Zeszyty Naukowe ASzWoj nr 1(110) 2018
War Studies University Scientific Quarterly no. 1(110) 2018
ISSN 2543-6937

CONTEMPORARY BATTLEGROUND AND INNOVATIVE TECHNOLOGICAL SOLUTIONS

Aleksandra DOŁHAN, MA
Akademia Sztuki Wojennej

Abstract

The intense development of informational technology in the second half of the 20th century had a considerable impact on the art of warfare, which visibly benefitted from the development of new technologies and the scale of their application. Discernible new trends that became popular included developing a conception of the future battlefield, departing from violent armed clashes, and introducing dynamic, concentrated actions together with a wide scope of possessed information about the enemy and an operating environment as well as innovative technologies. State-of-the-art technologies have a powerful influence on the development of the contemporary battlefield.

Key words: contemporary battlefield, new technologies, innovation

Introduction

The 20th and 21st centuries were particularly rich in events that facilitated the development of the economy, innovation, and armies. There were numerous transformations that were connected with technological, informational, and telecommunications advancements. Experiments proved that sharing information increases the effectiveness of actions and, therefore, the need for transformation was born. Consequently, modernisation plans and national conceptions were also conceived. Special attention should be paid to the cooperation between civil and military spheres. Over the years, there was a strong demand for changing the way combat strategies are developed and how wars are waged.

Analysing the literature, one comes to the conclusion that closer relations between military and civil spheres are reflected by economic and technological trends. The technological thought and abilities to introduce trends on the market facilitate the competitiveness of industry, science and that of the army. It is no accident that innovativeness, especially technological, is a key element in innovativeness. The army with state-of-the-art, innovative equipment can achieve the height of its power. This is demonstrated by the fact that it can manage knowledge, think strategically, and implement new technological solutions.

Innovative technologies have a considerable influence on the contemporary battlefield. Innovations are perceived in the light of national defence.

Technological advancements contributed to developing numerous conceptions of the contemporary battlefield that require modernisation of equipment and possessing new innovative solutions. Only in cooperation with industry and scientific institutes, can the military acquire equipment that will increase national security.

This research is aimed at determining in what way innovative technological solutions influence the contemporary battlefield. The objective was achieved by answering the following research questions:

How can the contemporary battlefield be characterised?

What examples are there of innovative technological solutions for the contemporary battlefield?

The present study was prepared on the basis of the data provided by the leaders of the international defence industry and an analysis of the specialist literature.

Characterisation of the contemporary battlefield

Undoubtedly, a special role in any transformation process is paid by information, which is in high demand and, therefore, an inherent part of the present day. The importance of these changes is best reflected by Toffler's[1] conception that indicates three waves of societal development of humanity. The modern, third wave describes an informational society which depends on how much computer and telecommunications technology is developed. Most importance is attached to immaterial information that stimulates the development of knowledge, scientific progress as well as the design of new technologies and inventions. Such information is translated into a product or technology that guarantees the desired added value.

The increasing importance of information in the contemporary world and the awareness of the necessity to possess crucial data contributed to creating new global threats, such as the terrorist attack carried out on 11 September 2001 in the USA, and is said to have opened the way to widespread terrorism. Asymmetric threats, which gained in popularity after terrorist attacks, became more common. Asymmetric threats are defined as new, nonclassical warfare tools and methods used by a party to a conflict that is believed to be weaker. The findings show that the term 'asymmetric threats' will acquire a new significance along with an increase in civilisational activity and changes in science and technology. Unfortunately, the negative consequences of such activities cannot be avoided and, therefore, appropriate preparation will be necessary in order to minimalise their effects.

Changes in the contemporary world stimulated changes in the art of warfare and triggered the introduction of new rules, according to which the armed forces should be used. One major breakthrough in this area is a new conception of an operation

1 J. Kręcikij, *Działania sieciocentryczne. Wybrane problemy*, Akademia Obrony Narodowej, Warszawa 2008.

carried out in line with the principles of expected results (effects based operations)[2]. The conception was developed in order to increase the operational effectiveness of countries involved in settling a critical situation while minimising losses and incurred expenses. The conception of an effects based operation assumes that an established objective can be achieved by destroying only selected industrial plants, preventing the enemy from using their resources and eliminating the enemy's command. It is also possible to reduce their combat capability to the extent that they will not be able to continue any armed activities.

Another change involved a revolution in armaments. Most importance is attached here to precision-guided weaponry. New opportunities are created by artillery ammunition, mines, and small arms. Unmanned ships and vehicles are gaining in popularity. Contemporary technological solutions are meant to reduce or minimise the number of crew members. These actions are driven by the desire to reduce losses, economic issues, and the contemporary principle of waging war that emphasises minimising the loss of human life on both sides of a conflict. The breakthrough in armaments is justified, since human beings will not be entirely eliminated, but they can be excluded from the most dangerous missions and tasks where the risk of losing one's life is most likely.

