred who assumed the role of the industrial, technological, and commercial lead for the weapon system. The HERO series seems like a logical choice in terms of weapon acquisition for Canada. The variants of the HERO series can attack against Infantry targets, mobile light vehicles, tanks, air defense systems, fortified enemy positions and high valued targets. It also provides a distance capability from short-range tactical strikes to long-range strategic operations. It allows transfer of controls between operators, can operate day and night and in GPS denied environments. Every loitering munition would be purchased from one company, making overall logistics and training much easier. Lastly, UVision's advanced HERO integrated simulator is a full-service training solution that enables operators to train on the HERO munitions using high-fidelity simulated scenarios combined with a live flying environment. Overall, the HERO ammunition would offer the best advancements in capabilities regarding loitering munition, which seem to be the higher advanced technological weaponry in warfare at this present time. Thus, they would provide an even level in comparison to other countries

Artillery range capabilities and with the convenience of acquisition/ purchase from one easily accessible primary location.

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JIM Compact

WO C.W. Kennedy

Introduction

For close to the last 15 years, the military has been using the CORAL C and CRC as our primary night observation optic for the dismounted observer. While it has served its purpose, it is time to update and modernize to a newer more capable, compact, and user-friendly design. With the current availability of thermal optics on the market, they have enhanced the observer's capabilities to detect threats quicker, identify them and engage them with better accuracy.

The need to have accurate and responsive indirect fire in the opening rounds of a fire mission on a target is a necessity on the modern battlefield. The current dismounted thermal technology, the CORAL CRC that observers possess, unfortunately do not meet this standard. There are current modernized optics which can be mounted on sterna kits with long range thermal identification that will give observers the accurate fire required. This ability then in turn, will leave the guns less vulnerable to counterbattery fire.

My long course journal will argue that the current CORAL C and CRC equipment is outdated and needs to be updated with modernize thermal technology to give the observer the ability to deploy quickly and with accurate fire on opening rounds during day or night with one piece of equipment.

History

In 2008, the trials began for a new thermal optic that would meet the requirements needed for Afghanistan. They required an optic that was lightweight and wasn't as cumbersome as the one available at that time. Elbit Systems was chosen to fulfill this capability with the CORAL C. At the time, this system was at the leading edge of technology for thermal observation as it was lightweight, capable of target detection and recognition at greater ranges then the current one in service. The CORAL C was trialed by 2 RCHA for artillery observation and 3 RCR for the platoon commanders and reconnaissance sections. While the soldiers that trialed the new thermal optic were mostly satisfied with the system, it did come with its fair share of problems. The observers form 2 RCHA were mostly concerned that there was no radial pattern while in wide field of view (WFOV). This was a big issue from the observer's standpoint, as the narrow field of view (NFOV) was too narrow and had difficulties observing rounds. Furthermore, both units had concerns with the batteries being unreliable and the chargers having a large difference in charging time related to temperature extremes. The CORAL C was also missing a couple key components that was integral for artillery observation, which was an internal Global Positioning System (GPS), laser range finder and the ability to plug in external devices. However, in spite of the shortfalls, the system overall was deemed fit for purpose and implementation into theatre.

In 2013, the system was upgraded to the CORAL CRC. This was a huge improvement from its predecessor as it now included an internal GPS, laser range finder and had the ability to plug into external equipment. Unfortunately, there was still some drawbacks with the system. Most notably, the WFOV still had not improved its radial pattern. The charging time to use the laser was unsatisfactory and

CORAL C and CR

there was always a possibility of it overheating when used too many times over a short interval. With this new system, members were able to plug in a Defence Advanced GPS Receiver (DAGR) externally which was a big improvement but was not user friendly. Users would have to completely reconfigure the DAGR for the CORAL CRC which was an extensive process and then reconfigure it back to normal settings afterwards. Due to this shortfall, most Observer Parties (OPs) would carry two DAGRs, one for the vector and another for the CORAL CRC. This meant that a dismounted party would have to carry a minimum of two DAGRs and a mounted crew would have to have a minimum of three DAGRs. One for the light armoured vehicle (LAV) turret, another for the vectors and one for the CORAL CRC. There were some improvements to the CORAL CRC with the batteries, as they were smaller, more reliable in extreme temperatures and the charger was drastically more portable. Most users viewed the upgrade as a large improvement from the CORAL C and accepted the added complications.

Since then, the technology has only continued to improve and with that our CORAL CRC has once again become outdated. Current systems have become lighter, more user friendly and have been designed to do more tasks within a smaller package. With systems having day and nighttime channels, upgraded internal GPS, lasers and laser pointers all incorporated into one. This means, that users will have less equipment to carry and be even more capable to achieve their tasks. With soldiers having to carry less equipment, this means that they can deploy faster on the battlefield.

Equipment

Equipment that should be considered to replace the CORAL CRC should be lightweight, equipped with day/nighttime channels, class 3 laser, user friendly and be able to plug and play with other system that we currently possess within the artillery. After doing some research, it is this author's opinion that the replacement should be from Vectronix. Their systems are lightweight (roughly 2-4Kg) with a battery installed. They have a wide variety of equipment that can be suited for all users from Joint Tactical Air Controls, artillery observers and recce parties. One of these systems is the JIM compact (Jumelle Infrarouge Multifonction). The company claims that the JIM compact meets the most demanding expectations of dismounted operators and is currently being used by Britain, the United States, Denmark, Australia and multiple other NATO countries. It is lightweight, roughly 2Kgs with batteries installed and have multiple features incorporated into it. It processes a day/nighttime channel, internal GPS, class 3 laser up to 12Km in range, laser pointer and the ability to plug in and play with multiple other systems that we currently have. This system has multiple advance setting from image stabilization, continuous eZoom and multi-mode image fusion. Along with all these features it can have a video output for LAN streaming and if purchased, the ability to control the system remotely without the user being in direct observation of the enemy is achievable. You can also take high-definition pictures and video recording transferable via USB stick or transmitted digitally. This would make for a great briefing tool for commanders and the ability for command posts to be updated with live videos or pictures as the battle unfolds. This system has the ability to work with the current sterna kit that is fitted to the vector 21s. By being able to incorporate the sterna kit to a thermal optic, it would give the user greater orientation of the equipment and give the observer better accuracy while engaging artillery at night. The sterna kit has shown its reliability, precision and accuracy over the last 7 years while on exercises and deployments. It is currently the main piece of equipment for any dismounted observer who wants to improve their probability of achieving target rounds. One of the complaints from many of the users with the CORAL C was plugging in the DAGR. With the JIM Compact, it is a one step process to connect the DAGR into multiple systems afterwards without changing any setting, therefore reducing the need for multiple DAGRs within the party. With its capability to have a day and night channel, it would give the observer the ability to carry less equipment with one optic verse two.

The Way Forward

The way forward for the observers, is to have a piece of equipment like the JIM Compact or similar, which can do multiple tasks in one compact optic. Thermal technology has improved drastically over the last 13 years since upgrading to the CORAL CRC to enable detection and identifying targets earlier.

If this type of optic was to be procured, I suggest that we transfer to using the thermal as our primary optic during the day, which would enhance the observer's ability to detect, acquire and positively identify targets faster. We would use the system in the same fashion as the LAV 6.0 optics with the thermal image being the primary optic and the daytime channel being the back up. By having an optic with a day channel in the thermal device, the observer would not have to carry the vectors for daytime observation.

If a thermal optic is procured that possess a daytime channel, the OP parties would not require the vector 21s and they could then be reallocated to the gun line and/or Surveillance Target Acquisition batteries to conduct recces, as both streams have shown interest in using them. The only thing that is restricting them from using the equipment, is that we currently do not have enough in are inventory.

With only having one optic for the observer, the tactics, techniques and procedures (TTPs) would have to be written primarily from the perspective of shooting at night as the Forward Observation Officer would otherwise not have the means to observe the rounds impacting. I see the drills being executed in two different ways depending on the situation at the beginning of fire mission and the remainder would follow the same procedures. The procedure is explained at the end and lays out what everyone's responsibilities are when conducting a mission at night with the thermal equipment. The procedure for engaging targets during the daytime would not change from the current TTPs taught.

One area that requires investigation if Canada procures a new thermal device, is to have a well-defined training plan. When procuring the CORAL C back in 2008, one of the big complaints was that the training package was incomplete. The PowerPoints only gave the basic information that was required to use the device. What we have found over the time, was that the CORAL C and CRC had lots of advanced functions available but was only found out by playing with the devices and through continuous usage. The problem with this, is there is no guarantee that this information would be passed on to future generations of observation post technicians. A proposed solution is to get an in-depth training package from the company that we procured the thermal device from. This should include an in-depth look into all the advanced functions, how to properly setup all configurations, and what the users can do when troubleshooting faults with the device. This should be taught in a classroom and field environment by an instructor from the company. Once this is completed, a train-the-trainer program should take place with individuals from all Regiments. In this training package, all candidates should have to complete tests on all functions of the device to ensure they are competent in all aspects of the thermal device. The candidates should also have to deploy the equipment in the field during day and night observation with the new TTPs that have been adopted. Once candidates have completed the train-the-trainer program, they will then be responsible to instruct soldiers from their unit and ensure that all soldiers in the Artillery Tactical Groups (ATGs) have been taught. All further users of the thermal device would be taught on Observation Post Detachment Member and Observation Post Detachment 2I/C courses.

Conclusion

In conclusion, my research demonstrates that the Canadian Armed Forces should procure new modernized equipment that will enable dismounted forward observers to complete their duties with more responsiveness and lethality. An upgrade to our current dismounted optics for the observer is necessary. With the armoured vehicles becoming more vulnerable to anti-tank weapons and the LAV 6.0 being a huge thermal target, the need exists to equip our observers to operate dismounted with the same capabilities as being mounted. With today's technology, the optics are lighter and more compact, thus giving the observer the ability to transport less and maneuver more rapidly therefore, making the observer more effective on the battlefield during day and night operations. After doing research on multiple different thermal optics, it is this authors recommendation that the JIM Compact from Vectronix would best suit the observer's needs on today's battlefield.

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A Vehicle to Supplement MUAS Tasking.

WO E. Mercier

Aim

The aim of this journal is to research a vehicle platform that would be more practical when Mini Uncrewed Aerial System (MUAS) detachments (det) are deployed alongside sub-units such as reconnaissance party, sniper, Joint tactical Air controller (JTAC) etc. Currently, MUAS dets are using any available vehicle platforms such as the Light Utility Vehicle Wheeled (LUVW), Milcot, Tactical Armoured Patrol Vehicle (TAPV) or Armoured Vehicle, General Purpose (AVGP). Those accessible vehicles are not well suited to support MUAS tasks due to their limited size, speed, off road capabilities or their abilities to enhance detachment security. There is presently an ongoing project for a specific Canadian Armed Forces (CAF) vehicle platform, the Mobile Ground Control Station (MGCS) TAPV. This vehicle is equipped with a suite that has been thought to support the reality of the MUAS dets when they are getting employed or deployed in training or on operations. Although this vehicle is bringing advantages to the current state, there is still some issues with regards to when dets are mandated to deploy with smaller teams as mentioned above.

