THE IMPACT OF EMERGING TECHNOLOGIES ON ARMED FORCES OVER THE NEXT 10 YEARS

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ABSTRACT
During last twenty years, information technology has expanded to almost all operations and to most work areas of the state, including armed forces that use various types of digital processes, semi-automatic and automated ones, in both daily operations and in combat operations. The level of use of information systems can be compared to what constitutes the fourth industrial revolution. The presented study includes the concept that new technologies will have a growing impact on the armed forces over the next decades, but they will not replace the human element in armed conflicts. The human factor is and will continue to be a key player, determining whether to take part in an armed struggle or not and how to manage future military operations.

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Introduction

'Beam me, Scotty!' is a folk saying from the Star Trekseries, which could be echoed in reality for over a millennium. The science fiction authors have always been good at predicting the future - from the flight to the moon to the uprising of artificial intelligence (Bratanič, 2018).

Science fiction stories like *Twenty Thousand Leagues Under the Sea* and later stories of travelling to space and battles there, unbeatable robots and the superpower of new weapons originating from high-tech technology, as well as today's heroes using lasers and supersonic weapons have always been attracted by people of all ages, regardless of whether they have been presented in books, cinemas, DVDs or other media. Today, we often find them in various professional magazines and articles, as well as in defence documents and they are no longer a fantasy, they have become a reality. The resentment of the super-techno weapon, however, has a bearing on the community and its impact on the reason, time and place and the way of the development of the war.

Forthe last two decades, information technology has expanded to almost all activities and to most work areas, including the armed forces. Different types of digital, semi-automated and automated processes are present almost everywhere, both in the work environment and in everyday private activities. Our activities of the mind and of the body, the activities of the entire society have increasingly been connected with various technologies, and some experts and futurologists say that we are entering the transhuman or post-human phase of existence, which is characterized by the increasing interconnection with technology. 'Professor Klaus Schwab, the chairman and the founder of the World Economic Forum, argues that the collapse of barriers between digital and physical, and between synthetic and organic, constitutes the fourth industrial revolution, promising a level change comparable to that brought about by steam power, electricity and computing' (Schwab, 2016).

The development of military technology has become considerable with the emergence of big and small development companies and research agencies, in addition to traditional military defence development institutions. 'They created what President Dwight Eisenhower called in his farewell address a "military-industrial complex", a perpetual arms race, not necessarily with any particular enemy, but with the status quo' (Roland, 2009).

This essay will confirm that emerging technologies will have an impact on the armed forces over the next ten years. Given the wide range of emerging technologies and the analysis of their impact on modern warfare, this essay will argue that even though technology development will have a significant impact on the armed forces, it will not replace the human element in conflicts. Humansare key players, who decide if they will or will not go into an armed conflict and how they will lead it. Technology only offers them the opportunity to help to achieve their goals with more sovereignty and fewer casualties. The technologies and their potential military use in the following ten years will be presented and their impact analysed. Military strategic planners are already deeply engaged in these technologies, as they need to define the place and the mission very accurately and integrate the technologies into the structure. That changes the wholesome structure of the armed forces and the strategy and tactics of warfare. In addition, the essay will investigate what these technologies can mean for the future and whether all new technologies are actually also practical and versatile.

The essay consists of five chapters. The introductory part presents the topic, defines the subject, purpose and the structure of the essay. The second part presents the scientific and technological progress with regard to the armed forces, its importance, its indicators and what are the overall trends in the development of the armed forces, especially in developed countries. The third part presents the implication of these trends in the armed forces. The advantages and disadvantages of progress and the fact that human remains the main factor in spite of the technology are presented in the fourth part. The last part outlines the facts that support the claim that the development of technologies will affect the armed forces over the next ten years, but that the person remains in the first place.

Scientific-technological development and its implications on the armed forces

According to the professor (lecture delivered under the Chatham House rule):

> The use of new technologies for military purposes has two objectives: im-

> proving the capacity of its own forces compared to the forces of opponents in situations similar to battles (operational advantage) and archiving strategic advantage with the ability to influence the full potential of the opponent (Notes, 2018).

