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CANADA'S LACK OF GROUND BASED AIR DEFENCE: RISK IS INCREASING

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AIM

1. The purpose of this paper is to provide information to the Commander Canadian Army (CCA) highlighting the increasing risk involved to the successful conduct of future Joint, Interagency, Multinational, and Public (JIMP) operations from a future land operations perspective if the current deficiency in Ground Based Air Defence (GBAD) capability endures. The decision to divest GBAD was made almost twenty years ago, under a different government and in a different global security environment. The risk assessment is now markedly different. This paper will describe the elevated risk to future operations given the JIMP construct, the increase in conventional operations, the global proliferation of Unmanned Aerial Systems (UAS) and the availability of UAS to state and non-state actors. This paper will make recommendations concerning the scope of the current Ground-Based Air and Munitions Defence (GBAMD) project, and suggest areas for future study in Air Defence (AD) weapon technology.

INTRODUCTION

2. Given the recent changes in political structure, including a new Prime Minister (PM), a new Minister of National Defence (MND), a new Chief of Defence Staff (CDS) and a new CCA, it is important that the AD problem space be defined in order to enable informed decisions regarding the current capability deficiency. The current government inherited risk to the Canadian Armed Forces (CAF). They inherited a force without the capability to prevent the enemy from interfering from the air with the conduct of operations on the ground. An AD capability resides within the Royal Canadian Air Force (RCAF) in terms of the CF-18 fighters, but that is the only AD organic to the Canadian Armed Forces at this time.

3. This paper will first discuss past AD capabilities in terms of the operational functions, Command, Sense, Act, Shield, Sustain, and Generate.[1] It will then discuss the AD operational concept, to include the layered approach to an Integrated Air Defence System (IADS), and how the principles of air defence Mix, Mass, Mobility, and Integration contribute to the protection of ground forces. It will then address an intensifying threat in order to highlight the risk involved in allowing this capability gap to remain.

DISCUSSION

Background

4. In the late 1990s the Canadian Armed Forces (CAF) made the decision to start divesting the GBAD capability within the Canadian Army (CA) and its force employer, The Royal Regiment of Canadian Artillery (RCA). At one time the Army possessed the Short Range Air Defence (SHORAD) and Very Short Range Air Defence (VSHORAD) equipment necessary to effectively contribute to the safe conduct of JIMP operations in an Adaptive Dispersed Operations[2] (ADO) context.

5. The RCA once employed the Javelin Man Portable Air Defence System (MANPADS), the Orlikon GDF-005 Twin-35mm anti-aircraft Gun, the Skyguard radar system, and the Air Defence Anti-Tank System (ADATS). This equipment represented, within the land force, a GBAD capability designed to contribute across the operational functions Command, Sense, Act, Shield, Sustain, and Generate; though GBAD primarily contributed to the CAF force protection capability in the Shield domain and intelligence, surveillance, and reconnaissance in the Sense

[1] Department of National Defence, B-GJ-005-000/FP-001 *Canadian Forces Joint Publication CFJP 01 Canadian Military Doctrine*, (Ottawa: DND Canada, 2011), 2-7.

[2] Department of National Defence, D2-188/2007E *Land Operations 2021 Adaptive Dispersed Operations the Force Employment Concept for Canada's Army of Tomorrow*, (Ottawa: DND Canada, 2011).

domain.[3] The divestment continued to such point where the AD can now only enable the Sense and Command functions.[4]

The Air Defence Operational Concept

6. The AD in operations is responsible for the protection of forces on the ground, forces involved in littoral operations, and prevention of fratricide in the air through the effective coordination of airspace. "AD provides the security coverage, under which all other forces can operate. The Army has the primary responsibility to provide Ground Based Air Defence (GBAD) against the low-level air threat."[5] The protection of ground forces extends to all forces on the ground in a JIMP environment. When the decision to divest GBAD was made almost twenty years ago, the JIMP concept was not practiced and the CAF thought it was accepting risk only to its CA personnel. With more actors on the ground conducting operations, the AD capability gap puts all ground forces at risk, not just CA personnel.

7. GBAD functions in levels of responsibility, or capability to function at distance and altitude within an IADS. At the very lowest level is All Arms Air Defence (AAAD) using personal and crew-served weapons. VSHORAD is the next level at which MANPADS are traditionally effective against Air Breathing Treats (ABT) and UAS. SHORAD is the level that extends to approximately 8-10,000 metres above ground level (AGL). ADATS was the Canadian AD SHORAD equipment in recent use. The US Patriot missile system is an example of High to Medium Air Defence (HIMAD), and is the next layer and extends to the lower limits of Terminal High Altitude Air Defence (THAAD).