Purchasing new equipment has always been a long and slow process. This is why I decided to focus on existing platform available to write this journal. By implementing a side-by-side type platform in the CAF, the effectiveness of the MUAS to fulfill their role properly would be greatly enhanced. Those type of vehicle platforms have been through trials by many other nation Forces and for the most part the results were positive. CANSOFCOM and JTF2 are using a vehicle platform similar to what will be proposed in this journal.

Discussion

The biggest problem the military are currently facing in regard to vehicles, is that typically, they are trying to accommodate the needs of a new system with an already existing vehicle. By doing this, most of the time, we are unable to achieve the full potential of a new system such as the MUAS and are self imposing limits that should not have been there in the first place. The following are some of the issues encountered while using the MUAS with the vehicle available in the CAF.

First off, the LUVW (G-Wagon), a small four wheeled soft skin vehicle that can carry up to a four person det. It has been used for quite a while when the MUAS was first introduce in the CAF. In training, this vehicle has shown to be somewhat efficient, but performed very poorly in some aspects. The off-road capabilities were disappointing and dets were not able to accomplish their mission by being forced to stay on main roads. This has been proven to not be an effective vehicle, especially when dets were being attach with an infantry company. The limited speed combined with the off-road deficiency were just insufficient to provide good support.

Another platform used was the AVGP (Bison). This was an excellent platform for the MUAS, the vehicle had enough space to accommodate the needs of an MUAS det. It was able to provide good speed through rough terrain and provided good overall security for the det. The main reason why this option became obsolete, in fact, is because the vehicle was getting worn, maintenance was becoming harder, parts were less available, and their accessibility were reduced.

One vehicle that was really anticipated for the MUAS was the TAPV. This platform has shown desirable capabilities to support the needs and requirements of the det, however some

flaws started to appear as the vehicle was used. Firstly, was the space situation for the det commander (cmdr) having to be seated beside the driver. The det cmdr had to place the MUAS laptop on their lap, which made it difficult to manage the mission as the moving vehicle would make it nearly impossible to navigate the menu needed to successfully and safely conduct any MUAS mission. Another flaw was that the vehicle was not able to execute mobile operations without having at least one hatch open since the antenna had to be wired outside of the vehicle. The space inside the vehicle for personal and basic equipment (ie. stove, lantern, ration, and tools) were minimal but functional. The avenue the CAF chose to mitigate those issues were to modify the platform to be more accommodating for the MUAS needs. The project started in 2019 with the following two modifications.

1. A proper "commanding station'' for the det cmdr with a laptop mount allowing a better control over the mission; and
2. A ground control station built in the platform enabling the vehicle to conduct mobile missions with all hatches closed therefore allowing for better security of the det.

These alterations were welcomed upgrades from the original TAPV, but there were still some issues with some of the missions that MUAS were expected to perform especially when supporting smaller sub-unit task such as reconnaissance party, sniper, JTAC, etc. Those concerns could be well mitigated with the proposed vehicle platform that this article is about.

As mentioned prior, the MUAS are more than often used to support smaller units and when this occurs, having a large vehicle like the TAPV can create some undesired effects. The MUAS is mostly vulnerable during the launch and recovery operations are about to be completed. The sound of the MUAS during pre-flight check or the noises created at low altitude can give away the dets position. This becomes critical when supporting a reconnaissance party or snipers. Even with the new vehicle, the MGCS TAPV, the det size are enlarging the footprint which is, again, not desired. By having a side-by-side type vehicle, this aspect could be mitigated. The selected crew commander would remain on position with the supported unit, while the remainder of the crew would depart with said vehicle to a second location to execute the launch of the un-crewed aerial vehicle (UAV) and execute a Hand-off to the other det cmdr. The same procedure could be completed for recovery. With these proposed drills, the position would not be exposed by the sound of the UAV propeller. Of course, with the nature of this vehicle and how it is built, the security aspect would be minimal for this detached crew but at the same time, this aspect would be traded for having a better manoeuvrability and speed for deployment and consequently increasing their survivability.

Specification will be covered shortly about the type of platform but in the meantime, let's discuss about how this proposed transportation could actually be deployable with an MUAS perspective. Initially, let's examine the member's space. Unfortunately, the space for each individual would be limited since this is a smaller vehicle than what we usually employ, but on the other hand, one of the goals of having this type of platform is to reduce the footprint created by bigger vehicles. Nonetheless, the space for the MUAS kit and personnel equipment would be sufficient as there is small cargo space in the back of the vehicle where it could be stored along with basic required items (ie. stove, reconnaissance tent and lantern). The vehicle can also haul a trailer that could carry any related MUAS equipment.

As discussed, this vehicle would not be an all in one vehicle for MUAS troop, the new MGCS would still have its places depending on what tasking the dets are mandated to accomplish. Every close support regiment should have five of these vehicles, one per det and one available as a spare.

Proposed Vehicle Platform

There is one platform that has been identified during this research, The MRZR made by the Polaris company which is currently being used by the special forces. This vehicle can be purchased with a militarize suite which is more rugged than the civilian version. It comes with more protection, although this not considered an armoured vehicle. It has cargo space and can carry up to four persons. These vehicles have the option to come with a diesel engine which could facilitate the aspect of maintenance and resupply. The off-road capability of this vehicle type is unmatched. It could be easily transportable either on roads or even by air. Going back to what has been said in this journal regarding the issues encountered with previous vehicles used with the MUAS. This author came to realise that most of them would be well mitigated by implementing a type of vehicle recommended in this article. We would be achieving more speed of deployment and would definitely reduce the footprint on the ground on missions where discretion is a huge part of its success. Off-road capabilities would not be something that would no longer slow down an MUAS det compared to what has been used this far.

Possible Option For Other Use

Even though this research has been focussed mainly with the MUAS

needs and requirements as the principal aspect, this platform could be also employed in other stream of the Surveillance and Target Acquisition (STA). For the Acoustic Weapon Location System (AWLS) troop, this vehicle could facilitate the deployment of their system due to their improved off-road competence and smaller size vehicle could provide more possibility on previously unreachable sensor post (SP) location. This system requires troop members to go on sensor post location every eight hours to conduct battery maintenance to keep the system operational. This transport would be more discreet and efficient when troops are moving on the ground versus a sizable vehicle like the TAPV. For the Light Counter Mortar Radar (LCMR) troop, this vehicle has a 1500 pounds towing capacity which would be more than sufficient to carry the LCMR and personal kit. New possibilities for deployment location could be created with that type of vehicle.

Conclusion

To conclude this journal, here are some of my own thoughts behind this whole endorsement. The MGCS TAPV is looking really promising for future MUAS operations but is it an absolute perfect vehicle that will sustain all the needs and requirements for MUAS? I don't believe so. Can the proposed vehicle in this journal be the optimal vehicle for the MUAS? Of course not. But by combining a side-by-side vehicle alongside the MGCS TAPV would greatly benefit future employment of the MUAS and other STA systems used at the close support regiment. With both vehicles available to them, MUAS troops could sustain multiple types of operations from the Battle Group level down to sub-unit level. By gaining speed, manoeuvrability, and off-road capabilities compared to the other vehicles mentioned, this will be a vast improvement for future MUAS operation.

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Flight Path, Fixed-Wing Hybrid Vertical Takeoff and Landing (Vtol) Rising To The Challenge!

WO L.J. Sheppard

Introduction

In late 2017, the implementation order for the CU-172 BLACKJACK was signed. The CU-172 is the current Canadian Army's (CA) Small Uncrewed Aerial System (SUAS) capability that is employed out of the 4th Artillery Regiment (General Support) and is meant to fulfill Intelligence Surveillance Reconnaissance and Target Acquisition requirements at the Brigade level. Current and past systems used by the CA were advertised as runway independent for launch and recovery. All systems use a pneumatic launch system, however recovery operations for each differs. The SPEWER uses a parachute with air bags while the SCAN EAGLE and CU -172 use capture ropes, making them capable of multi-mission operations from forward deployed areas. Since the CA has been using these Uncrewed Aerial Systems (UAS) there have been many lessons learned on the effect Launch and Recovery (L/R) equipment have on mission capability, which potentially can be resolved by a fixed-wing hybrid Vertical Take-Off and Landing (VTOL) system. The purpose of this article is to identify why the CA's SUAS should have a fixed-wing hybrid VTOL capability.

Current Capability

In order to understand why a fixed-wing hybrid VTOL system would benefit the mission capability of the SUAS, we must first understand the CA's current capability. Our system requires a troop of 36 personnel (pers), which includes a L/R detachment (det) of 6 pers and a maintenance det of 8 pers required for L/R operations. It is briefed as being able to provide 2 lines of task over 24 hours that can be broken up into Hub and Spoke operations. Each 24 hours task requires ground L/R equipment, 1 Ground Control Station (GCS) (2 if a Spoke is deployed), 2 GCS dets (based off a 12-hour crew duty day), and 2 air vehicles (AV). The troop is incapable of providing its own local defence due to its large foot print and crew rest, therefore it requires an attached security force while on operations. This combined with having a 50 nautical mile range line of sight (LOS) and remote operations video enhanced receiver/tactical data link capabilities solidify the need to keep the system together in a Hub position, as there is no reason to push a GCS forward other than LOS. The Hub is ideally located in the Brigade Staging Area (BSA) on an aerodrome or in an area of comparable size. This allows the troop to take advantage of its integral security and support. Below will elaborate on what is currently required to conduct L/R operations with the CU-172, description of the fixed-wing hybrid VTOL, a discussion, original equipment manufacturer (OEM) solutions and recommended systems.

Cu-172 Launch/Recovery

https://www.flightglobal.com/us-navy-purchases-six-more-insitu-rq-21a-blackjack-systems/117793.article

The CU 172 requires a pneumatically controlled launch device that is self-powered and accelerates the AV to flying speed over a limited range of environmental conditions. It enables expeditionary employment of the UAS in locations without suitable runways and is designed for transport by air, ship or towed by light vehicles into somewhat rugged terrain.

