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ROBOTICS UTILIZABILITY IN THE ARMY AND IN THE MILITARY LOGISTICS CONDITIONS – ECONOMIC POINT OF VIEW

This essay deals with problem of the utilizability robotic technology in the military conditions. The main aim of the essay is description of rational reasons for introduction and development this technology not only into army but also in military logistics namely. The essay shows economic background of robotics technology, points out not only economic but also military and socio-political consequences of implementation of this technology. The essay indicates an array of advantages for military logistics, too.

Keywords: *logistics, robotics, economic, military and socio-political reasons for implementation,*

Introduction

Historical analysis of the development of military robotics proves it has become clear that the attempt to mechanize, automate or robotize in the conditions of the armies of the national states is not entirely new. Neglecting the first attempts at the beginning of the last century that is represented by radio or otherwise controlled means**.** We can probably consider among the most important moments the use of unmanned means by Israeli armed forces in the so-called First Lebanon War in 1982, during which through a number of imperfections these means have shown the hidden potential, above all the ability to provide valuable information about the real conditions of ongoing combat operations (Fahlstrom, Gleason, 2012, p. 5)

This demonstration of potential capabilities has incited further exploration and development of unmanned vehicles that have entered security and combat operations in full force thanks to the progressive development of technology, changing security conditions and the nature of combat operations. The war in the former Yugoslavia, the attack on the World Trade Center in New York and the declaration of the war against terror (Afghanistan and Iraq) were the stages for the introduction of robotic technology in a new way**.** Especially the last mentioned sphere

has experienced a real expansion of robotic means and systems at the war scene (Singer, 2009, p. 229).

What reasons have led to such development? The answer to this question is not simple and therefore it is necessary to provide a simplified answer.

General reasons for implementation robotics into condition of army and military logistics

Looking for reasons for implementing robotic technology into army conditions including military logistics, it is possible to assume there is an analogy with the reasons that have been critical for the implementation of robotic technology into industry. A short overview of these reasons was presented in Todd in his monograph in 1986 (Todd, 1986, p. 36). He listed the following reasons:

a) saving financial resources,
b) productivity growth, operating time shortening
c) performance quality growth via standardization,
d) performance growth via increasing physical capabilities (especially increase of manipulation skills - larger and heavier objects).
e) elimination of dull, dirty and dangerous work;
f) extension of reachability of places and environment unreachable by humans,
g) performance quality growth via so-called precization (meaning the operations requiring high degree of precision above human abilities).

In the case of military robotics, saving money can be considered on the condition that the cost of the robotic system is lower in its lifecycle than the costs of recruiting, training and retiring human military force. The amount of financial savings is determined by the intensity of the substitution, i.e. the extent to which the soldiers are actually replaced by the robotic system, together with the degree of changes in the technical implementation of the unmanned and manned system.

Higher quality and better recognition ability of sensors and increasing operational capacity of information technology enable robotic systems to acquire and process a larger volume of data than human can, which leads to higher productivity (Singer, 2009, p. 227). . The absence of crew in the case of UAVs offers the ability to move at higher speeds and better manoeuvrability and therefore reduces operating times.

Even standardization, as a reason for implementing robotics, is applicable in the military sphere. While the training of soldiers can achieve high quality, homogeneity, and robust performance, the robotic system, thanks to its character, can achieve almost 100% of its success without any significant external influences. Human factor cannot compete with this ability.

Efficiency growth through expanding physical options has two possible concepts. The first one is associated with so-called exoskeletons, which increase the

soldier's physical capabilities. A soldier is able to carry more weight and further while maintaining the same or even shorter operation time. The second concept relates to UGVs, as the robotic device brings relief to the soldier or extends the durability of his operation (Nakládal, 2008, p.35-38). Critical aspect is also the development of drive unit technology, which will affect the usability of these devices in real combat situations (this is mainly a problem with noise and the duration of the drive unit). At the same time, it is common for both concepts that thanks to postponing or reducing physical exhaustion, the probability of failure and potential loss of a deployed soldier is reduced.

In the case of elimination of dull, dirty or dangerous work, robotic technology does have something to offer even in the army field. In national armies environment the abbreviation 3D is used, which refers to the suitability of robotic technology for Dull, Dirty, or Dangerous work. Although this is a very simplified view, we can mention tracking or guarding activities in the first case, moving in the environment after a chemical or biological attack in the second, and in the third case, it is possible to carry out reconnaissance missions in or over hostile territory, where the risk of losing a human life is very high.

Improving the reachability of places or environments that are impossible to reach by human, such as narrow pipelines, infested spaces, debris after natural disasters or industrial accidents is, thanks to new technologies inspired in the world of nature, a very considerable motive for the further development of robotics in military practice.

Performance growth via so-called precision is a situation including operations requiring high degree of accuracy, which is above normal human potential. Experiments were made to compare the accuracy of shooting at a distant target between trained snipers and soldiers without any particular practice in control of terrestrial robotic systems equipped with a sniper rifle. The accuracy of shooting by remote-controlled robots was surprising (Singer, 2009, p. 86).

