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ENHANCING INFANTRY SOLDIER PERFORMANCE THROUGH INTEGRATED SOLDIER SYSTEMS

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Service Paper

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AIM

1. The aim of this service paper is to outline a number of integrated soldier systems which should be investigated in order to enhance the performance of infantry soldiers as Canada continues to move towards the modern battlefield of the future. While a number of the systems which will be discussed are still very much in their infancy stage of development, and some of these technologies are still to be developed or fully defined, Canada's coalition partners are investing significant time, money and resources into these projects as these technologies will become imperative as the future of warfare continues to evolve. Failing to partner with our allies or failing to undertake these initiatives ourselves will undoubtedly marginalize our national ability to contribute to future global efforts, while at the same time posing significant risk to our forces; more specifically our people.

INTRODUCTION

2. Throughout history there have been a number of technological inventions which lead to direct and lasting impacts on countries and their militaries. Inventions such as barbed wire, gun powder, chlorine and the machine gun each played a significant role in changing warfare as it was understood and lead militaries to challenge their ways of conducting war, the tactics used and the technologies they employed. No different today technology continues to drive the way militaries conduct operations throughout all phases of war. However unlike in years past the rate at which technology is being developed has never been experienced. As a result, militaries around the world are working to develop new technology which will augment human performance and increase operational effectiveness. "Employment of soldiers and autonomous systems will provide maneuver units with the capacity to operate at extended distances to support distributed operations, deliver improved lethal effects, and enable a higher OPTEMPO than threat forces"¹.

3. The wars in Afghanistan and Iraq have provided the opportunity for our adversaries to make significant gains in these fields over the last decade. In fact, the "Russian military industry committee, responsible for Russian military policy, has set a goal to replace 30 percent of all military technology with Robotics and Autonomous Systems (RAS) by 2025"². Canada and its allies must strive to make up for lost time in the human-machine teaming programs already being developed by our enemies. This paper will focus on five categories of soldier enhancement which as previously mentioned should be explored in earnest by Canada. For the purpose of this

¹ U.S. Army, Army's Future Force Warrior passes major milestone, last modified on September 2008, https://www.army.mil/article/15/armys_future_force_warrior_passes_major_milestone.

² U.S. Army, Integrating Army Robotics and Autonomous Systems to Fight and Win, last modified July 2017, <https://www.ausa.org/sites/default/files/publications/SL-17-2-Integrating-Army-Robotics-and-Autonomous-Systems-to-Fight-and-Win.pdf>.

paper these categories will be broken down into shoot, move, communicate, protection and sustain.

DISCUSSION

Shoot

4. With advancements in body armour and personal protective equipment, weapon lethality requires constant modification and improvement. Along with these increased capabilities comes the need to increase individual soldiers' ability to conduct surveillance and target acquisition operations. As a result, both weapon systems as well as their optics require updating and modification. Many militaries, including Canada, have begun developing new technologies aimed at employing munitions capable of self adjustment based off the type of target being engaged. Prior to being projected, munitions can be adjusted to ensure maximum lethality when detonating within proximity or upon contact with enemy targets. "To engage targets hidden in trenches or behind shelters, the soldier can measure the range of the target with a laser rangefinder. The range data is downloaded to the weapon's round and the overflying weapon round detonates at the designated range to strike the hidden target."³ This is one advancement currently being investigated through the Future Infantry Soldier Technology program being conducted by the United Kingdom.

5. Coupled with the need to increase weapon and munition lethality is the requirement to enhance soldier's ability to identify and engage enemy combatants on the battle field. Upgraded weapon optic systems as well as helmets and eyewear with integrated heads-up display (HUD) are rapidly beginning to take shape and can already be observed on current battlefields. The UK FIST program is working to develop technologies that will enable the weapons sight system to be "linked to the soldiers helmet mounted sight. A linked sight system allows the soldier to fire around corners at the target while remaining in a protected position."⁴ This sort of technology goes a long way to helping ensure soldier survivability on the battlefield. In addition to potentially saving lives, these systems can assist with reducing sustainment lines of communication as it relates to medical support, casualty evacuation, repatriation and regeneration of replacements. Ensuring modern day soldiers can engage enemy positions from behind cover and with rounds capable of achieving maximum lethality will have a direct and lasting impact on soldier moral, and willingness to engage in combat operations.

Move

6. Many militaries are conducting extensive testing as it relates to "advancing human sciences related to cognitive, social, and physical development in order to develop resilient soldiers, adaptive leaders, and cohesive teams"⁵. To enhance human physical capabilities the development of exoskeletons has made tremendous headway over the last decade. So much so

³ Defence Connect, Future Infantry Soldier Technology trials, last modified October 2007, <https://www.army-technology.com/projects/fist/>.