So far, the research and development in the field of military technology have emerged from the empirical fact that the lifetime of the average modern weapon system is about 15 years. 'Since the development of an armaments system takes from 6 to 8 years, followed by 1 to 3 years of testing, it is very important that we anticipate what the opponent will develop or construct in the next 6 to 8 years' (Žabkar, 1994). If developers are able to truly develop the technology that will upgrade, develop and update automatically, this cycle will drastically change to an unpredictable dimension. Detection, development, the use of advanced knowledge, the latest sciences and technology are essential to preserving the technological standard. 'The NATO Science and Technology Council (STO), with about 5000 scientists, engineers and analysts, has identified the list of twelve technological areas expected to have the largest impact on capabilities and operations in the future' (NATO STO, 2017).

SHOR-TERM (<6 YEARS)	MID-TERM (6-20 YEARS)	LONG-TERM (>20 YEARS)
1. Additive Manufacturing 2. Everywhere Computing 3. Predictive Analytics 4. Social Media 5. Unmanned Air Vehicles	6. Advanced Materials 7. Mixed Reality 8. Sensors are Everywhere	9. Artificial intelligence 10.Electromagnetic Dominance 11. Hypersonic Vehicles 12. Soldier Systems

Innovation in some of the most advanced areas of science and technology according to the Margaret Kosal:

> [ ] include robotics and autonomous unmanned system; artificial intelligence; biotechnology, including synthetic and systems biology; the cognitive neurosciences; nanotechnology, including stealth meta-materials; additive manufacturing (aka 3D printing); and the intersection of each with information and computing technologies, i.e., cyber-everything (2016).

On the other hand, the concepts 'that such technologies could yield doomsday scenarios and that military applications of such technologies have even greater potential than nuclear weapons to radically change the balance of power' and their fundamental strategic importance were defined at the multinational level in the NATO Strategic Concept of May 2010 (Kosal, 2016). By developing the perception and understanding of potential threats, anticipating technological changes and predicting possible upcoming technologies military organizations such as 'NATO can take advantage and an opportunity to make better choices today about the required capabilities in the future' (NATO RTO, 2011).

Technological improvements affect the reliability of operation in particular, due to the automation of communication means, combat assets, the control over the work of power units and the control of the damage caused. As far as automation is concerned, it also includes the infallibility and the possibility of constant adaptation to changes and their integration into the digitized command control network. New technologies emerge on a global level, they become cheaper and more accessible, communication with them and among them is faster

every day, and various product manufacturers appear in different designs. The ownership rightof new technology has fallen into oblivion. Çalişkan is convinced that it is becoming increasingly more important to possess new technologies than knowing them properly and use them appropriately and that when developing these technologies we must constantly search for answers to the question: 'What is the best way or method of using the new technology' (Çalişkan, 2017).

Artificial Intelligence

The term 'Artificial Intelligence (AI)' is understood as the ability of devices to equate themselves with people in terms of learning, inference, design, and performance in complex cybernetic physical environments. This practically means that AI is a substitute for human thinking, decision-making and control in all areas. 'AI is located in autonomous robots or vehicles, boats, aircraft, it carries out functions of automatic detection of information and the detection of anomalies and their elimination, psychological operations and intelligent mentoring for various military and support missions' (Notes, 2018). Developing AI software will allow to make faster decisions based on a much larger amount of data collected than human beings could master. How far could the development of artificial intelligence go? 'By 2050, the computer power of 1000 USD will be equal to the processing power of all the brain on earth' (Evans, 2010). Also, one ought to consider the possibility of 'smart dust' that will connect everything to the internet, which will allow us to monitor and manage our environment. It's a fact that technology innovations are occurring at a fast pace and the exponential growth of computational power, data storage, bandwidth, and the information is unthinkable. Computers will have self-aware abilities and no longer just exponentially cognitive abilities, because of this ability to instantly interpret things it will overcome language barriers.