It is possible to divide reasons for implementing robotic technology into national armies into several groups that may possibly relate or intersect with each other. Consequently, the arguments for replacing man with robotic technology can be found not only in the military, but also in the economic and socio-political field.

Military reasons for implementation of robotics into the army and military logistics

Military reasons for implementing robotic technologies into the national states army conditions and their use in real combat operations can be found primarily in the need of modernization of the army and, at the same time, in the need to protect a soldier as a martial artist. Satisfaction of these needs can be found thanks to:

a) the growing ability of this technology to fulfil a wide range of tasks and functions that have till recently belonged only to the human subject,

b) the ability to perform these tasks under distinctly various conditions, while maintaining the equal or better results than the soldier or the available technology,

c) the ability to perform these tasks and functions with a significantly lower risk of failure than usual when performed by a professional soldier.

Economic reasons for implementation of robotics into army and military logistics

The economic reasons for implementing robotic technologies into the national states army conditions are connected with the business-economic and national economic level (Olejníček, 2016, p.145). The first mentioned level includes:

a) potentially achievable savings of financial resources,

b) higher productivity considering the provided resources of a given device compared to a human soldier.

In the other level, the aspect is connected with the indirectly created conditions for the economic growth and development of the country. The modern security and defence system prevents potential aggressors from ground attacks. This preventive effect creates the conditions for:

a) business development and investment income,

b) development of a specific part of the national economy, the robotic industry,

c) development of specific part of robotic industry, the military robotic industry.

According to the Spanish study of 2008 done by scientists from the National University of Distance Education and the Institute for the Study of Future Technologies led by professor Peláez, technological inequality is expected to develop during the next 12 years between the countries with access to the robotic technologies and those without it (Peláez, 2008, p. 248). „*Thanks to the enormous automation capacity of robots and their ability to interact with humans, we can expect to see mass hybridization between humans and robots during the next 15 years*. This imbalance can lead to divergent dynamics of economic growth, stability and economic performance, employment impacts, and an even greater increase in the polarization of wealth and poverty in the world. This technological inequity may significantly influence security and defence. According to Professor Antonio López Peláez, we can assume that by 2020 approximately 40% of the armies will be equipped with robotic systems, just as it is in the automotive industry at present times. This will lead to a reduction in human losses during an armed conflict.That may cause a reduction in defence capabilities on one hand, and on the other its increment. Thanks to supporting the development of the robotic industry in all its segments, this technological inequality can be avoided in both the national-economic, and military, defence and security spheres.

Socio-political reasons for implementation of robotics into army and military logistics

The socio-political reasons for implementing robotic technologies into the national army are connected with the governments' responsibility to provide security of state and in this field; robotic technology offers very interesting solutions. In connection with these responsibilities of governments to provide security and defence of their countries, it offers the implementation of military robotics in order to solve certain socio-political problems. The basic phenomenon's are:

a) disgust of the population to be engaged in armed conflicts,

b) increasing intolerance to war losses, both material and human (lives of soldiers and civilians),

c) aging of the population and problems associated with it,

d) declining share of the economically active population as available recruitment potential,

e) deteriorating health status of the economically active population.

Are these reasons strong and clear enough to convince us of the justness of the implementation and further development of robotic technology? Considering the reasons stated above, number of benefits associated with the implementation of robotic technology can be found. Question is, at the same time, is it possible to find these benefits in the military logistics conditions, too?

Specific reasons for robotics introduction into military logistics

Military logistics is crucial for securing army needs both at home both during foreign operations and deployments. There are some reasons of great importance for considering introduction of robotics into military logistic:

a) vulnerability of supply convoys,

b) sustainment troops in war theatre,

c) equipment requirements on the soldier.

There are some interconnection between fuel and water consumption and soldier deaths as a result convoy protection. The supply convoys strongly attract direct enemy attacks or improvised explosive device (IED) attacks. Two studies have stated that the casualty factor for fuel resupplies in Afghanistan is 0.042, which is 0.042 casualties for every fuel-related resupply convoy or almost one casualty for every 24-fuel resupply convoys (Ward, Captain, 2010, p.15; Eady, Siegel, 2009, p. 1-38). It means that costs of resupplying of troops can be calculated not only in financial means, but also in war fighter's lives. Using robotic technology, we can reduce number of death tolls.

The robotics can help to increase distribution speed and quantity of materials, ammunitions, foods for troops. Leaving troops vulnerable and without resources

threatens their performance and efficiency and in the end, it puts soldiers' lives at risk.

The usage of some logistics autonomous system can lighten the soldier´s workload. These means increase soldier speed, stamina, combat vigilance and performance. Less tired soldiers do less fatal errors.

For better understanding of economic point of view on suitability of robotics in the military logistics, it will beneficial to evaluate the level of utilizability and economic impact existing technology.