⁴ *Ibid.*

⁵ U.S. Army, Army's Future Force Warrior passes major milestone, last modified on September 2008, https://www.army.mil/article/15/armys_future_force_warrior_passes_major_milestone.

that Raytheon, a company that has partnered with Lockheed Martin to develop an exoskeleton suit called the XOS, believes they will have an active suit, untethered from its power supply, in the field, within the next five years. Exoskeleton suits are being looked at to enhance an individual soldier's physical capabilities, reduce joint fatigue/strain, muscular injury, prolong performance, and reduce the number of soldiers required to perform tasks. "The XOS allows the soldier to operate faster and for longer periods of time, often fulfilling the role of two or three soldiers, allowing the reallocation of soldiers for more strategic tasks"⁶. Current exoskeleton suits can carry loads of up to 200 pounds, are being fabricated using titanium and carbon fibre, and have been fitted with "liquid body armour" and other protective measures thus further removing the physical strain applied to soldiers. This has led to an increase in stamina and lengthens the time soldiers are able to conduct operations for. The largest challenge currently being faced by this technology is the requirement to create a power source capable of sustaining the needs of the suit which is untethered and therefore not a hinderance to the soldier. With the advancements in fuel cells and other power supply options being explored this challenge is sure to be alleviated in the very near future.

Communicate

7. As has always been a challenge for militaries throughout time has been the need to relay, receive and process information in a timely manner. Today with the advancements in communications equipment and the ability to outfit individual soldiers with radios and data processing systems, operations have become network enabled like never before. Never have we been able to transfer such large volumes of information, over extended lines of communication, through both secure and unsecure means. Referenced previously, the FIST project is working towards being able to send both voice and data to the soldiers "directly or via drone relay links from headquarters, which have downloaded battlefield commands, information and images from forward observers, unmanned air vehicles, remote sensors and other airborne or satellite surveillance assets"⁷. These new abilities will help shape and coordinate battlefield operations and the employment of soldiers like never before. As tactical situations develop on the ground, or as the situation changes, commanders will have the ability to almost instantaneously alter and communicate updates to ground forces; helping to overwhelm the enemy's decision/action cycle and their ability to manoeuvre opposing forces.

8. While there is much to be gained from a networked enabled military force, the ability to generate and sustain the power requirements for these systems continues to grow at exponential rates. As an example, the new Canadian Light Armoured Vehicle (LAV) 6 requires an incredible amount of power to sustain its weapons and sight systems when the vehicle has been powered down, such as when it occupies an observation post or defensive position. The challenge being faced currently by mechanised forces is that they are not able to run their turrets for more that 90 minutes without having to power up the vehicle. This increases the risk to

⁶ Defence Connect, Military exoskeletons uncovered: Ironman suits a concrete possibility, last modified January 2012, <https://www.army-technology.com/features/featuremilitary-exoskeletons-uncovered-ironman-suits-a-concrete-possibility/>.

⁷Defence Connect, Future Infantry Soldier Technology trials, last modified October 2007, <https://www.army-technology.com/projects/fist/>.

friendly forces as the noise and thermal signature of the vehicle is instantly broadcasted. As our technologies increase, so does our need for power. “Future infantryman power requirements are estimated to be ten times higher than currently used”⁸. While lithium ion batteries continue to be largely employed to meet power requirements, technology such as fuel cells and fuel cell charges will likely mark the way forward to overcoming these gaps. Companies such as the German based SFC Energy have developed fuel cell generators and silent vehicle mounted cells capable of delivering continuous, independent power. “Inside the vehicle, the fuel cell is connected to the on-board power system and batteries. It constantly monitors the charge status of the batteries and will recharge them when needed, quietly and automatically, without needing any user intervention”⁹. Their studies have proven that this system can maintain the vehicle’s power requirement for days without any need of outside assistance, such as starting the engine or connection to an exterior generator. Technologies such as this will enable infantry forces to become more self-sufficient and able to operate independently during dispersed operations as will likely be the future of modern conflict.

Protection

9. The need to develop and enhance our force protection capabilities will also require significant investment as technologies related to optical systems and weapon lethality continue to evolve. One such technology which Canada has made great strides in is our CADPAT digital camouflage pattern employed on our combative clothing and equipment. While this has served Canadian Forces well in environments where this pattern was permissive to operations, further developing camouflage patterns capable of being employed in multiple environments is required. Clutter metrics refers to the science behind human neurology and the reasons for which we can identify and discern objects. Technologies currently being examined include adaptive camouflage which could be incorporated into clothing to further aide in the ability to evade detection. This technology “has been inspired by the way certain species of fish seemingly effortlessly change colour and pattern to blend in with their surroundings”¹⁰. While there is still much work to be done to further refine the science behind this process (biomimetics, nanotechnology, genetic modification) significant headway has been made. “Bachand predicts that this kind of clothing will be ready for duty in as little as five to ten years”¹¹. It cannot be overstated that a technology such as this would greatly assist in increasing survivability rates of dismounted infantry soldiers employing this form of clothing.

