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ROBOTICS AND AUTONOMOUS SYSTEMS

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ROBOTICS AND AUTONOMOUS SYSTEMS

AIM

1. The Land Component is the essential domain for responding to a wide range of threats. It is flexible and scalable and can be deployed from war to stabilization operations to domestic support in the event of natural disasters or the like. Soldiers can be deployed individually up to a whole brigade. Due to the wide range of missions and the flexibility in manpower, equipment, armament and mobility required, it is already necessary to support all this technically with semi-autonomous or autonomous systems. Due to the comparatively small number of soldiers in the land forces, this lack of human resources can be partially compensated by systems. For the Land Domain, it is imperative to quickly implement and master technological advancements on a day-to-day basis. Only in this way will the Canadian Army (CA) be able to perform adequately and successfully in its missions. One of the largest fields of action in the future will be autonomous systems, as we already find them in parts of the armed forces. This service paper is intended to give examples of land operations and military tasks in which RAS technology will be suitable.

INTRODUCTION

2. The main aspect and focus of autonomous systems is to support the soldiers in their tasks and missions in such a way that the result can be optimized. Autonomous systems are already able to replace the soldier completely in his activity. Here, time, effort and danger play an essential role. Artificial intelligence and autonomous systems are often very fast in their reactions and implementation of actions. This, and the partial replacement of soldiers, often minimizes or even eliminates the risk to humans. All this requires a high technical and logistical effort, which is quite justified because of the manifold possibilities. Often the focus of autonomous systems and robotics is rather on flying technologies or certain weapon systems on or under water, as well as for missiles or bombs. However, the range and diversity of land operations offers an enormous number of possible uses for autonomous systems, which are outlined below. These possibilities include all functions: command, sense, act, shield and sustain.

3. To understand the possibilities for future systems in land operations in the context of functions, robotics and autonomy must be defined, each in a brief summary. Robotics is the overlap of science and technology, of machines or robots that replace or mimic human actions. According to a Pentagon definition, autonomous (weapon-) systems are weapon systems in which target selection and the decision to attack are combined in one system without human confirmation. The soldier may be given the option to abort, and development also allows for situations in which the soldier can no longer exert any influence.¹

¹ BuiltIn. "Robotics. What is Robotics? What are Robots? Types and Uses of Robots." Last accessed 12 January 2022. <https://builtin.com/robotics>

DISCUSSION

4. The range of semi-autonomous systems is already enormous today, both in the civilian sector but also in the military sector in particular, and in all functions (command, sense, act, shield, and sustain). The speed of development of these systems is extremely high and will inevitably lead to fully autonomous systems in the future and thus also to the question and challenge: Which land operations/military tasks would be suitable for Robotics and Autonomous Systems (RAS) technology?

5. The Future Land Operating Environment (FLOE) describes the future circumstances and challenges to be dealt with in land operations. These are described as "complex, dynamic, volatile, and highly uncertain"². The last few years have shown how fast-moving and dynamic the world, and therefore the threats, can be. These rapid changes are complicated by a high degree of complexity, for example hybrid warfare and cyber threats. Enemies and threats can often no longer be clearly defined or recognized. Major technological trends, which are interrelated, will influence the land component and have a significant impact on its education, training, composition, leadership and ultimately its operations and missions. These are artificial intelligence, autonomous systems, and robotics.

6. Land forces must be able to deploy and employ scalable, self-sustaining, and interoperable force packages capable of conducting full-spectrum operations (major combat operations, stability operations, humanitarian operations and disaster relief (HODR), stability and domestic operations)³. Due to the possibilities offered by artificial intelligence, especially in the area of data collection, analysis and one or more recommendations for action, there is a very good possibility of scalability. The further systems, partly themselves, develop, the greater is the hope for simple interoperability.