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[3] Department of National Defence, B-GJ-005-000/FP-001 *Canadian Forces Joint Publication CFJP 01 Canadian Military Doctrine*, (Ottawa: DND Canada, 2011), 2-7.

[4] *Ibid*.

[5] Department of National Defence, B–GL–372–001/FP–001 *Air Defence Artillery Doctrine*, (Ottawa: DND Canada, 1999), 7.

8. In order for an IADS to function properly and provide effective protection to forces on the ground, GBAD operates using principles of employment. The principles of employment include: Mix, Mass, Mobility, and Integration.[6] These concepts are explained in more detail in the following four paragraphs.

9. Mix is "achieved through employment of a combination of weapons…the capability of one offsets the limitations of another."[7] This implies that the GBAMD capability must include more than one type of AD weapon. No single AD system is designed to counter all natures of AD threat. The threat will be discussed in detail in a following section.

10. Mass is "the concentration of sufficient resources to adequately defend an asset."[8] Given the technological advancements in AD equipment, this may simply mean one system may be sufficient. It could mean massing effects. Regardless of the interpretation, the procurement concept must include a sufficient number of systems to Shield ground forces and defended assets.

11. The concept of Mobility requires that "AD units should have the appropriate mobility to maintain protection of its specified task."[9] This concept should guide the capability procurement staff to consider a mix of mounted and relatively static AD equipment. If the AD element must provide protection for a manoeuvre Brigade, it must be capable of keeping pace. If an AD element is providing protection for a static asset, such as an airport, sea port, or Forward Operating Base (FOB), the requirement for mobility decreases.

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[6] Department of National Defence, B-GL-332-005/FP-001 *Insert: Air Defence Artillery (V2.4)*, (Ottawa: DND Canada, 1999), 8-2.

[7] *Ibid*.

[8] *Ibid*.

[9] Department of National Defence, B-GL-332-005/FP-001 *Insert: Air Defence Artillery (V2.4)*, (Ottawa: DND Canada, 1999), 8-2.

12. Integration requires that the IADS is linked to the joint command and control network in order to provide early warning to ground forces, plan operations, provide situational awareness to the commander, and coordinate with protected assets. It implies integration with sensors and communications equipment. AD operations "are joint and the integration of all service components is required to fight the counter air battle."[10]

13. The principles of Mix, Mass, Mobility, and Integration are essential considerations when procuring a new GBAMD capability. A clear understanding of these principles is vital in identifying risk when considering specific weapon limitations and the quantity of weapons procured. The AD solution must include a combination of equipment that can maintain pace with its protected asset, communicate with the command and control network, and concentrate the appropriate effects on the various air threats posed by the enemy, both domestic and foreign. The threat has changed.

Current and Future Threat

> "Understanding the threat is the first step in countering it. By focusing on an enemy's capabilities and methods of operations, Air Defence (AD) commanders can best employ AD resources to protect the force and selected assets, minimize casualties, and provide freedom to manoeuvre."[11]

14. In a recent discussion with the CDS, he stated "Conventional warfare is on the rise."[12] The terrorist group ISIS is employing conventional military equipment such as artillery, tanks, and AD in Syria. The war in the Ukraine provides another ongoing example of conventional warfare. Conventional warfare involves the traditional air threats such as fixed wing aircraft,

[10] Department of National Defence. B–GL–372–001/FP–001 *Air Defence Artillery Doctrine,* Directorate of Army Doctrine, (1999), 34.
[11] *Ibid*., 11.
[12] CDS, (discussion, Toronto, ON, Thursday, 4 February 2016), with permission.

rotary wing aircraft, missiles, rockets, mortars, and artillery. It now, more than ever includes the use of UAS in surveillance, targeting, or attack roles.

15. The nature of the conventional air threat has changed. According to Dr. Karber, the Harvard educated President of the Potomac Foundation and internationally recognized expert in defence and national security matters, the impact as seen in the Ukraine war, is revolutionary.[13] In his 2015 report concerning the lessons learned in the Russo-Ukrainian war, he noted that both sides are using a number of types of UAS, all varying in altitude, range and endurance capabilities but the greatest impact is coming from the Russian use of operational and tactical level UAS.[14]

16. The Russian tactical level UAS are considered Class I UAS and are identified by NATO as small, mini, or micro UAS.[15] The Russian emphasis on the employment of mini and micro UAS in the Ukraine is different from the Coalition employment of UAS in Afghanistan. The Russians have proven their ability to dramatically reduce the time involved in executing the kill chain, using fourteen (14) types of UAS,[16] with mini UAS as targeting support for Multiple Light Rocket System (MLRS) engagements and micro UAS for Battle Damage Assessment.[17] According to Karber, "the increased availability of overhead surveillance, coupled with massed

[13] Phillip Karber. "Lessons Learned from the Russo-Ukrainian War." *John Hopkins Applied Physics Laboratory and U.S. Army Capabilities Center*, (July, 2015): 11, https://prodev2go.files.wordpress.com/2015/10/rus-ukr-lessons-draft.pdf.