Siting of the launch site requires an area with firm and flat ground that can accommodate the quite large hazard area required for personnel safety and a sizeable area clear of obstacle for the AV to safely climb during launch. The Small Tactical Uncrewed Arial System Recovery System (SRS) is a hydraulically controlled telescoping crane mast mounted on a trailer chassis that uses a vertical capture rope. It features a bungee and rope dissipation system to catch the AV on the leading edge of the wing and stops flight in a capture hook on the AV wing tip. It is not uncommon for the AV to experience damage from the violent catch such as broken winglets and stress fractures on the wings during recovery. This system also limits the operating weight of the AV to a maximum gross takeoff weight of 135 pounds and must remain erect while the AV is in flight.

https://apps.dtic.mil/sti/pdfs/ADA623607.pdf

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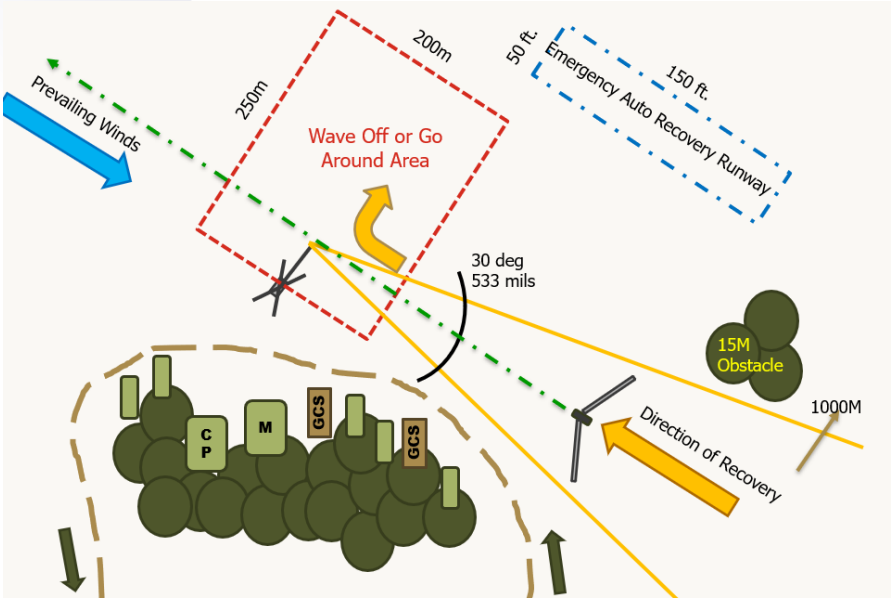
Siting for recovery requires an area with firm and flat ground and free of obstacles approximately the size of a runway which will accommodate the large hazard area, hazard zone, final true course (FTC), and missed approach profiles. It must also take into consideration, that the fiber reels that connect the GCS to the SRS cannot be coupled or extended. The picture below roughly depicts the area required to conduct a standard recovery.

For the L/R equipment, maintenance is performed daily, monthly, before and after L/R inspections and must be completed and logged by the maintenance/launch and recovery dets. AV operators and maintenance personnel are trained on this equipment with the maintainers being qualified different levels of release. The maintainers course is conducted at Insitu and is 6 weeks long while the flying crews learn the equipment on the det member and det commander courses.

Fixed-Wing Hybrid VTOL

Fixed-wing hybrid VTOL UAS utilize an AV with a combination of rotary and fixed wing capabilities. Rotary is used for the vertical takeoff and landing of the AV and transitions to a traditional fix wing flight pattern (horizontal flight) once it reaches a safe altitude. These AV's require a much smaller L/R area and minimal to no L/R equipment. These VTOL systems sacrifice endurance and payload carrying weight by a small margin compared to the strictly fixed wing AV's due to added weight and decreased aerodynamics. However, it is typically capable of heavier payloads and greater endurance of strictly rotary AV's, making it a flexible capability which by the author's opinion is superior to the one dimensional options. They are divided into the following types.



https://acims.mil.ca/org/RCAS-EARC/45/sta/Tech/New%20STA%20Tech%20Sup%20Draft/Forms/AllItems.aspx

1. ***Tail-sitter:*** Operate in vertical flight for takeoff and landing and then transition in horizontal flight using their proprotors to shift their entire body horizontally similar to a missile.
2. ***Convertiplane:*** Operate in vertical flight for takeoff and landing, then convert to horizontal flight. This is achieved by either deactivating their rotors or angling their proprotors (propellers that are used in both vertical and horizontal flight) for forward propulsion. The types of convertiplanes include quadplanes, tilt-wing UAVs, and tilt-rotor UAVs.

Discussion

Now that we understand the CA's current SUAS capability and what fixed-wing hybrid VTOL is, we will

now discuss how this capability can improve SUAS operations. The limitations of the CA's SUAS make it a fair weather system at best. They affect its mission capability in regards to ground movement due its large foot print that make finding a suitable location challenging in an austere environment and nearly impossible in a built up urban area. Its L/R equipment are large and bulky, mission limiting, maintenance heavy and staff intensive compared to a VTOL system. For example it takes up to 72 hours to recce and deploy a Hub position if you're even able to find a suitable location, plus the Brigade would lose SUAS coverage while the troop is mobile because the SRS is in transport and therefore not erected during flight. With the Hub likely being located in the BSA, its location selection will also be undesirably influenced. These factors combined makes this proposed capability challenging to achieve and furthermore difficult to sustain.

While a fixed-wing VTOL capability may increase the price of each individual AV's, it reduces the cost in other areas such as requiring minimal to no L/R equipment. It also reduces deployment time, training and personnel to conduct L/R operations. It significantly shrinks the footprint on the ground and airspace required for L/R operations hence increasing flexibility of suitable locations. There will be no need to sacrifice UAS coverage while the Hub position is mobile, since having an SRS erected when the AV in is flight will no longer be required. An AV with this capability can be recovered virtually anywhere while the troop is moving, making the function of a mobile GCS more feasible and potentially increasing on station times and survivability since it is not tethered to a single L/R position.

CU-172 OEM SOLUTIONS

Insitu, (OEM) of the RQ-21A BLACKJACK (CU-172) has developed two capabilities that can be applied to the CA's current capability.

1. **Flying Launch and Recovery System (FLARES):** Is a multicopter that lifts the AV to launch altitude, makes a dash forward to generate lift and then releases it to fly the mission. When it's time for recovery, the FLARES multicopter lifts the rope and bungee up to recovery altitude and captures the AV just like the SRS. Then it lowers the AV to a small mast (like a fishing pole) where the recovery crew loads it on to the cart. Then the FLARES multicopter lands.

Pros: Doesn't sacrifice endurance as the AV for operation maintains its aerodynamics, weight, and doesn't use its propulsion for launch and recovery. It also has a smaller foot print than what is currently being used for L/R of the CU-172.

Cons: It potentially has a larger footprint than a fixed-wing hybrid VTOL AV. It may take longer to launch and recover, creating the potential of the site being detected since there is a need to have a hovering AV to hold the capture rope during recovery. Still utilizes equipment for L/R.

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2. **Hybrid VTOL:** Although this upgrade is not currently available for the CU-172, there is a hybrid VTOL variant of the Integrator (similar to the CU-172) that uses a lithium ion battery-powered lift modules with 2 rotors attached to each wing. An engineering request would be needed to obtain this capability for the CU-172.

   Pros **-** Requires less space for L/R compared to current CU-172 capabilities. No equipment required to conduct L/R.

   Cons **-** Reduced endurance due to extra weight, loss of aerodynamics and energy robbed from the generator to keep batteries warm at altitude. Can be an issue in sub-zero temperatures experienced here in Canada.

Recommended Systems

Based on the authors research, the 2 AV's below would be suitable options of each fixed-wing hybrid VTOL AV type if the CA decided to purchase a new SUAS.

1. **FLEXROTOR:** This is a NATO tier 1 **Tail Sitting** modular fixed-wing hybrid VTOL AV developed by Volatus Aerospace. The AV has a class leading endurance of 30 hrs and a 120km range LOS. A small footprint requiring only 10 minutes to assemble and a 12'x12' site for L/R and is able to L/R in windy/gusty conditions of + 27 knots. It has been tested in extreme weather conditions with an operating temperature range of -40 to 50 degrees Celsius and is reported to be able to operate in harsh condition experienced in regions such as Ukraine.

   Pros **–** Requires a small area for L/R, no L/R equipment, greater endurance, shorter deployment time, better environmental limitations, requires less personnel to operate and less combat service and support (CSS) requirement.

   Cons **–** Potential for the propeller to interfere with camera field of view if observing rearward of the AV. Damage upon an emergency belly landing may be more severe.

2. **FVR 90:** This is NATO tier 1 **Convertiplane** fixed-wing hybrid VTOL AV developed by L3Harris Technologies. The AV requires a 2 person operating team and possesses an endurance of 8-16hrs with a 100km range LOS. It can be launched within an hour utilizing a small footprint of 25'x 25' area for L/R. L/R can be conducted in windy conditions at a max of 30 knots, with an operating temperature range of -29 to 49C.
   Pros **-** Requires a small area for L/R, no L/R equipment, endurance, shorter deployment time, better environmental limitations, requires less personnel to operate, and less CSS requirement.

   Cons **–** Larger L/R area and less endurance than the Flexrotor.

Conclusion

In conclusion, the benefits of having a SUAS with a fixed-wing hybrid VTOL capability are undeniable. When we consider L/R for the SUAS operations and its influence on mission capability, a system possessing a decreased footprint/airspace requirements for L/R, no L/R equipment, decreased L/R time, and less personnel to operate/maintain only increase flexibility and functional integration. A fixed-wing hybrid VTOL AV brings the best of both worlds in regards to vertical and horizontal flight and is the future of UAS capabilities.

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CAF Flexrotor Brief

Pic 13, 14:

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Selecting a Howitzer for the Future Land Operating Environment

Capt T. Gilchrist

The international security environment has changed dramatically in recent years. Western militaries are in the process of reconstituting their ability to conduct sustained large scale conventional war fighting operations. After nearly two decades of focusing on counter insurgency (COIN), the Canadian Armed Forces (CAF) has allowed its ability to conduct conventional high-intensity combined arms operations to atrophy. This has led to significant equipment deficiencies and a lack of experience and expertise amongst both junior and senior leadership. The War in Ukraine as well as an emergent China, have dramatically increased the urgency with which the CAF must procure new capabilities and train its soldiers to be effective in the current and future land operating environments.