7. Through the further development and implementation of artificial intelligence, it is possible to massively increase the speed of decision making, from the smallest tactical level to the strategic level. This capability will have a smooth transition into function command to also be able to react and command quickly at all levels in the ongoing battle. AI and autonomous command and control systems will be able to use data analysis to determine the most suitable units and weapon systems available before the start of an upcoming mission, regardless of its intensity, and to take all logistical aspects into account. Already today, command and control information systems at all levels of command support the decision-making process, regardless of the mission or task. The more autonomous these systems become, the faster orders can be evaluated and implemented. This starts at the smallest tactical level. Thanks to augmented reality, an infantry group can act faster and more efficiently and process and use a large amount of

² Canada. Department of National Defence. *Close Engagement: Land Power in an Age of Uncertainty: Evolving Adaptive Dispersed Operations*. Kingston: Canadian Army Warfare Centre, 2019.

³ IBID

information simultaneously⁴.

8. The presented possibilities of leadership information systems have a very similar impact on the function Sense. Due to the already prevailing mass of data, it is difficult to almost impossible to collect, evaluate and assess all this data without technical tools. Beginning at the strategic level, enormously large data volumes are required, for example, to collect and evaluate information from a wide variety of sources, areas or conversations, in order to be able to define strategic goals on as precise a basis as possible and to be able to implement these with instructions for action at the operational level. With corresponding further developed systems, an enormous amount of time can also be saved here in future operations across the board and, in the best case, translated directly into recommendations for action. This frees up a large number of resources in the area of human resources to concentrate on another focus, such as the further development of autonomous systems for data analysis and evaluation.

9. In the function Act, the development of robotics and autonomous weapon systems is already well advanced. The example of the Israeli company Rafael and their system "Fireweaver" shows that a very fast target acquisition can take place completely autonomously by means of reconnaissance and an effector assignment up to the combat of the target. This requires as described in the paragraphs before a possibility of the data acquisition, the data analysis and evaluation, as well as a fast possibility of independently going through the guidance process with the best possible decision basis, in order to finally achieve an effect in the function Act and to have eliminated the danger. Here, too, a high degree of interoperability is required to ensure communication between the various sensors, evaluation tools and effectors. Autonomous weapon systems, which in the best case are highly mobile, minimize the danger to the soldiers themselves, since there is no need for direct operation of the equipment, but at most a monitoring and a kind of supervisor function, which can be performed anywhere in the world⁵.

10. For North America and Canada, one of the current and continuing threats is a missile attack. This threat has existed since the invention of the intercontinental ballistic missile, but recently this threat has increased significantly due to the technical development of hypersonic missiles. The pioneer in the development of these weapon systems is currently China. There, successful tests with such missiles have already been carried out. Due to the cooperation between China and Russia it can be assumed that Russia has at least knowledge about the technology of hypersonic missiles. Currently, the Western world, especially North America, is not able to efficiently defend against this type of missiles. Furthermore, Russia's own development of hypersonic missiles is not as advanced as that of China. Not even the USA is so far in the development. This example shows how essential further development in the Shield function is in order to minimize or

⁴ Europäische Sicherheit und Technik. "Information superiority and combat enhancement thanks to augmented reality." Last modified 18 February 2021. <https://esut.de/en/2021/02/sponsored-content/25628/informationsueberlegenheit-und-kampfwertsteigerung-dank-augmented-reality/>

⁵ Rafael. Advanced Defense Systems Ltd. "Fire Weaver - A Networked Sensor-to-Shooter System for Maneuvering Forces." Last accessed 14 January 2022. <https://www.rafael.co.il/worlds/land/multi-service-network-centric-warfare/>

completely counter such a threat with AI and autonomous defense systems. Canada is aware of the importance of the partnership with the USA and its significance in the area of national defense, in particular in the NORAD alliance, and the advantages this brings for Canada. Furthermore, Canada would not currently be able to perform the function Shield as outlined above with the same quality, nor will it be able to do so in the foreseeable future. This challenge again shows how important it is to keep pace with potential adversaries in technical development and advancement, or in the best case to be faster than them. With this type of threat, an exchange between partner states, such as the USA, is necessary in order to keep up with the speed of technical development in the area of artificial intelligence and autonomous systems in the Shield area⁶.