[14] *Ibid*.

[15] NATO, "Guidance for the Training of Unmanned Aircraft Systems (UAS) Operators" ATP-3.3.7, *NATO Standardization Agency*, (2014): 1-4.

[16] Phillip Karber, "Lessons Learned from the Russo-Ukrainian War." John Hopkins Applied Physics Laboratory and U.S. Army Capabilities Center, (July, 2015): 11.

[17] Phillip Karber, "Lessons Learned from the Russo-Ukrainian War." *John Hopkins Applied Physics Laboratory and U.S. Army Capabilities Center*, (July, 2015): 11.

area fires of artillery and MLRS has produced a new level of intensity in modern conventional combat."[18]

17. In addition to conventional forces, terrorist organizations such as Hezbollah have employed UAS against Israel on multiple occasions since 2004.[19] According to a report authored by Dr. Todd Humphreys and submitted to the U.S. House Committee on Homeland Security, "never before have highly-capable UAVs been so inexpensive and widely available…one can buy over the internet today a UAV that rivals the…surveillance and guidance capability of military UAVs."[20] The global proliferation and accessibility of UAS has now made it possible for a terrorist of any kind, from a lone-wolf to ISIS to buy a cheap UAS and turn it into an aerial Improvised Explosive Device (IED) or a surveillance tool.[21] The proliferation of UAS and their accessibility to the public poses a great threat to our forces both at home and abroad.

18. A number of recent events highlight the threat that the micro and mini UAS pose to our security. In September 2013, a protester crashed a micro UAS in front of the German Chancellor during a rally.[22] In 2015 there were two White House incidents involving UAS.[23] Again in 2015, a UAS was involved in an incident at the Kuala Lumpur Airport in Malaysia.[24] Finally, in April 2015, a UAS was landed on the roof of the office of Japan's Prime Minister.[25] These incidents show how susceptible to attack or surveillance by mini and micro UAS, both at home and abroad

[18] *Ibid*., 41.
[19] Milton Hoenig, "Hezbollah and the Use of Drones as a Weapon of Terrorism," *Public Interest Report* (2014): 1.
[20] Humphreys, Todd. "Statement on the Security Threat Posed by Unmanned Aerial Systems and Possible Countermeasures," *House Committee on Homeland Security*, (2015): 2.
[21] Dinesh Sathyamoorthy. "A Review of Security Threats of Unmanned Aerial Vehicles and Mitigation Steps," *Science and Technology Research Institute for Defence*, (Ministry of Defence, Malaysia, October, 2015): 1.
[22] *Ibid*., 2.
[23] Dinesh Sathyamoorthy. "A Review of Security Threats of Unmanned Aerial Vehicles and Mitigation Steps," *Science and Technology Research Institute for Defence*, (Ministry of Defence, Malaysia, October, 2015): 2.
[24] *Ibid.*
[25] *Ibid*.

because they can so easily be used to deliver bombs or bio-chemical agents.[26] Two such plots were uncovered in the US in 2011 and 2015.[27]

19. The Canadian military is not the only modern military unprepared for counter-UAS operations. According to an article written by Colonel Matthew Tedescu of the U.S. Army, the U.S. is also unprepared to counter this intensifying threat. He states further that "militaries that are not examining ways to defend against the use of…UAS are not preparing adequately for the next war."[28] As many of our adversaries "already have the ability to employ them against the United States and its allies."[29] Colonel Tedesco confirms that the lack of counter-UAS capability despite the fact the U.S. Army possesses a very robust IADS, will have a direct impact on future operations, increasing the risk of casualties, and decreasing the likelihood of mission success.[30] His recommendation that the U.S. military "modernize their air and missile defence capabilities and examine other materiel solutions to address the growing threat"[31] both supports the purpose of this paper, and provides a unique opportunity for Canada to partner with its closest ally in order to develop a solution to the growing UAS problem.

20. The counter UAS issue is complicated by the design of the micro and mini UAS. The materials they are generally constructed with and their size make them difficult for radars to detect. The UAS problem is complicated by the fact that most current AD radars are designed to detect and identify larger threats such as large UAS, aircraft, and missiles which travel at high

[26] Laurent Beaudoin, Antoine Gademer, Loica Avanthey, Vincent Germain, and Vincent Vittori, "Potential Threats of UAS Swarms and the Countermeasure's Need", in *European Conference on Information Warfare and Security*, p. 24 (Academic Conferences International Limited, 2011), 24.