AI is useful in all areas and has long since exceeded the capacity of a man. It is capable of controlling weapons, including nuclear weapons. It can also be used to control everything and everyone, wherever a fast and current response is needed even before something happens – much faster than a human response. Brimley argues that 'the success of future forces will depend on their ability to search, correct, and complete goals faster than their opponents' (Brimley, 2018). At this speed, this has led to further development and even faster AI performance, which means faster collection, analysis and reaction. Everyone is aware that the winner of the next war will be the one who is faster, which is why everyone is striving for a faster and more sophisticated AI technology. The question is, is this development of technology under control and what does it bring? The superpowers are competing which one will develop an AI system that will be much better (faster) than the opponents. Can Russia take lead in developing AI and move the scale of weapons technologies and military domination on its side? 'The statement of the Russian President, Vladimir Putin, who suggested that with the help of the AI, Russia could shift the power, speaks of how important, strong and influential the AI is. The state-sponsored media reported that AI "is of key importance for Russia" (Meyer, 2017). The Arms Control Arrangement is one of the mechanisms that were put in place to control arming, but at the moment there is no agreement on the AI to be included in this group, so it is currently not under control. Each AI can be used for military purposes it would be necessary, not only for official and regular armed forces, but also to pre-

vent access to it for terrorist and other militant groups and organizations, non-state actors and individuals, as it allows for the creation of massive destroying, threatens the stability and allows for more possibilities of hybrid wars, which in turn means that conflicts are escalating to unpredictable consequences. There is also an ethical concern about AI technology. Have we come up with the idea of building AI, which will decide instead of us to cause harm to us, decide on a war and peace, on being or not being? State institutions create and prescribe legal and moral norms and also, control. Will AI systems, if they are able to make decisions, be responsible for their consequences? However, 'there are fears that with the use of a variety of AI applications such as drones, self-driving vehicles and cybersecurity, we may again enter into another cold war' (Straub, 2018). As we are in the constant anticipation of some of the major change and the use of new technologies and their appropriate tactics, the units have constantly increased the state of alert, which on a longer period leads to doubt and uncertainty.

Robotics

Robotics can be defined as a science fiction from the recent past that became a reality. A robot is defined as a 'machine with sensors, processors, and effectors able to perceive the environment, have situational awareness, make appropriate decisions and act upon the environment' (Echevarria II, 2009). They are characterized by being devastating, surviving and consuming, and therefore useful in more or less all areas. 'Their use works on a two-sided basis: they are faster, better, more efficient and cheaper than people, but tactical, organizational and structural changes are necessary for their complete placement in the system' (Notes, 2018). All robotization issues have not been resolved yet. One of them is how to control a robot – how to control a weapon that strives for a greater autonomy, how can we rely on the robot to be reliable in separating enemy units from soldiers.

'The most recognizable unmanned aircraft are definitely drones, which are some kind of flying robots, similar to insects and capable of many things. In addition to transmitting cargo, observing, recovering, perceiving, shooting with various weapons, receiving commands at long distances and automatically avoiding obstacles, they are also able to respond to hand gestures and follow their owner' (The Economist, 2017), and to automatically switch to standby operation or transport position. Due to their versatility and relatively low prices, they are highly sought-after on the market and represent a cheap toy, a business opportunity and an expensive and dangerous weapon. Bunker, in a study entitled 'Weapons Systems Life Cycles Analysis and New Strategic Realities', claims that 'armed robotic systems in the form of teleoperated, semi-autonomous and even autonomous drones and droids are not yet equipped with AI, but are still operated by soldiers who use standard connections and control devices for management, while the more sophisticated ones are using wireless and satellite systems. In the near future, they will be equipped with AI and are likely to be able to respond independently and achieve some forms of self-awareness' (Bunker, 2017).

As in all areas, humans have always tried rationalising in the field of warfare. Therefore they always looked for a way and for means of defeating the opponent by using only the necessary forces and resources and resulting in the least number of victims. Today the first robots have entered the battlefields and many are eagerly waiting for it. It is true that robots reduce the need for people to carry out the tasks and that con-

sequently brings fewer victims and in principle, there should be less collateral damage. On the other hand, this contests the traditional notion of being a soldier – the warrior, and the mentality of the war. The management of the battle with remote machines and without the physical danger changes the mindset of the warfare. The forces of a technically inferior enemy and attacks on civilians give rise to the abuse, such as attacks from self-interest, etc. On the other hand, there is always the risk when such a weapon is separating a friend from the opponent, what if it breaks down or is injured and turns on us? How will we handle it and under what laws? It is true that machines must serve us, but we must control them, manage them, and take responsibility for their actions- the machine cannot protect our interests in the war. The machine can only be a tool and must remain a tool.