The CAF has a history of successfully adapted to demands across the full spectrum of operations. The Canadian Army (CA) faced challenges when it first deployed land forces to Afghanistan in 2002. Over the course of the War in Afghanistan, the CAF rapidly equipped and trained its soldiers to become highly skilled and effective in the conduct of COIN operations. Despite the different challenges presented by COIN operations, the need for responsive and accurate indirect fire support to ground forces remained a critical capability that led to the procurement of thirty seven M777 155mm howitzers between 2005 and 2011. The M777 was the ideal IDF system to support Canadian operations in Afghanistan. Its light weight meant it could be transported by helicopter between FOBs and it could deliver reliable and accurate fires. At the time of its procurement, the Royal Regiment of Canadian Artillery (RCA) relied on C3 and LG1 105mm towed howitzers which had limited range, weight of fire, and could not fire modern advanced munitions such as the 155mm XM982 Excalibur shell. The M777 continues to be the main weapon system of the RCA. The United States and Canada have donated an accumulative 152 M777 howitzers to Ukraine and they are being used very effectively against Russian forces. However, the M777 does have several limitations in the context of the current and future land operating environment (CLOE/FLOE) that will be discussed in this paper. The ongoing war in Ukraine will be used to determine both the capabilities and limitations of the M777 in a conventional conflict. Additionally, several publications from both the CA and RAND Corporation will identify the role of IDF in the expected FLOE. This paper will then identify the capability gaps of the RCA and suggest which capabilities the CAF should aim to procure to retain a robust ability to provide indirect fires effects on the modern battlefield.

The war in Ukraine has become an artillery war. At the outbreak of the conflict on the 24th February 2022, it was unclear whether the Armed Forces of Ukraine (AFU) would be able to mount a robust defense against the perceived superiority of the Russian Armed Forces. Nearly a year later, Ukraine has mounted a heroic defense and the conflict has become protracted. Relatively stable front lines, contested air supremacy, and increasingly effective kill chains have favored long range IDF over combined arms maneuver. Ukraine began the war with approximately 1150 Soviet-era howitzers firing 152mm and 122mm ammunition. Ammunition was immediately a concern as the main producers of Soviet calibers are Russia and China. Ukraine would not be able to supply adequate ammunition for a prolonged conflict despite the U.S. buying old stock of Soviet ammunition and supplying Ukraine with 45000 152mmand 20000 122mm shells. The AFU desperately needed to transition to NATO equipment in order to solve the ammunition prob-

lem and modernize there IDF weapons systems. By April 2022, the U.S. and allies began supplying the AFU with modern artillery pieces. As of January 2023, the number of artillery pieces sent to Ukraine is estimated to be 350+ howitzers with the bulk of these howitzers consisting of 152 M777s. Canada has sent four of its thirty seven M777 howitzers with ten replacement barrels.

When comparing the M777 to the existing AFU 152mm howitzer, the 2A65 MSTA-B, the main differences are the weight (9300 lb M777 vs 15000lbs 2A65), the lack of electronic fixation and orientation devices, and the inability for the soviet weapon to fire precision munitions. Although the AFU rarely transports the M777 by helicopter, the light weight of the M777 makes it much easier to tow across muddy or rough terrain as well as reduces fatigue on the crew. It also increases the speed at which it can be deployed and taken out of action. A well trained crew can both deploy and take the gun out of action in as few as three minutes. In a conflict where CB fire is always a threat, the maneuverability is vital and no other 155 or 152mm towed howitzer can compete with the M777. The M777 is easy to camouflage and is accurate enough to reduce the need for adjustment therefore limiting the risk of detection from air and ground observation and CB assets. The M777 also has a digital fire control system and is more accurate than the 2A65 MSTA-B. As a towed howitzer, the M777 requires significantly less maintenance than a self-propelled howitzer. Additionally, limited use of maneuver in the conflict has reduced the need for high mobility self-propelled artillery. It is easy to train new artillery soldiers to operate the M777 and requires a minimum crew of five to operate. Despite the existence of much more modern and mobile 155mm systems, the performance of the M777 in Ukraine has increased interest in the howitzer from several armed forces looking to transition away from soviet artillery pieces. As the excess stock of M777 from the U.S. and allies has been exhausted, BAE Systems has even considered restarting production of the howitzer although it would take several years to return to full production. The conflict in Ukraine is not a perfect representation of the FLOE and therefore the successes of the M777 in Ukraine should not be interpreted as a proof of concept for towed howitzers in the context of the FLOE.

Ukrainian soldiers are firing 2000 to 4000 of rounds per day which is still less than what Russian forces are expending. Of the 350+ donated howitzers, roughly a third are consistently out of action for maintenance. Maintenance issues that cannot be repaired at front line maintenance facilities are being transported to facilities in Poland. The details and logistics of the maintenance and supply of donated howitzers is not public information but what is clear is that there are considerable challenges to maintain the AFU's M777s. The M777s are firing significantly higher numbers of rounds and at further ranges than they did in previous conflicts. The higher charges required to achieve the maximum range of the M777 increase wear on the recoil mechanisms and reduce the barrel life significantly. These maintenance issues are not specific to the M777 but common to all howitzers. Rocket launched artillery such as the high mobility artillery rocket system (HIMARS), require less maintenance as the ammunition is contained in preloaded tubes and there is no increase in wear on the system from firing at the further ends of its range. Although the M777 is the most maneuverable 155mm howitzer available, consistent fire and movement as seen in firing point and maneuver deployments dramatically increases the risk of damaging the howitzers while being towed across rough terrain.

As with all towed howitzers, the M777 lacks any armor or protection for the crew. Even a small amount of effects from counterbattery fire has the potential to incapacitate the crew and damage sensitive electronic and hydraulic operating systems of the howitzer. Gun pits may be dug to protect the crew and howitzer but they take engineering resources to construct in any reasonable amount of time. Remaining mobile and moving to a new deployment area after each engagement is the safest option to avoid receiving CB fire. However, frequent movement is exhausting for the crews and extremely hard on the equipment, especially if conducted on rough terrain. It is also important to understand that although maneuver has been limited so far in the war in Ukraine, which has allowed the M777 to be used more effectively, the FLOE and our doctrine is still based on combined armed maneuver. Therefore our heavy artillery must be capable of remaining mobile, not just to avoid counter battery fire, but also to be able to keep up with advancing friendly forces. Ideally, a howitzer designed for this purpose would be self-propelled and at a minimum lightly armored.

Another critical limitation of the M777 is range and ability to mass fires. Although it can achieve ranges of 40km with Excalibur munitions, the true maximum range which it can accurately and consistently mass fires with conventional munition is 23km with M795. Low numbers of precision guided shells were effective in COIN operations, but in Ukraine and any conventional conflict described in the FLOE, large quantities of conventional munitions are needed. As seen in Ukraine the M777 is consistently being used at this extended range, and not just for the deep battle. The use of UAV observation makes detecting targets in depth achievable at all levels. The need for artillery to support

friendly force exploitation will quickly reach the limits of the M777's range, therefore requiring more movement and more guns out of action.

The M777 is capable firing four rounds per minute but can only sustain two rounds per minute. Although the vast majority of howitzers can only sustain two rounds per minute due to barrel temperature, automation of the loading process has increased the maximum rate of fire of most modern self-propelled howitzers of up to ten rounds per minute such as the German PzH 2000 155mm SP howitzer. Although sustained rates are similar in most 155mm systems, the M777 somewhat lacks the ability to mass fires at the decisive moment compared to automated guns.

The global balance of power is shifting to an increasingly multi-polar reality. The implications being that, "great power competition has returned as a prevalent factor of the international environment." Technology is developing at a faster rate than ever before and western militaries can no longer rely on the technological superiority. While the likelihood that Canada will be engaged in major combat operations in the immediate future remains low, the need for robust conventional forces is the highest since the end of the Cold War. The CAF's ability to effectively conduct major combat, along with our NATO allies contributes to a deterrent effect against our adversaries. Western militaries must therefore be proactive in maintaining and improving their conventional capabilities which cannot be created on short notice. The Canadian Army will remain an expeditionary force due to, "the vast size of our country and the global nature of our national interests." The CAF must be able to deploy its forces quickly over great distances in support of both domestic and international operations. Future operations will require land forces that are, "able to operate in a dispersed—low density—posture while retaining the ability to aggregate force quickly for mass effect." One of the key limitations of a dispersed force is the ability to provide effective IDF support, "A widely dispersed force in an adaptive dispersed operations construct will require dispersed and long-range supporting fires that include all-weather and day/night capabilities in order to effectively support maneuver."Artillery will be just as essential to the success of the future land force as it is in the CLOE. However, dispersed forces will require the artillery to overcome a number of new challenges. These include the requirement for increased mobility, protection, range, and the ability to disperse internally down to the troop level.

The greatest threat to our own artillery on the modern battlefield is counterbattery (CB) fire by an adversary with capable CB radars and a quick kill chain tied to sophisticated long range artillery. Other threats exist, such as electronic warfare and the risk of encountering adversary maneuver units in a dispersed environment however CB fire remains the artillery's greatest threat. In order to address this threat, the RCA must balance survivability, mobility, and increased range when procuring new systems. Survivability normally takes the form of armor. Artillery is generally armored against the effects of blast and fragmentation rather than direct fire weapons. Mobility is significantly increased through the use of both wheeled and tracked self-propelled howitzers which reduce the time to put the gun in and out of action and move between firing points. Greater range means greater stand off from both adversary artillery and CB targeting systems. Standoff will increase the time of flight and reduce the accuracy of incoming CB fire giving friendly artillery more time to safely come out of action and move to the next deployment.

Range is a complex issue with a plethora of potential solutions and is being covered by a colleague so this paper will focus on the issue of survivability and mobility. RAND's *Army Fires Capabilities for 2025 and Beyond*, suggests improving both survivability and mobility in its key recommendations. It states that the Army must, "Improve the survivability of artillery units against enemy indirect fire, airborne, and ground threats." As well as, "Reduce the artillery's vulnerability to enemy fires through reduced exposure to EW targeting, improved mobility, and use of camouflage and decoys."

The growing threat posed by long-range rocket artillery is common to all ground forces on the modern battlefield. A system such as the Chinese WS-2 which has a range of more than 200km means that the entire depth of our forces on the battlefield may be targeted. *Close engagement* identifies "robustness" as one of the key areas that must be enhanced to continue to be a combat effective force. Addressing modern conventional threats, "implies continued physical hardening for much of our equipment." *Close Engagement* discusses the five operational functions (*Command, Sense, Act, Shield*, and *Sustain)* in the context of the FLOE. The necessity to shield the force from the he increased risk of being targeted by integrated reconnaissance-strike systems requires the ability to protect against explosive and kinetic projectiles. Similarly, *Advancing with Purpose,* identified survivability as one of its priorities for research and development in efforts to support its modernization strategy. Automation of the gun can reduce the number of personnel who must be exposed during operation while simultaneously increasing the rate of fire. Ideally a future system would be able to operate while all crew are under protection of armor against the effects of blast and fragmentation. Of course, it is unrealistic

to expect any system to be able to withstand a direct hit from and artillery shell or direct fire from a main battle tank, but light to medium armor against to counter the threat of CB fire is achievable.