[27] Brandon Wallace, J Ryan, and Jon M. Loffi, "Examining Unmanned Aerial System Threats & Defences: A Conceptual Analysis" *International Journal of Aviation, Aeronautics, and Aerospace* 2, no. 4 (2015): 1.

[28] Col Matthew T. Tedesco "Countering the Unmanned Aircraft Systems Threat," *Military Review* (2015): 64.

[29] *Ibid*., 65.

[30] *Ibid*.

[31] *Ibid*., 67.

speeds.[32] In other words most AD radars are designed to identify things like birds and small UAS as clutter and to filter them out.

21. Cost is a significant factor when considering the use of traditional AD weapons to counter the UAS threat. According to Russian academic Eugene Miasnikov, "the cost of air defence interceptors is also a significant factor. One “Patriot PAC-3” sur- face-to-air missile costs about $3.5 million and the cost of a SAM of the 48N6E type for the S-300 air-defence system is likely comparable.”[33] The same can be said for air to air missiles. It is illogical to spend millions to destroy a cheap terrorist UAS.

22. The threat posed by the proliferation is significant and challenging to defeat. Canadian Army doctrine recognizes that AD capabilities will be required for the conduct of future operations. It states, "while shielding the force will remain an all arms responsibility, specialist roles will still be required, most notably, combat engineers, ground-based air defence, military police and chemical, biological, radiological or nuclear defence."[34] The GBAMD project is designed to deliver between the year 2023 and 2025 and is funded at approximately 350 million dollars Canadian. Given the approximate increase in defence procurement costs of 10% per year, the real value of the money available to the project will be closer to 300 million dollars and will not be enough to acquire a complete IADS for the CF.[35]

CONCLUSION

[32] Dinesh Sathyamoorthy, "A Review of Security Threats of Unmanned Aerial Vehicles and Mitigation Steps," *Science and Technology Research Institute for Defence*, (Ministry of Defence, Malaysia, October, 2015): 6.

[33] Eugene Miasnikov, "Threat of Terrorism Using Unmanned Aerial Vehicles: Technical Aspects,": *Center for Arms Control, Energy, and Environmental Studies, Moscow Institute of Physics and Technology* (Moscow, Russia, 2005): 23.

[34]Department of National Defence, D2-188/2007E *Land Operations 2021 Adaptive Dispersed Operations the Force Employment Concept for Canada’s Army of Tomorrow*, (Ottawa: DND Canada, 2007), 34.

[35] Information provided by Directorate of Land Requirements Staff on Thursday, February 4 2016.

23. The decision to divest the GBAD capability was made by a previous government and in a different security environment. The situation has changed, yet the capability deficiency endures. Conventional operations are on the rise, and so too is the employment and proliferation of UAS. These UAS can be used by a lone wolf, terrorists, criminal organizations, or conventional forces to attack Canadians at home and abroad.

24. The Canadian Armed Forces unable to protect its military members against UAS or any other air threat due to its lack of GBAD. Other than the increased UAS threat, what has changed is that the CAF must now protect the members of other government agencies and civilians who will be at risk during a JIMP operation, given Canada's Whole of Government (WoG) approach to operations. This was not the case when the decision was made to divest the GBAD capability. It can be argued that the CDS is not authorized to accept this risk as other government agencies and civilians not previously in harm's way will be forced to conduct operations without adequate force protection.

25. The increasing risk due to the current and future operating environment requires the commander to make a conscious decision to either assume risk by allowing this GBAD capability deficiency to continue, or to assume risk by underfunding the GBAMD project, or alternatively, the decision must be made to invest in a IADS capable of protecting those who will conduct future operations on behalf of the Canadian government.

26. Canada is not alone in its GBAD capability deficiency. The US Army is unprepared to counter the intensifying UAS threat. This presents an opportunity for the CAF to partner with its greatest ally in order to design a solution.

RECOMMENDATION

27. It is recommended that the Canadian forces conduct a detailed threat assessment of the current and future operating environment in order to inform the commander and enable him to make the decision regarding where, and how much risk he is willing to assume. It is recommended that a specific focus be paid to the UAS threat as it pertains to those who will operate in a whole of government approach in future JIMP operations domestically and abroad.

28. It is recommended that the Canadian Government invest immediately in a robust IADS, taking into account the AD principles and partnering with the U.S. Army to increase interoperability and reduce procurement costs. To do so will require the Directorate of Land Requirements (DLR) to quickly adjust the scope of the current AD project in order to avoid lengthening the current capability deficiency.

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