Nanotechnology

'The field of nanotechnology is defined as 'imaging, measuring, modelling and manipulating with substances in dimensions between about 1 and 100 nanometers', where unusual physical, chemical and biological properties can occur due to such low values also outside the Newtonian Physics Act' (EchevarriaII, 2009). This opened the way for new solutions to mechanical and biological problems that lead to completely new military capabilities. Due to the improved detection and decontamination capabilities, nanotechnology is located in many applications related to the defence against weapons of mass destruction and due to the required low power, low mass and low prices in handheld radio devices. Nanofibers are tested to seek better protection against chemical, biological, radiological, nuclear and high-energy explosive weapons or use in military uniforms and equipment.

The concept of the equipment for a modern soldier states that this should be an integrated technological system that will provide the military with chemical, biological and ballistic protection, communication and information support, power, physiological control and climate control. All this additional protection, safety, greater survival and efficiency should be provided by nanomaterials. On the other hand, the question arises as to what happens when these matrices destabilize during combat, how they affect the environment and the soldier who uses this equipment. Is it an advantage or a weakness? What do all these implants and supplements mean for a soldier's long-term health and stability and are there also any side effects?

Biotechnology

'One of the areas with high potential is biotechnology, which includes biometrics and genetic engineering and represents an area of non-limitative possibilities' (Notes, 2018). Genetics determines our strongest physical characteristics such as height, eye colour, body shape, muscle strength and practically all other features of our physical structure, while also affecting our mind, psychical traits and talents. It's not hard to imagine that by encroaching on our genetic design we could almost create people by a recipe. 'Genetic engineering seeks to translate biological systems into engineering systems, transforming the army through biotechnology' (Echevarria II, 2009). Soldiers Systems increase, 'individual human abilities using artificial means such as robotic exoskeletons, smart textile, drugs, and seamless man-machine interface. Uses include thecapacity to endure extreme environments, better health monitoring and care provision, decision making at individual level' (NATO STO, 2017).

Biotechnology is characterized by the use of organisms, tissues, cells, or molecular components of living beings to function and to act in such a way that they interact in the action of cells or their molecular components. This, in practice, means that biotechnology can increase the physical ability of a soldier to fight for longer under extreme conditions. Fewer soldiers are needed for the same task. The question is, however, how all these changes and 'defects' in the organism reflect human beings in the long turn. It is true that biotechnology corrects the defects in organisms and corrects their genetic records. What does it mean for an organism when biotechnology 'breaks down'? What happens to a soldier when the fight is over, is it possible to return to a former state without any consequences? We will probably not receive a real and honest answer to this question. It is always necessary to weigh what improvements bring, both positive and negative.

Cyberspace

'In 2011, the US Defence Department declared cyberspace a new field of warfare; since then DARPA has begun a research project known "Project X" with the goal of creating new technologies that will enable the government to better understand and map the cyber territory' (Wikipedia, 2014). Cyber-attacks cause greater damage to state authorities, business entities and critical infrastructure day by day, and are becoming frequently better organized, difficult to manage and costlier. According to the NATO; 'they can reach a threshold that threatens national and Euro-Atlantic prosperity, security and stability. Foreign militaries and intelligence services, organized criminals, terrorist and/or extremist groups can each be the source of such attacks' (NATO, 2010). The recognition of the cyberspace as a field of operation should include the current problem of different views and find a common position and agreement on a cyber-domain that would explain possible cyber operations. NATO Summit in Warsaw in July 2016; 'recognised cyberspace as a "domain of operations", that cyber defence is part of NATO's core task of collective defence, and that NATO is ready for the Allies to invoke collective defence in response to a significant cyber-attack, equivalent of an armed attack through cyberspace' (NATO CCDCOE, 2016).