Although armor mitigates the risk of receiving incoming CB fire, the best way to combat the threat of CB is to remain highly mobile. IDF systems must move immediately after the termination of an engagement. The duration of the fire mission should also be limited by forgoing adjustment and firing the method as quickly as possible. Self-propelled howitzers with increased automation and digitization are already capable of deploying, firing, and moving without any crew leaving the vehicle. For example, the Archer 155mm self-propelled howitzer can be on the move in just 40 seconds after the final round is fired. Being able to leave the deployment area before the final round of a method hits the target dramatically reduces the likelihood suffering casualties from CB fire. Emphasis must be placed on the ability to leave the firing point before the adversary can detect, process, and execute a CB mission. Self-propelled howitzers are ideally suited for this task.

Self-propelled howitzers and rocket artillery systems are either wheeled or tracked. Tracked systems are much more capable off road. However, they require much more maintenance, are generally heavier, and are slower when moving on roads. Wheeled vehicles can move much further and faster on roads, are lighter, and require less maintenance. The Canadian Army must balance, “inter- and intra-theatre mobility with the requirement to operate in difficult terrain, including urban centers.” Expeditionary and domestic operations alike require the ability for land forces to be easy to transport and be able to travel long distances at high speed once they arrive in theatre. Heavier tracked vehicles are also much more difficult to deploy internationally and are a logistical burden to support and maintain. Since the Canadian Army is a primarily wheeled force, less training would be required to employ a wheeled SP howitzer Therefore the CA should procure a wheeled self-propelled howitzer. The CA is a medium, mostly wheeled force. A wheeled SP howitzer would integrate perfectly into the CA and aligns with the expeditionary nature of our forces. The reduced maintenance, relative ease of transport, and ability to travel at high speeds on roads, outweigh the increased off road ability of a tracked system.

The requirement to operate with a dispersed posture and retain the ability to mass effects will prove to be challenging. Static battery and troop positions will be less frequent. Dispersed deployments, firing points, and maneuver deployments will become the new standard. As previously discussed, the M777 is not ideally suited to these kinds of deployments due to increased stress on the gun and the gun detachments. A self-propelled howitzer would enable the RCA to perfect the conduct of dispersed firing point deployments in a sustained manner without breaking equipment and over burdening our Gunners. Rather than static troop and battery deployments, SP howitzers would operate out of a central hide well hidden from observation where resupply, rest, and routine maintenance would occur. SP Howitzers would leave the hide to dispersed locations and receive fire mission data digitally, fire the mission, and move immediately to a new firing point or return to the hide for resupply. Dispersed firing points would be the standard type of deployment. Until SP systems are procured, the RCA should continue to develop the TTPs with existing equipment and dispersed operations should be integrated into all levels of training at the RCAS. “Frequent moves by firing elements (whether cannon or MLRS/HIMARS) will be necessary given the Russian target locating capabilities.” Training scenarios must emphasize major conventional opponents in field artillery and combined arms exercises. Static deployments would be deadly in both the current and future land operating environment.

The RCA should procure a wheeled, lightly armored, SP 155mm howitzer that maximizes the use of digital fire control systems and mechanical automation. Survivability and mobility will be critical for our IDF assets to avoid the devastating effects of long range rocket artillery systems linked to ever evolving CB radar and target acquisition systems. The RCA must fill the capability gaps of the M777 to stay relevant on the modern battlefield and continue to analyze what the FLOE may require. Our soldiers deserve safe and effective equipment that will allow them to overcome the threats they could face in major combat operations and the Canadian public deserves a robust and modern fighting force that can operate through the full spectrum of operations at home and abroad. Several systems that meet the criteria specified in this paper already exist and are being employed by our allies and even more are in development. It takes time to develop and integrate new capabilities and the CA cannot let itself fall behind our allies, and worse, our adversaries while the global world order is being threatened in a way not seen for decades.

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Morality, Machines and Munitions

Capt C.J. Lardner

"Let machines target machines and let humans target humans."

"It is a minimal expression of respect due to our enemy - If war is going to be governed by morality at all – that someone should accept responsibility, or be capable of being held responsible, for the decision to take their life."

Introduction

While the adage "dulce et decorum est pro patria mori" may seem an anachronistic one to people outside the military today, an argument can be made that any idea worth killing for should be worth dying for. We may, however soon enter an age where humans dying in war for any reason at all, (antiquated or otherwise), will also be viewed as anachronistic. Automation on the battlefield has become more prevalent over the last several decades, but is this anything new? Hasn't warfare been evolving since the first battle was waged? The idea of fully autonomous weapons systems has been around for thousands of years. The myth of Jason and the Argonauts reveals that centuries ago "people [conceived] of the idea of manufacturing a bronze android with encoded instructions to carry out complex activities." Long before Predators and Harpys roamed the skies over modern battlefields, the myth of Talos foreshadowed "modern moral qualms that surround our robot-AI technologies." These ideas, however, are no longer the imaginings of the engineering brilliance of Hephaestus, but rather, the real world products of companies like General Dynamics and Raytheon. This paper is meant to explore some of the current discussions surrounding the ethical use of autonomous - human out of the loop - weapons. This paper is not meant to be a comprehensive overview of the issue – to explore the issue in its entirety would presumably be too protracted for our purpose. The paper starts with an overview of Canadas's new code of military conduct, Trusted to Serve. This is followed by a short introduction to different types of autonomous systems (human in the loop, human on the loop and human out of the loop). In section three, the notion of the "responsibility gap" is introduced. The responsibility gap may raise significant questions for the Canadian Armed Forces (CAF) – and by extension the Royal Canadian Artillery (RCA) - and how we may conduct military operations in the future. Ultimately the question arises of whether or not the CAF can ethically employ fully autonomous weapons systems in the pursuit of military goals.

Canada's current defence policy, Strong, Secure and Engaged (SSE) recognizes that the future of warfare will look much different than it does today, stating, "technological developments point to a future of defence that is expected to be vastly different than today, with a greater emphasis on information technologies, data analytics, autonomous systems…any number of these advances has the potential to change the fundamental nature of military operations." SSE also outlines Canada's commitment to "employing new technological capabilities in a manner that rigorously respects all applicable domestic and international law, is subject to proven checks and balances and ensures full oversight and accountability." While this seems to imply that the CAF will always have a human in the loop with regards to future capabilities, it is not hard to imagine us being forced by the increased tempo of combat (as adversaries adopt human out of the loop weapons) to adopt fully autonomous weapons which will be "entrusted with decisions about target identification and destruction." This possibility/likelihood of automatic target recognition should force us to consider what moral decisions in warfare require uniquely human judgements.

Ethical Decision Making

It has been argued by some scholars that "[w]arfare is one of the most paradoxical of all human activities." War has been described as a blight on humanity and writers can be found telling readers that war is, "along with pestilence, famine and death one of the four horseman of the Apocalypse." While this sentiment may seem hyperbolic to some, the fact remains that war is a subject that evokes strong emotions. Somewhere between jingoistic chattering and pacifistic lamentation lies a balance that war fighters must discover. That balance can be found in the ethics of war. From just war theory to international treaties the ethics of war have been codified into a system that combatants are expected to follow in order to reduce the horrors of war. In addition to these treaties (Geneva and Hague Conventions etc.), the CAF has released its own internal code of conduct. For Canadian soldiers the guide rails for ethical deci-

sion making are found in Trusted to Serve.

Trusted to Serve outlines how CAF members must "embody the CAF ethos and employ its values in our decisions and actions," and also states that "as military professionals, we must internalize all the elements of the CAF ethos because it needs to underpin our character." Furthermore, "CAF personnel who embody and live our military ethos allow our profession to operate with the trust of those within the organization, with the trust of the government and of Canadians." This ethos is what defines the spirit, community, and culture of the CAF as manifested by the beliefs and aspirations of all those who serve. This incorporates several key tenets: respect the dignity of all persons, serve Canada before self, and support and obey lawful authority. It is not unreasonable to assume that the second and third tenets can be achieved by autonomous - human out of the loop - systems. When it comes to respecting the dignity of all persons the situation, arguably, becomes extremely difficult. For all intents and purposes, respect is the product of reciprocity between two moral agents. In warfare, this reciprocity creates a moral community that extends from the population of Canada, through the CAF, and to enemy combatants. This moral agency cannot be replicated in an autonomous weapon. Human out of the loop systems cannot understand the value of a human life, or the significance of its loss, and as such any automated decisions that result in death are an affront to human dignity. Mutual respect should ensure an adherence to the guidelines of jus in bellum. There must be responsible actors in war as "there can be no justice in war, if there are not, ultimately, responsible men and women" fighting that war. As Kaurin and Hart eloquently state the case, "War is a meaning making enterprise and reflects the values of those that wage it as well providing meaning and values for the society and the war fighters. Part of that meaning is the moral justification of war and moral parameters on the conduct of war." In particular, there needs to be accountability for "harm or death caused in the targeting process and the subsequent decision to release (or not release) deadly munitions." When things go wrong in war, the public expects that someone will be held accountable.

The Shortening Loop

There are three components to autonomy. These components are: "the type of task the machine is performing; the relationship of the human to the machine when performing that task and the sophistication of the machines decision making [ability] when performing the task." For the purpose of this paper it is the sophistication of the machine that raises (or could raise) ethical questions. In his book *Army of None* author Paul Scharre outlines three types of systems that employ some type of automation. The first is the "human in the loop" system. In this system, automation may be used to search for and detect targets and carry out engagement, but the human makes the final decision to engage specific targets. In this instance, the system does not make any decision regarding an engagement. Second is "human on the loop." Once this type of system is activated, the system will search for, detect, and decide to engage all on its own but the human can intervene at any time. In this instance, the system may make the decision to engage, but a human can override that decision. Lastly is "human out of the loop." Once activated, these fully autonomous systems can search for, detect, decide to engage, and engage all on their own and a human cannot intervene. In this instance, the entire targeting cycle is system driven. For this third type of autonomous engagement, it is the decide and deliver aspects that raise ethical concerns.

The Responsibility Gap

While moral agency continues to be debated among moral philosophers (a never ending task to be sure), most laypeople accept that when a person performs an action they have control over, they are ultimately responsible for that action. According to Andreas Matthias, "when we judge a person to be responsible for an action we mean either that the person should be able to offer an explanation of [their] intentions and beliefs when asked to do so, or that…the person is rightly subject to a range of specific relative attitudes like resentment, gratitude, censure or praise." Furthermore, the person can only be held responsible "if [they] know the particular facts surrounding [their] actions" and freely chooses to act upon that decision. Galliot argues that in order to be held responsible for an action "a moral agent must be capable of fully considering and deliberating about the consequences of their actions, understanding the relevant risks and benefits they will have and to whom they will apply." The question of responsibility is of the utmost importance when the consequences of an action is death, especially death in war. Jus in bellum stresses that someone must be held responsible (responsibility principle) if unwarranted deaths occur on the battlefield. This becomes more complex when death is delivered by an autonomous weapon.