11. Because of the Army's mission to sustain itself in the future in all possible operations worldwide, no matter what the intensity, and even when deployed in the homeland, one of the essential cornerstones in terms of endurance and robustness is the function sustain. All examples of war history show how essential logistics and support of the armed forces are to ensure success. If the necessary support is not available on time or in sufficient quantities, success will not be achieved and the mission will most likely fail. Lack of logistics can only be compensated for a limited time by management, courage, ingenuity or cunning. Even in the function Sustain, processes can already be optimized and perfected with automated processes on all logistic levels. Conceivable and already visible in the civilian economy, as in Amazon, are logistic warehouses that are autonomous and supported by robotics. Through the use of AI, starting from a single shooter up to a brigade, logistic processes can be triggered and executed autonomously. Based on the intensity of the mission and the expected duration and follow-up orders, necessary support can be preemptively determined and implemented in processes in advance, so that the soldier no longer has to spend time identifying or calculating this service, requesting it and, in the worst case, waiting for it to be implemented.

CONCLUSION

12. It is essential to be better and faster than the opposing forces in the further development of AI, autonomous systems and robotics⁷. Without a head start in the development and implementation of this technology, Western governments will only ever be able to be reactive, and even that only to a limited extent. In order to maintain the necessary flexibility and to have all options of a reaction, the speed of the development is elementary important. This is the only way to be able to act at all levels, strategically, operationally and tactically, in all areas such as land, sea, cyber, space and the information environment. Furthermore, evolutionary improvements must be made in the following key areas: Connectivity is a key element in working together with Allies and Partners. Agility must be faster than adversaries are, therefore enhanced decision support tools can help to succeed. Adaptability is important for the fast and ongoing technology

⁶ CBC. "NORAD commander warns Canadian officials about the threat posed by hypersonic missiles." Last modified 30 November 2021. <https://www.cbc.ca/news/politics/commander-norad-hypersonic-weapons-canada-position-1.6268141>

⁷ Collins, L., and Harrison, M. "Affordable, Abundant, and Autonomous: The Future of Ground Warfare." *War on the Rocks* (21 April 2020).

change. Integration is a key element in terms of joint, combined, non-military tasks, missions and operations. For all these enhancements is robustness also a key element to be successful⁸.

13. Canada and the Western world must realize the importance of autonomous systems for the future. This is the only way to keep up with the pace on the battlefield, during a prolonged stabilization operation, or humanitarian aid abroad or at home. The balancing act between laws, ethics and the need for implementation, the technical possibilities of robotics and autonomous systems must be achieved as far as possible without friction. Many of the opponents are subject to significantly fewer ethical or legal constraints. These limitations, which apply to Canada and its partners, limit the range of applications for autonomous systems and will do so even more in the future. Even without a concrete technical implementation, discussions and debates are possible and necessary in order to be able to clarify ethical and legal questions in advance and not to start with them just before a system is implemented.

RECOMMENDATION

14. In order not to lose the connection to hostile forces in land operations and thus to get into a substantial disadvantage in the long run and in the long run, conceptual possibilities must be comprehensively worked out already today in order to be able to start directly with an implementation and utilization in case of a technical realization on the part of science and industry. The exchange of ideas for further development between armed forces and industry, as well as between allies and partners, is not only desirable, but logical and consistent in order to save resources in development and to be fast and interoperable. Even if it is difficult to look into the far future (2040) and it is impossible to predict all threats and political implications and changes, it is necessary and indispensable to invest personnel in the conceptual development of artificial intelligence, autonomous systems and robotics⁹.

⁸ United Kingdom. Watling, Jack. *Land Warfare Conference 2021 - Integrating for Operations Today and Warfighting Tomorrow*. London: Royal United Services Institute for Defence and Security Studies, 2021.

⁹ IBID

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