10. Thermal signature is another substantial threat faced by modern forces as the ability to detect signature does not solely rest with a near-peer enemy but is an ability inherent to even our less advanced adversaries. Off the shelf technologies from around the world have made their way into conflict zones which has forced the requirement to advance, and safeguard, new

⁸ Army-Technology, Military Charging Systems: Fuel Cell Generators and Power Management, last modified October 2008, <https://www.army-technology.com/contractors/electrical/sfc-energy/>.

⁹ *Ibid.*

¹⁰ Defence Connect, Government launches project for new soldier field equipment, last modified September 2011, <https://www.defenceconnect.com.au/land-amphibious/2861-government-launches-project-for-new-soldier-field-equipment>.

¹¹ *Ibid.*

technologies as they come online. New thermal defeating clothing has been developed and already employed in both Afghanistan and Iraq, and companies such as Ceno Technologies out of Buffalo are looking to develop thermal paint which like camouflage paint would be used to cover the hands and face to eliminate the threat of thermal glare.

11. Along with the evolution of weapon ballistics and lethality comes the need for increased protection from incoming enemy munitions. Body armour is essential for ground forces such as the infantry who are required to “close with and destroy”. While our current protective equipment, when employed in conjunction with ballistic plates, can stop several incoming munitions employed on the battlefield, there are still many it is not capable of stopping. This equipment is also very heavy and cumbersome and not well suited for dismounted operations, especially in arid environments. Technologies such as liquid armour which are currently being developed around the world and in locations such as the United States Army Research Laboratory, and a similar technology called “Moratex” being developed in Poland are looking to create “a suit of armor that remains soft and malleable during normal operations, but hardens instantaneously at the point of contact- deflecting and dispersing the immense destructive energy produced by a hit from an enemy round or shrapnel”¹². Being able to wear protective equipment such as this would greatly enhance soldier mobility and dexterity, while offering the added benefit of wearing a more comfortable, malleable armour.

Sustain

12. With the introduction of various new soldier systems, weapons, munitions, optics, armour, portable surveillance systems and multiple other battlefield enablers comes the need to be able to transport and sustain these unique capabilities. While these emerging technologies offer ground breaking options for soldiers operating today and moving into the future one consideration that cannot afford to be overlooked will be the maintenance and sustainment of these systems. While they provide unique capability to the battlespace, they are often fragile, disposable, dependent on alternate power source and highly susceptible to the harsh living conditions experienced by dismounted ground forces. As such the need to incorporate additional replacement components, batteries, multiple natures of ammunition, individualized transportations cases, or perhaps complete units, places an increased burden on already overloaded ground forces. These challenges coupled with the likelihood that adaptive dispersed operations are likely the model to be employed in conflict zones moving forward will necessitate the need to incorporate what will likely be an autonomous equipment transportation platform for soldiers at the section and platoon level. Systems like Lockheed Martin’s Human Universal Load Carrier (HULC) or autonomous systems “such as the Squad Multi-purpose Equipment Transport (SMET) can drastically lighten equipment loads by carrying up to 1,000 pounds of mission-essential equipment for the team or squad”¹³. Failing to incorporate systems of this nature into current research/procurement cycles of the future will undoubtedly hinder Canadian

¹² Futurism, New “Ironman” Special Forces Exoskeleton Stops Bullets With Liquid Armor, last modified June 2006, <https://futurism.com/2018-will-be-big-on-special-forces-exoskeleton-tech>.

¹³ U.S. Army, Integrating Army Robotics and Autonomous Systems to Fight and Win, last modified July 2017, <https://www.arsa.org/sites/default/files/publications/SL-17-2-Integrating-Army-Robotics-and-Autonomous-Systems-to-Fight-and-Win.pdf>.

Armed Forces ability to operate on deployed missions in the future; and would place undue, and unfair, strain on infantry forces.

Conclusion

13. Where systems, processes and advancements used to be updated quarterly in the private sector, new and emerging technologies are now introduced daily. While not all are significant or relative as it relates to Canadian Armed Forces future operational goals, many of these technologies will directly impact Canadian Forces and our ability to deploy and operate in the future battlespace alongside our peers and coalition partners. Failing to embrace these new challenges and invest significantly in the above-mentioned domains will drastically impact Canada's ability to deliver trained, resourced and relevant soldiers to initiatives it views as globally significant and will surely marginalize the way in which our country is viewed moving forward.

Recommendation

14. Considering the topics covered throughout this service paper it is recommended that funding and resources be allocated to DG Land Strat and tied to Strong, Secure, Engaged sections 91, 98 and 105. Doing so will help to facilitate Canada's requirement to expand its research and development in systems not only specific to the Canadian Infantry Corps, but all ground forces.

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