When actions are performed by machines, we ascribe responsibility for the consequences of that action to the operator of the machine (assuming the machine has acted in accordance with the manufacturer's specifications). If, however, the machine does not operate according to the manufacturer's specifications, we can ascribe responsibility to the manufacturer as opposed to the operator. This, however, assumes a human somewhere in the decision-making process. In the future, these decisions may be delegated to autonomous systems in which humans have diminished, or no, control. With less control, these systems may become less predictable in their actions. These systems may incorporate machine learning which will allow the system itself, rather than a human, to "analyse sets of data and as applicable [draw] inferences about any correlations that might exist in the analysed data." This analysis can include everything from pattern recognition, pattern anomalies, facial recognition and biometrics. This delegation of responsibly inevitably leads to a responsibility gap. Andreas Matthias defines this responsibility gap as "an increasing class of machine actions, where the traditional ways of responsibility ascription are not compatible with our sense of justice and the moral framework of society because nobody has enough control over the machine's actions to assume the responsibility for them." Porter, Habli,

Monkhouse and Bragg break this definition down into two component dimensions, the causal dimension and the epistemic dimension. The casual dimension relates to the "what" of a system while the epistemic dimension relates to the "how" of a system (often leaving the human unable to explain or understand why a system made the decision it made.)

Alex Leveringhaus argues that for "those concerned about the impact of machine autonomy on responsibility, it is the element of unpredictability that gives rise to a responsibility gap." Robert Sparrow agrees, stating that autonomous weapons systems will eventually have the ability "to learn from experience…this is likely to mean that the actions of these machines will quickly become somewhat unpredictable." This unpredictably leads to a responsibility gap wherein there is an inability to "identify an appropriate locus of responsibility" for an action. More succinctly, the responsibility gap arises "when circumstances are such that no human being is morally responsible for the wrongful harm inflicted by an autonomous weapon [which acts unpredictably]." If the system is truly autonomous (human out of the loop), than only the system can be held responsible for any actions it takes – as opposed to operators or manufacturers. However, as outlined above, a moral agent will be subject to a range of specific relative attitudes like resentment, gratitude, censure or praise in relation to the consequences of their actions. An autonomous system will not feel the implications of these attitudes. How does one reward or punish a machine? Intent also matters. As Marc Garlasco of Human Rights Watch points out "A machine has no capacity to want to kill…if they are incapable of intent are they incapable of war crimes?" Human Rights advocates go further claiming that we need "that human element…the human has morality, has an empathetic response. The human has the capacity to make complex decisions; they can draw on their humanity." If war is going to be governed by morality, then someone has to be held responsible for any decisions that lead to deaths.

A thought experiment may shed light on this issue. Imagine an autonomous weapons system, guided by artificial intelligence, deliberately targets a group of enemy combatants who are in the process of surrendering. They have placed their weapons on the ground and clearly indicated that they desire to surrender. Let us further imagine that the system made this decision predicated on past experiences with hostile combatants and it was not a mistake or targeting error. In accordance with the principle of discrimination (*jus in bello*), this is a war crime. But who, if anyone, is responsible for the crime? The programmer? The Commanding Officer? The operator? The machine? Or change this scenario to one in which a group of Canadian soldiers are conducting a night firing range and an autonomous system believes it is being engaged and drops a bomb in self -defence. Again, who is to be held responsible (to ask nothing of what "self" was being defended – again, this question is beyond the scope of this paper)? If no one can be held accountable, how can aggrieved communities gain a sense of justice? Accountability allows for retributive justice for families of victims. We should note that there is no reason to believe that the aforementioned munitions could not be delivered by a fully digital sensor to shooter link involving an aerial observer and a digital firing unit. In fact, American military officers have predicted that one of the first combat capabilities that will be replaced by "robots" will be the forward observer. In the current operating environment CAF members are held directly accountable for their actions: "A CAF member who uses force, or the commander who authorizes it, must be able to identify the facts that led to the belief that the application of force was justified in the circumstances. Commanders and individuals will be liable for the use of excessive and otherwise unlawful force." When humans – vice machines -make immoral decisions in war those decisions imperial their moral integrity and put the mission and the reputation of the force (and state) at risk.

In 2020, when The Brereton Report was released outlining alleged war crimes committed by Australian Special Forces, Australian Defence Force Chief General Angus Campbell lamented the loss of moral authority stating that ""If we do not hold ourselves, on the battlefield, at least to standards we expect of our adversaries, we deprive ourselves of that moral authority, and that element of combat power." He went on to state that "Moral authority is an element of combat power." Historically, Canadian soldiers have waged ethical warfare and they should be proud of this legacy. If the CAF decides to adopt autonomous systems, there must be a conversation about what this will mean for an institution that has forged an important relationship with the communities we serve. We can ill afford another blemish to this relationship.

Conclusion

For many people, the idea of autonomous systems making decisions on whom, and what, to target seems farfetched, if not like something out of science fiction (to say nothing of a dystopian nightmare). In fact, the proliferation of autonomous weapons may just be the next mutation of the protean nature of 21st century warfare. The rapid advancement of technology makes us wonder "if the first step of technologies effect on command and control is to force officers to learn how to lead troops fighting from home bases, and the second is to make generals have to figure out just when to intervene directly in the battle, or not, the final step may be figuring out just which command roles to leave to people and which to hand over to machines." Moreover, it is fair to say that technology is "rapidly taking us to a place where we may not want to go, but are unable to avoid."Technology is developing exponentially and our adversaries – many whom have less/different ethical convictions than us - will likely not hesitate in deploying autonomous - human out of the loop - systems. It is easy to foresee a future in which decision making will have to occur so quickly that there won't be any place for humans in the loop. Adversaries that employ human out of the loop autonomous weapons will quickly find themselves within the CAFs observe, orient, decide, act (OODA) loop. If these autonomous weapons represent the next paradigm shift in warfare (or the next Revolution in Military Affairs), the CAF/RCA may have no choice but to adopt the technology or be left behind by our allies who see no place for us in any coalitions. This

paper is in no way meant to suggest that the CAF/RCA should not deploy these systems (in fact the development of the Joint Fire Automation System and Joint Algorithmic Warfighter Sensor may lead directly to human out of the loop systems), simply that the tough conversations are better had sooner rather than later. As Christopher Coker observes "Some wish to purge war of its existential and metaphysical elements and render it wholly instrumental… others wish to remain in touch with their humanity and the spiritual dimension of being." Whatever happens, as autonomous systems become the factotums of war, and inevitably become ubiquitous on the battlefield, we may see the end of the human monopoly on warfare.

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A Way Forward for the RCAs 105mm Howitzers

Capt D.C. McKernan

The Canadian Armed Forces (CAF) has a critical fire power shortage within its current structure. Pre-eminent in this shortage is the CAF's current capabilities when it comes to providing indirect fires in support of its maneuver forces. In its current form and equipment state, the Royal Canadian Horse Artillery (RCHA) Regiments and their 155mm M777 howitzers support the Canadian Mechanized Brigade Groups (CMBGs). Each Regiment fields two understrength batteries of M777s and are tasked to provide fires to four maneuver forces of battalion strength. The M777 struggles as a towed howitzer in keeping up with mechanized infantry units on an advance and filling the gaps in fire caused by relocating a more cumbersome and slower system than a modern self-propelled gun. The lack of available guns and limitations of a towed platform combine to create a reality where the RCHA struggles and has significant gaps in its firepower capability to support the current structure of the CMBGs.

There is however another howitzer fleet used by the CAF. In comparison to the 33 M777s in the Royal Canadian Artillery (RCA), the combined 105mm howitzer fleets of the LG1 mkII and the C3, number 116 platforms. There are unfortunately, major problems with these howitzer fleet in Canada, and as it currently sits, these howitzers are not considered for operational use. 105mm howitzers, while not being a mainstay in modern militaries by any means (that distinction definitively lays with the 155mm caliber), are still used by several major allies to Canada and are currently actively being used in the Ukraine war. The lack of a current 105mm employment structure within the CAF, distinguishing it from the 155mm guns, is a problem which institutionally limits the RCA's ability to effectively employ them in an operational context. Couple this with the current age and lack of modernization of the 105mm platforms fielded by the RCA heavily limits their usefulness. There exist several modern examples of capabilities for 105mm howitzers that can bring them up to an operational level. By doing this we could look to fill some of the firepower gaps that exist within the RCA with an interim solution until a permanent solution is delivered.

To propose a way forward we will look at current 105mm platforms fielded by allied nations and examine their force employment structures. Further to this, and bridging from the employment, we will look at the equipment that could be used to better enable the effectiveness of the 105mm fleet. Lastly, we will look at potential ways forward for the howitzers themselves, with possible modernization options available to them, with a specific look at the abandoned Mobile Artillery Vehicle (MAVs) program, and the once trialed MOBAT system.

Of the nations within the Five Eyes alliance, (The United States, Great Britain, Canada, Australia, and New Zealand), four of these nations currently field 105mm howitzers within their land forces. Three of these nations (The United States, Great Britain, and New Zealand) field and use them operationally. Only Canada lacks in employing its fleet of 105mm howitzers in a structure and manner that sees them operational. Looking at how The United States employs their fleet of M119 105mm howitzers, shows a very clear role and structure in which they are employed in comparison to their 155mm howitzer fleets.

The United States Army fields their M119s to support three distinct organizational structures within their force. Firstly, we see M119's being used to support American light infantry, including airborne, and air assault Divisions. In the case of the 101st Airborne (Air Assault) Division, we see the M119's used alongside M777s in

supporting each of the Brigade Combat Teams (BCT). This allows for each BCT to have direct support fires integral to their structure, with a fires platform that is smaller and more mobile to support their style of operations, and a longer range more powerful 155mm platform when needed. The lighter weight nature and increased mobility of the M119 allows it to provide fires and continue to move and support the BCTs without the heavier lift capability needed by the M777. The M119 is able to provide the fires needed by the BCTs in their infantry role as it can deploy alongside them in an air assault insertion and keep pace with the slower advance of dismounted infantry (in comparison to mechanized infantry). The vehicles required to tow a M119 are also more airmobile in comparison to those required for an M777. The 101st is able to leverage the size of the M119, and their integral rotary wing aviation, to be able to move and deploy the M119 wherever is required.