This action additionally confirms the fact that cyberspace represents an environment in which there is a great possibility to implement network operations and therefore it is urgent to be edited. Today's tendency is that more or less all systems are integrated into a single, common network, providing significantly faster, better quality and better data exchange, while simultaneously opening a new and vulnerable space for various cyber-attacks. These attacks are constantly increasing, both in terms of numbers and in terms of the depth of their impacts, which poses a threat to the functioning of public and government information systems and data protection, as well as the functioning of banks and all other institutions that use the network, and therefore jeopardize their functioning, credibility and trust. This is why the question arises as to how to protect this proctor from cyber-attacks and whether this represents a new, completely digitized form of wars?

Implication on the armed forces

According to Margaret Kosal;

> The widespread enthusiasm for emerging technologies is reflected not only in official rhetoric but is also codified in respective national technology strategies and the global upswing of dedicated funding. Military-related pro-

> grams in potential peer competitors in Asia (China), in states posing regional security challenges in the Middle East (Iran), in the former Soviet Union (Russia), and in rapidly developing areas (including South Asia, Southeast Asia, and Brazil) offer comparisons for advanced, allied states (U.S., Western Europe, Japan, ROK) in order to understand the national meanings, organization, and strategic implications surrounding the development and fielding of emerging technology (2016).

It should be emphasized that the integration of new technologies into armament platforms is a complex and multi-layered process. 'There is no time for error on the battlefield. War is a matter of heart and will first, weaponry and technology second' (Sullivan, 1993). The Centre for Strategic and International Studies (CSIS) wrote that we are entering an era in which:

> Computers are becoming faster and more ubiquitous, medical breakthroughs are prolonging and enriching lives and machines are becoming smaller by the day today. At the same time, as new technologies become embedded in our lives, we are forced to address issues of ethics, privacy, discrimination, and even basic human interaction. Technology will increasingly test the ability of individuals, cultures and governments to adapt to new opportunities and dangers (2018).

Success or failure of future conflicts will largely depend on how quickly and effectively different available technologies can be used on the current battlefield. All technologies will not have the same effect on the military field, and some will have a significant impact and will condition the future functioning of military systems, military planning and decision-making in the future. By changing the way forces are organized according to the available technologies, 'we may be able to change the speed and extent of combat in the battlefield,' (Orio, 2018). But science and development go ahead in all areas. Some large and rich countries have financial resources and invest in development, while others are looking for alternative solutions and responses to newly developed weapons through the action-reaction system.

The mission of deciding belongs to a human, not a machine

The future generations of military robots will operate more autonomously than comparable devices today, but will they be able to make decisions about life or death? The technology means a lot, but not everything. In Rand, the relationship between technology and human beings has been written as follows:

> Technology cannot substitute for sociocultural, political, and historical knowledge. This knowledge is critical for understanding a conflict, formulating a strategy, and assessing its implementation. There has been a deficit of this knowledge, partly due to a continuing overreliance on technology and a belief that wars can be fought and won by reliance on technology alone. Without sociocultural, political, and historical knowledge, necessarily developed over time, the required adaptations in a strategy cannot be recognized and made (2014).

When we analyse the history of wars and battles, we quickly find out that everything did not proceed in accordance with the 'rules', such as, for example that in order to succeed it is necessary to ensure a ratio of forces of at least 3:1, that technologi-

cal superiority also automatically means victory. For example, in the Second World War, the Nazi German Army was much better equipped than other armies and also used the tactics of 'blitzkrieg'. They developed modern tanks, planes, missiles, an atomic bomb, but despite all this technical advantage, they were not victorious. Similarly, in the Vietnam War where the US had the great technological power, American advantage did not bring them victory. In Afghanistan, the highly modernized coalition troops were equipped with drones, reconnaissance robots and engineering, and on the other side there were poorly armed Talibans and their mine-explosive obstacles on the roads, which caused a lot of victims and material damage. All these examples show that despite military superiority of the one side, a person who is threatened, in distress and under pressure is always able to find an answer and an asset. Humans are the beings who think and actand do not follow some recorded logs as a robot, but they feel, think and react outside such frames. This brings them progress and development in the field of tactics and the use of units, funds and counter-agents. And here humans are irreplaceable and it is the humans' responsibility to prosecute the target.