The usefulness of the logistics robotic and autonomous systems can be plotted using two-axis quadrants. The vertical axis expresses the degree of utilization robotics in military logistics; the horizontal axis expresses the measure of economic impact of robotics implementation in military logistic (see Figure 1.). In this figure, the utilization of robotics is understood as degree of increasing or decreasing performance, vulnerability, effectiveness, efficiency and stamina of troops or warfighters. The degree of economic impact of robotics implementation is evaluated as a level of acquisition costs, unit price, costs savings or saved lives of soldiers /extend of substitution soldiers by robots/.

Figure 1. Classification matrices of the usefulness of robotics in the military logistics

Source: Authors' own figure (*Olejniček, 2018, p. 75*)

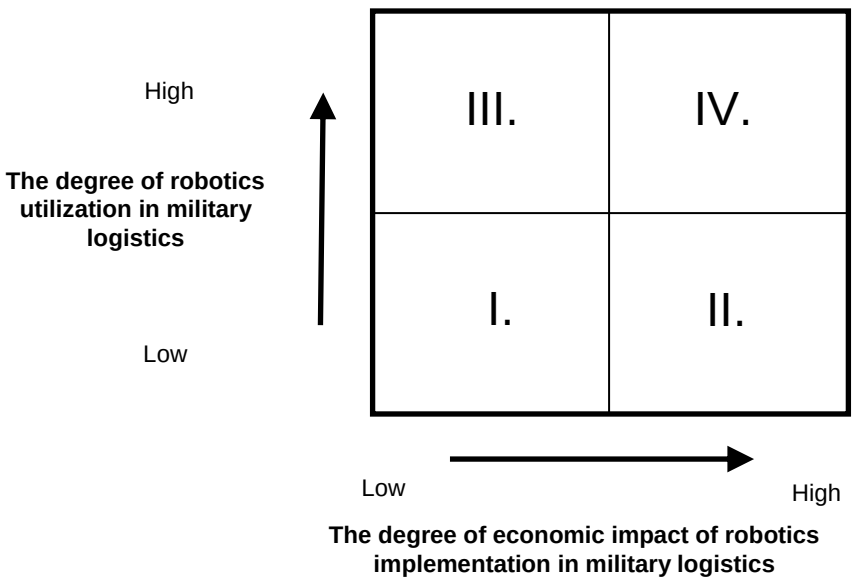

Table 1. Selected examples of existing robotic technology and its categorization in quadrants I. – IV.

Nr. quadrant	Type of logistic robotic system	Example of existing logistic robotic system

I.	Warehouse robots	Handle, Pick (Boston Dynamics)
	Loading robots	Oshkosh PLS (Palletized Loader System)
II.	Supply convoys	Autonomous Aerial Cargo/Utility System (AACUS)
III.	Transportation robots (heavy)	Autonomous Platform Demonstrator (APD)
IV.	Cargo aircrafts	Autonomous Aerial Cargo/Utility System (AACUS)
	Transportation robots (medium)	Squad Mission Support System (SMSS) GE, HDT Global
		Squad Multipurpose Equipment Transport (S-MET)
		LS3 (Boston Dynamics)
	Transportation robots (light)	Big Dog (Boston Dynamics)
		Spot Classic (Boston Dynamics)

Source: Authors' own table

Figure 1. and Table 1. show that usage the robotic technology for logistics purpose has real reasons. However, It is needed to develop this idea by theoretical conceptualization of the separate benefits and obstacles. Table 2. bellow offers some hints for better understanding of problem not only from economic point of view.

Table 2. Reasons and obstacles for robotics implementation into military logistics

Type of logistics robotic and autonomous system	**Fulfilling army requirement on robotics and autonomous systems**					**Implementations obstacles**	
	Minimization of 3D (dull, dirty, dangerous) works	Lightening soldier´s load	Sustaining troops in the theatre	Substitute soldiers by robots	Financial savings from running costs	Technical and energy limitation	Acquisition cost, unit cost, running cost
Warehouse and loading robots	Yes	Partially	No	Yes/ Partially	Yes	Partially	Yes/Partially
Supply convoys	Yes	No	Yes	Yes	Yes	Partially	Partially
Transportation robots (heavy)	Partially	Yes	Yes	Yes	Yes	Yes	Yes
Transportation robots (medium)	Partially	Yes	Yes	Yes	Yes	Partially	Partially

Transportation robots (light)	Partially	Yes	Partially	No	Yes	No	No
Cargo aircrafts	Yes	Partially	Yes	Yes	Yes	Partially	Yes

Source: Authors' own table

Conclusion

Pressure of dynamic security environment, asymmetric warfare, arms races, rogue and falling states, international terrorism, globalization and progress in technology lead to knowledge that national armies no longer will able to provide credible defence and security without sustainable investment in their modernization. One of possible way of modernization and transformation army capabilities is considering robotic technology as potential solution. The article points out reasons, advantages and obstacles, which are tied with introduction and usage robotic technology into army and military logistics. Theoretically is possible to gain many benefits from this implementation. However, we have to be aware of the potential problems, which are connected with reliability of robotic technology and economic consequences of robotics technology acquisition.

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