In looking at the M119's use in the 82nd Airborne Division, we see a similar picture as that of the 101st Division. They are structurally formulated the same as the 101st Airborne, but as a pure airborne division the M119 is able to provide a capability that the M777 is not. The M119, its supplies, gun detachment members, and prime mover are all airdrop-able into a combat theater and in larger numbers when factoring in airlift requirement. This allows for a pure airborne force to be able to strategically jump into a combat theater with all the assets they need to be able to fight and be supported, integral to their own structure. Each BCT of the 82nd still retains a battalion of artillery able to provide direct support, and is able to deploy and continue to move and support the force as needed. The M777s of the Division are air-droppable, but are fewer in number than the M119s, and require a larger draw on strategic lift assets to be able to deploy them.

The M119s within the IBCTs, such as the 10th Mountain Division, see themselves employed alongside the M777's at the battalion level, with each battalion consisting of two M119 batteries, and one M777 battery. The structure of the IBCT sees a less mobile force in comparison to American Stryker BCTs or armoured BCTs, and while they are traditionally motorized instead of purely dismounted, they suffer in terms of off-road speed in comparison to the more heavy armoured BCTs. This allows the M119 to be able to support for longer as they are not as easily outpaced by the advance of the infantry that they are supporting. Again, the size, crew, and vehicle requirement allows the M119 to be more mobile while still providing more than acceptable fire support to the maneuver elements within the IBCT.

From looking at how The United States employs their M119s is that they are used to support light infantry formations exclusively, with the airborne and air assault divisions treated as specialties of the light infantry. They do not use them to support mechanized or armoured formations and recognize the limitations of the platforms. They also use them alongside their M777s, and take advantage of the added strengths of the 105mm platform in comparison to the M777 to complement their fires instead of solely relying on the M777 platform to perform all indirect fire tasks. This also does not look at the employment of mortars within the IBCTs to further reinforce fires to the infantry battalions in comparison to Canada's own structure in the CMBGs.

Looking at how the British employ their fleet of L118 105mm howitzers (the L118 and M119 are by virtue the same platform, the difference being the barrels and ammunition that they use, with the M119 using the more common semi fixed ammunition vice the L118s separate cased ammunition), we see a similar force employment idea to the Unites States, even with the recent restructure of the British army. Currently there are seven regiments in the Royal Artillery that field L118s, these being four regular force regiments (3 RHA, 4 RA, 7 Para RHA, and 29 Commando Regt), and 3 reserve force regiments (103 RA, 104 RA, and 105 RA).[6] The restructure sees the L118s being allocated to support the light infantry formations of the British army, much the same as we see them being employed with the United States' military. In the case of 104 and 105 RA, they do support mechanized forces alongside the AS90 155mm self-propelled howitzers of 1 RHA and 19 RA, but as a reserve force augmentation unit their employment in these formations is not perfectly clear. Interesting in comparison as well, the RA does not field any towable 155mm howitzers, and in their structure, we do not see an integration between the 155mm howitzers and the 105mm howitzers as we do with the American IBCTs.

Along with the L118s being used to support light infantry, we also see them being used to support the air assault forces of the British army with 7 Para RHA providing indirect fire support to 16 Air Assault Brigade.[7] No doubt with the AS90 being the only other howitzer employed by the RA, it would be dubious at best to be attached to provide fires for an Air Assault element. We see once again the suitability and use of 105mm howitzers to provide fires effectively for lighter infantry forces in operation. Unique in comparison as well is 29 Commando Regiment RA, which provides fire support and specialist artillery qualifications for 3 Commando Brigade.[8] A unique capability in the UK, 3 Commando Brigade is centered around the Royal Marine Commandos who perform a light amphibious infantry capability, and its supporting Commando trained units from the Army, Royal Navy, and Royal Airforce. Again, we see the lighter 105mm cali-

ber supporting light infantry tasked units. The closest comparison seen to this would be the United States Marine Corps, and while the Marine Corps fires are provided by M777s and HIMARs systems, and not lighter 105mm howitzers, the Marine Corps has gone through a major force restructure recently that saw the majority of its M777s withdrawn and a shift being made to rocket artillery.

The use of 105mm howitzers in the United States Army and British Army point to a clear conclusion in their military deductions. 105mm remains to be a relevant caliber for artillery, and the advantages in size and mobility with 105mm platforms lend them to be a more suitable howitzer for support to light infantry forces. With Canada's current lack of firepower in its CMBGs, we should be looking at options available to fill our capability gap? Each CMBG contains a light infantry battalion, which from the examples of our allies, would be prime units to support with more mobile 105mm platforms.

The biggest problem faced with bringing our 105mm fleets back to operational usage is their age and the lack of modernization. The C3 and LG1 fleets are old and have run into problems in recent years with maintenance and sustainment. A shortage of muzzle breaks and replacement barrels plagued the C3 fleet and forced many guns out of action. A complete overhaul of the fleets would probably be required, however in terms of artillery systems fielded in the world, and the years of their design, neither the C3 nor the LG1 could be considered complicated technological systems, especially in comparison to the M777.

A first step in bringing the 105mm fleet into the modern era could be equipping them with a digital orientation and fixation system. The Digital Gun Management System (DGMS) on Canadian M777s is by no means a new or particularly complicated system by modern standards. So effective and common place has DGMS become with the M777 that it is being adopted as the primary instrument for orientation and fixation by the RCA. The use of Inertial Navigation Units (INUs) coupled with GPS with 105mm howitzers to aide in far quicker and more accurate orientation and fixation is not new either. The American M119, British L118, and New Zealand L119's are all fitted with some variation of an INU to enable their quicker and more accurate deployment time.[9] Even more so, the existence of a digital system for the LG1 already exists and has been in use for at least eight years now with the LG1's fielded by the Columbian Army[10]. Equipping the fleet with this capability is a simple and effective step in modernization.

A big push and advantage in recent years of 155mm platforms in comparison to the 105mm fleets has been the use of precision munitions. While Excalibur has been a much-lauded munition its price tag and use has seen a push for cheaper and shorter range rounds able to still achieve precision fires. This in turn led to the development of the M1156 Precision Guidance Kit, a cheaper but still incredibly effective fuze to turn standard M795 HE rounds into precision munitions. This is a munition that has already been trialed and adopted for use by the RCA and has seen allotment as part of the RCHAs yearly ammunition budgets. Interestingly enough, while it does not appear to have been adopted by any forces, PGK was developed and successfully trialed for use with 105mm munitions, with a reported 99% part commonality with PGK for 155mm munitions (it's said to have one mechanical part difference).[11]

Potentially the largest step to bring the fleets into operational use could be the mounting of, and adoption of, the 105mm fleets onto a truck-based platform to turn them into a self-propelled weapon system. The growing number of wheel based self-propelled guns, and their use in the current Ukraine conflict, shows an effectiveness and mobility in operations without as much of the heavy logistical burden of the tracked based self-propelled guns. The South Korean K105A1 is a fantastic example of just such a modernization project. Taking their domestically produced versions of the M101 105mm howitzer, the South Korean military brought an old and aging howitzer fleet into the future and back to tactical relevance through a little investment and ingenuity.[12] The K105A1 sees the M101 taken off its carriage and instead mounted on the back of a six-wheel patterned truck, comparable to Canada's old MLVWs. Adding a self-propelled capability with stabilization, INU with fixation, and digital fires capability within the truck itself, the K105A1 sees a legacy howitzer within the Korean Army's arsenal brought into a tactically relevant and operationally capable platform to fill a capability deficiency without heavy investment into a new weapon system. It is of particular note as well that the M101 howitzer is the original platform which our C3 howitzers are derived and upgraded from.

Interesting to the history of the RCA, is that undertaking a program to modernize the 105mm fleet has been looked at before. It was almost 20 years ago that Canada created the Mobile Artillery Vehicle System (MAVS) program.[13] MAVS was a project undertaken by the RCA between 2002 and 2005, with the intent of modernizing both the C3s and LG1's in Canada to fill a fires gap that was opening up in the Canadian Army. The aim of MAVS was, to "upgrade the capabilities of the current light artillery equipment of the Regular and Reserve Force Artillery to address capability deficiencies such as command and control, mobility, and obsolescence in order to provide a relevant and viable artillery capability to the Army of Tomorrow."[14]

Information on MAVs is hard to find, and the extent to which the program progressed or why it was cancelled has been hard to confirm. From photographic findings and speaking to some currently serving members, MAVs does appear to have gotten to a point where CAF personal did trial a system to some extent. This system was the RDM technology MOBAT. MOBAT took stocks of already existing 105mm howitzers and mounted them onto a standard 4 ton or 5 ton truck chassis with stabilization,[15] and proposed ammunition storage, digital fires capability, and INU support. The MOBATs that were produced by RDM were created by using 105mm howitzers identical to the C3 that Canada has, as it was a 33 caliber barrel M101 used by the Dutch.[16] The MOBAT does appear to not have had export success outside of the trial by Canada, with only 18 appearing to have been made and fielded by other countries.[17]

What MOBAT aimed to do and what the K105A1 has done, is take existing stocks of older 105mm artillery and upgrade them onto mobile platforms. By doing so it allowed these old guns to get a new life, and once again fill a tactical and operational role. These platforms also leveraged modern technology at the same time, to improve the base artillery system with many of the modern innovations we have seen come in artillery development that did not exist when they were first created.

It is clear from their employment by our allies and adversaries, that 105mm caliber howitzer can and does play a role in modern warfare. They are especially adept and well suited for providing fire support to light infantry forces, with their increased strategic and tactical mobility over towed 155mm howitzers. There are plenty of examples of modern technology and investment that could be done to bring the RCA's 105mm howitzers to the same capabilities and operational employment as our allies. On top of this, there are also plenty of current projects and examples of older 105mm howitzers being updated and brought into the modern age. We have a fires gap that exists within the RCA and CMBGs, we have these weapons in Canada, and they arguably remain tactically relevant. It is one thing for the RCA to want self-propelled 155mm howitzers, to bring back 120mm mortars, MLRS, or prioritize extending range and precision, but we have a fires gap already and a potential means to improve it. There are no approved programs or platforms coming as of yet to solve our fires gaps, so using the equipment that we do have to help ourselves until a permanent solution is something the RCA should explore.