We will use robots as the soldiers who will always appear first before the dangerous and invisible enemy. Antulio J.Echevarria II wonders:

> What laws and ethical codes will be needed to govern the use of such weapons? What signal or "message" do we send to those on the other side or to the international community when we send machines-rather than our own blood-to protect our interests in wartime (2009)?

However, human will be irreplaceable in the most difficult and most complex environments such as cities and the jungle. If robots' sensors and AI work flawlessly they should recognize and act automatically in front of an opponent or an intruder. What if they will not, what if their sensors receive distorted information and turn on us? The new technology does not only bring advantages, it also brings its' weaknesses that military institutions have to face. This is also confirmed by Van Creveld when he says:

> The greatest victories that have been won in war do not depend upon a simple superiority of technology, but rather on a meshing of one side's advantages with the other's weakness so as to produce the greatest possible gap between the two (1991).

That is why we must understand technological changes and develop doctrinal rules that will solve the future questions of war. Technology should not become a guide, but it must remain useful as a service to use when it is needed, and for the purpose it is intended for. We must not become its slaves, but we must learn how to manage it so it serves us. According to James Andrew Lewis:

> Computers were invented to augment human performance. They are powerful tools, but even as processing speeds increase and algorithms grow more sophisticated, these machines still cannot "think." Eventually, this will change. A group of leading scientists and public figures signed an open letter warning of the dangers of this moment. One famous scientist warned that "The development of full artificial intelligence could spell the end of the human race" (2018).

Soldiers are fighting wars in the name of politics, everything else are just tools and weapons that they use to eliminate the potential enemy and achieve the desired victory. With all these innovations, the attitude towards warfare is likely to change. After all, the question arises of what will be the role of men in the decision-making system, if everything depends on the computer and what will this supercomputer decide to be superfluous.

Conclusion

Increasing power of some countries and the availability of new technologies further increases the complexity of the environment. War and clashes of the past have shown that technology has changed the mode of warfare. Strategies and tactics are changing due to new technologies. These technologies will have an impact on future kinetic and non-kinetic operations. For this reason, today's military planners and developers must think systematically about the possible future development of technology. This process should not be limited to technology but must include possible future weapons systems and military equipment, hybrid threats and social changes that can occur with technological development.

Equipment, weapons systems, tactical and strategic ideas, doctrines and the structures of the armed forces are being changed. The way of complementing the armed forces, the educational structure, age structure, social and sexual structure is changing. On the one hand, the structure of the armed forces reflects the attitude of the society towards them and on the other hand, it represents the needs of the armed forces. Scientific and technological progress has a significant impact on the armed forces. It offers them more efficient mode of operation, better protection against the enemy, simplifying the process of weapons production, allowing greater control of the battlefield and providing improvements that create the difference between defeat and victory. However, this requires well-trained individuals who are able to manage increasingly sophisticated systems. Being trained means not only the physical fitness, but also some mental abilities and the value of knowledge. The scientific and technological advances allow and at the same time require the involvement of highly educated personnel. Scientific and technological progress brings many direct innovations, such as armaments and support systems, into the armed forces, but it also brings indirect changes that arise mainly from the characteristics of the operation of these systems. Modern armament systems require knowledge of the systems and the importance of physical power decreases. Indirectly, scientific and technological progress has led the whole world to become a potential battlefield, which means that there is no clear separation between the front and the hinterland. At the same time, there is very little or no direct physical contact, even less visual contact, the personal image of the enemy is lost. Scientific and technological progress alters the operational, tactical and strategic ideas of the armed forces of the modern industrial states. In order to succeed, we must know very well the abilities and capabilities of technology, their tactical and technical abilities and use it accordingly. This can bring us the advantage and success. The massive and all-around non-intrusive use of technology does not ensure success. As Albert Einstein once said about the explosion of an atomic bomb; 'I know not with what weapons World War III will be fought, but World War IV willbe fought with sticks and stones' (Brainyquote, 2001). This suggests that our technology must remain the same, primitive.

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