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Looking back for the future: How historic capabilities in the RCA can shape the future of Indirect Fire Systems

Capt S.A. Raymond

The end of the year 2005 was a defining moment for the Royal Canadian Artillery (RCA). At the time, the RCA was utilizing both 81mm mortars and LG1 105mm howitzers to provide indirect fire support to coalition forces conducting operations in support of the War in Afghanistan. With combat operations mounting, the RCA identified shortfalls in their ability to provide long-range, continuous fire support to friendly force operations and in December of 2005 the first round was fired from the newly-acquired M777 155mm lightweight Towed Howitzers. With a range of up to 40 kilometers, and a larger caliber round to increase lethality, the M777 at the time was ideal for the current theatre of operations. In 2011, combat operations for the Canadian Armed Forces (CAF) drew to a close. This marked the end of the longest continuous deployment of Canadian gunners in combat operations since 1855, and a turning point for the RCA. 18 years later, the M777 remains in service as the primary means for the RCA to deliver indirect fire support, despite its age and the rapid shift in the combat environment seen in today's world. Much like in 2005, the RCA is being faced with a capability gap, in areas such as survivability, range, and mobility, which will need to be addressed if we are to remain a Branch capable of effectively supporting future combat operations. This paper will examine relevant capabilities that the Canadian Army (CA) has utilized in the past, primarily the 81mm mortar and the M109 Self-Propelled Howitzer (SPH). It will then examine the current Indirect Fire capabilities of the M777, before examining the possible way forward in increasing RCA capabilities and survivability in the modern battlespace. Through the use of self-propelled mortars, the Royal Canadian Artillery could modernize an aging Indirect Fires capability and remain a relevant force in future combat operations.

The history of Artillery within Canada dates back as early as 1534, when explorer Jacques Cartier fired rounds from his ship in order to scare off local First Nations warriors. Since then, Canadian artillery has served in conflicts such as the South African War, the First and Second World Wars, and as discussed earlier, the War in Afghanistan. While the RCA has pulled from its long history in developing and refining its way of war, we have come a long way from Cartier's cannon blasts to becoming the Branch we know today. Imagine Cartier's shock if he had seen the ease with which systems such as the 81mm mortar can affect targets at distances of more than 5 kilometers, or the speed that an M109 can move into position, engage targets further than 15 kilometers away, and continue to advance from their firing positions. These are just two examples of the RCAs long history of modernization over generations; however these two capabilities will be our primary focus as we discuss how these capabilities can shape our future procurement. Firstly, the 81mm mortar came into service within the RCA in 1967 before being upgraded to the C3 81mm mortar in 1968. The *Gun Drill Manual* describes the 81mm mortar as follows:

> "The 81 mm mortar is a medium mortar, which can provide indirect fire support in all phases of war. It can engage targets through an arc of 6400 mils and, depending on the ammunition used, targets can be engaged from approximately 200 to 5,600 metres. It has a high rate of fire (20 rounds per minute), and due to its small, long and narrow beaten zone, it makes for a very effective area neutralization weapon. Its crew and ammunition may be carried in one vehicle and can be brought in and out of action quickly. A mortar crew can man

> pack the weapon and ammunition over short distances."

The portability of the 81mm mortar gave the RCA a wider breadth of environments in which we could operate effectively. Since 1967, it has been utilized as a medium, man-portable capability that could be carried, parachuted, or transported by vehicle into the battlefield. The 81mm mortar saw extensive use as a means of local defence on gun positions, as well as a capable indirect fire system supporting both mounted and dismounted forces. In recent years, however, the 81mm mortar has been divested to the Canadian Infantry, who have begun integrating the system within their Battalions as a means of providing integral indirect fire support without reliance on the RCA or other external units. As stated in *The Infantry Battalion*:

> "The role of mortar platoon is the provision of integral and guaranteed indirect fire support to help enable manoeuvre above the platoon level and to provide defensive fires. Mortar fire support exists as the battalion's own indirect fire capability. Where artillery fire is not available to a rifle company, the mortar platoon will look to support the company with its resources."

This has seen the loss of a short-range, highly-mobile Indirect Fire System (IFS) for the RCA with no capability to replace it. While this divestment did not result in the loss of a capability as a whole, the same cannot be said of the M109 SPH.

The M109 Self-Propelled Howitzer was a tracked, 155mm SPH brought into service within the RCA in 1968, and seeing usage until the final rounds were shot in 2005. During this time, the M109 went through a series of upgrades included an increased barrel length, eventually reaching engagement distances of 18 kilometers with standard ammunitions, and up to 30 kilometers with Rocket-Assisted Projectiles (RAP). This SPH had a travel range of 350 kilometers, and relied on a 6-soldier crew. The M109 was a massive leap forward for the RCA, who was previously utilizing 105mm towed howitzers in the L5 and C1. This brought an increase in mobility, due to the lack of a need for towing the weapon system, and increased range and protection levels which contributed to overall survivability as well. A major issue with the M109, and part of the reasoning behind its retirement, was the extensive maintenance times seen in dealing with this tracked vehicle. As the M109 aged, the required maintenance hours needed for comparatively low hours of usage meant that the juice simply was no longer worth the squeeze, resulting in its retirement in 2005. With the loss of the M109, the RCA has since relied on a plethora of 105mm and 155mm towed howitzers to fill the gap and ensure sufficient IDF support to the maneouver arms as part of the Combined-Arms battle. However, major gaps have yet to be filled by the RCA, an issue becoming more glaring as the pace of modern combat has increased and factors such as engagement range, mobility, and survivability have become buzzwords for all IFS looking to contribute to the Joint Fires picture. This will become apparent as we discuss the RCA's current IFS, the M777 Lightweight 155mm howitzer.

The CAF first fired rounds from the M777 Lightweight 155mm howitzer in December of 2005, and since then have relied on the towed 155mm howitzer as the primary Indirect Fire System (IFS) supporting Land Operations. With the introduction of the M777A2 variant and its compatibility with the XM982 Excalibur extended-range ammunition, the M777A2 is currently capable of reaching 40 kilometers when using the XM982 Excalibur round, and 24 kilometers with standard ammunition. While this IFS was procured during the early stages of the War in Afghanistan, it saw employment primarily as a stationary IFS capable of a high rate of sustained fire and relatively accurate effects when all factors were accounted for and calculated. While the M777 was a formidable upgrade on Canada's IFS assets at the time, the current operating environment has seen a rapid modernization that has long since outpaced the M777A2's capabilities. *Advancing with Purpose: The Canadian Army Modernization Strategy* states that "Effective armies are dynamic in nature, constantly evolving and adapting to meet the demands posed by their adversaries and their operating context. History is replete with myriad examples of both successes and failures in this regard. We ignore the need to modernize at our peril." With the M777 now 17 years old in the RCA, it becomes difficult to deny that, unless we modernize our IDF capabilities in the near future, we will be outpaced by both our enemies and peers. While the CAF is unique in its relatively small-scale and specialized contributions to NATO-led missions such as Operation REASSURANCE, I believe a viable option in maintaining our IDF capabilities in the modern battlespace is the procurement of heavy, self-propelled mortars (SPMs).

As stated above, an effective fighting force should continue to evolve, modernizing with warfare to maintain currency and relevancy in a period of rapid progression in warfare. However, Canadians have seen the modernization of our aging IFS' stall, with no new systems currently on the ground to replace our towed howitzers that are better suited for the stationary FOB-style deployments that the howitzers were initially procured for. The use of these weapons systems in the ongoing War in Ukraine has proven

their effectiveness in some aspects, while underscoring the need for modernization in others. The use of off-the-shelf drones to rapidly locate and strike targets on the modern battlefield has been eye-opening for the world of combat, and has served to prove that a lack of mobility is deadly. With most modern drone footage featuring cheap, homemade features such as makeshift payloads, and the presence of suicide drones increasing, mobility on the battlefield is proving to be a key factor in determining survivability in the world of IDF. The United States Army currently utilizes the M1129 Mortar Carrier, which is fitted on a Stryker chassis and engages to ranges of 8 kilometers with its 120mm mortar. Recently, they have been testing updated versions of various SPMs, notably the Patria NEMO (New Mortar) which is being developed by Finnish-based company Patria. This SPM is marketed by Patria as "a turreted, light weight and remote-controlled 120 mm mortar system with a high level of mobility, protection and accuracy." Featuring both on-the-move engagement capabilities of direct and indirect fire, it also boasts 6 round multiple launch, simultaneous impact capability as well as the ability to come into action in under 30 seconds, and out of action in under 10 seconds. With a projected range of 10 kilometers, this is only expected to increase as research into improved ranges of 120mm mortars is ongoing. With countless countries currently using 120mm mortars, both mounted and dismounted, including the United States, Spain, South Korea, Russia, China, and much more, the market for 120mm mortars is only set to increase in the near future. Saudi Arabia also fitted the Patria NEMO to their LAV-based fighting vehicles, with a total of 36 installed on the General Dynamics vehicle chassis. IFS such as these would fill the engagement gap between 5 and 10 kilometers, allowing the M777 to remain ready for engagements outside of these ranges while maintaining a mobile, highly survivable IFS that can engage in the close fight. If the M777 remains 8 kilometers behind the Forward Line of Own Troops (FLOT), it offers an engagement range of 16 kilometers with standard ammunition. A SPM with a range of 10 kilometers would remain roughly 3 kilometers behind the FLOT, engaging out to ranges of 7 kilometers. While this would require the M777 to continue to cover ranges greater than 7 kilometers, it allows a greater flexibility for the RCA to engage shorter-range targets with a much lower risk of counterbattery fires and allow the M777 to remain masked until an opportunity for a High Value Target (HVT) or High Payoff Target (HPT) presents itself. Further, the compatibility of numerous 120mm mortar systems with our current LAV chassis would mean a reduction in cost to procure and maintain these vehicles. Finally, the RCA has an already established set of Standard Operating Procedures (SOPs) produced for both the employment of mortars (see the 81mm mortar) as well as the employment of a self-propelled IFS (see the M109 as well as the 81mm BISON mortar carrier). This would translate to a decrease in establishing these SOPs and a foundation of knowledge with which the RCA could build its future training and fighting principles around. If each field Artillery Regiment was able to transition to a single Battery of SPMs, with a single Battery of M777s bolstered by the amalgamation of both current M777 Batteries, we would see the ability to consistently field 4-howitzer Batteries while also fielding an increased mobility and survivability with the introduction of an SPM Battery.

Nato Fire Support Doctrine states that "The role of land-based IFS is to support the ground manoeuvre forces with indirect fires and its effects as a part of Joint Fire Support (JFS)." The RCA has historically achieved this through the use of systems such as the 81mm mortar, the M109 Self-Propelled Howitzer, and currently, the M777A2 lightweight howitzer. As the M777 ages and the RCA looks to develop a capability that will remain relevant into the future battlespace, 120mm Self-Propelled Mortars offer the mobility and survivability needed to fill these capability gaps at a relatively low cost to procurement and development due to our established vehicles and SOPs. Through the use of self-propelled mortars, the Royal Canadian Artillery could modernize an aging Indirect Fires capability and remain a relevant force in future combat operations.

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