At present, the art of warfare is present in four dimensions: on land, at sea, in the air, and in cyberspace. The fact that this space is four-dimensional was already noticed by the USA in the 1980s. At the time, a modern doctrine of the future battlefield was developed and was called 'the Future Combat System' (FCS)[3]. The FCS project focuses on organisational-functional subjects and aims to implement innovative weapons systems. The guiding principle is maximum automation and robotisation of the contemporary battlefield.

The Future Combat System (FCS), as a future system of managing the contemporary battlefield, is scheduled for 2040 and its cost is approximately 340 billion USD. Over 550 contractors and subcontractors from the USA have participated in the implementation of the project. The FCS involves the following corporations: Boeing, Lockheed Martin, Northrop Grumman, General Dynamics, BEA Systems, and Raytheon, while the scientific-technological contributors are: DARPA and the Army Research Laboratory[4]. The project consists of twelve organisational-functional modules and aims to implement fourteen new, or even innovative, weapons systems using highly advanced technologies and materials. The principal objective of the programme is to complete automation and robotisation of the future battlefield. It aims to develop innovative systems of communication and reconnaissance: unmanned air vehicles, new types of intelligent ammunition, land

2 M. Wrzosek, *Przyszły konflikt zbrojny- założenia teoretyczne*, Przegląd Wojsk Lądowych 2009, no. 1, pp. 14-15.

3 S. Magnuson, *Future Combat Systems Didn't Truly Die*, http://www.nationaldefensemagazine.org/articles/2017/9/26/future-combat-systems-didnt-truly-die.

4 K. Ficoń, *Sieciocentryczność idzie na wojnę*, Kwartalnik Bellona, 2011, no. 1, p. 202.

wheeled vehicles and tracked vehicles, both manned and unmanned. The project also involves developing state-of-the-art systems of soldier's equipment.

The FCS programme is coordinated by Boeing[5] and uses special technologies that belong to advanced tools of software engineering. It was officially approved that the FCS must have self-repair functions that will be used in the event of any problems. In battlefield networks, system crashes are practically unacceptable.

In accordance with the conception of robotisation of a battlefield, telecommunications technologies allow unmanned vehicles to be used in direct clashes on a battlefield. Unmanned planes, vehicles, cars, and combat ships can participate in the most dangerous operations without any problem, which can increase effectiveness. What encourages hope are bomb disposal robots, since they perform and will perform the most difficult tasks related to bomb disposal work without a threat to life and the wellbeing of soldiers.

The main advantage is a collective use of information –a statement from which one can deduce some constant assumptions pertaining to the contemporary battlefield. One of them is precisely sharing all data and information through a reliable network that connects all cooperating forces. Exchange of data and desired information improves quantity, quality, and creates a collective informational awareness. Cooperation and synchronisation are crucial since they facilitate commanding as well as improving speed and effectiveness.

Technological challenges need to be met, first and foremost, by people who should acquire new skills. Human beings will become 'administrators' of state-of-the-art technologies that will perform various tasks for them. The contemporary battlefield involves precision-guided weaponry and electronic warfare.

Innovative technological solutions for the needs of the contemporary battlefield

Modern technologies should render the best visual picture of actions carried out on a battlefield, since they will be used in collecting, processing, and conveying information. Innovative technologies will be able to take advantage of sound and visual information to make themselves more comprehensible and systematically inform soldiers about current changes in a situation. Additionally, they should fully facilitate planning, coordination, and synchronisation of actions thanks to visual simulations, tools, and a synchronisation matrix. Sensors are supposed to see and understand, which is why manned and unmanned combat air vehicles will be equipped with them[6]. Every now and then, American military laboratories create new technolo-

5 M. Ben Hazen, Implications for Structural Design and Information Flow, http://www.au.af.mil/au/awc/awcgate/transformation/oft_implementation_ncw.pdf.

6 A. Nowak, M. Wrzosek, *Projekt organizacyjny systemu rozpoznania w działaniach sieciocentrycznych: praca naukowo – badawcza: kryptonim „RECESYS",* Akademia Obrony Narodowej, Warszawa 2010, pp. 89–91.

gies that can be defined as 'science-fiction'. The soldier of the future is splendidly equipped with the most innovative gear and has a state-of-the-art arsenal.

What follows are the most desired projects that pertain to the combat capabilities of soldiers and machines and are implemented by the leader of the contemporary battlefield.

The main objective of all activities aimed at developing technologies, as previously mentioned, is to provide the full security of soldiers and receive the title of an innovative product. One effective and safe solution is to replace humans with robots or to provide the former with high quality protection in combat. To achieve this goal, the Defense Advanced Research Projects Agency (DARPA) and the Pentagon conduct research whose task is to create a mechanical substitute of a solder and a powerful laser[7]. According to the information available in the media, scientists are working on software for synthetic soldiers that would accompany human beings on a battlefield. Each soldier is expected to have an intelligent avatar that will carry out the most dangerous tasks for them, i.e. it will eliminate the enemy from a battlefield, will evacuate the wounded, and will be on guard in order to protect people. A two-legged robot needs to be intelligent and agile so that it can perform assigned tasks on a battlefield. An avatar will be a semi-automatic machine, i.e. it will be operated by a human being.

The Avatar Programme aims to develop an interface and algorithms allowing a soldier to cooperate effectively with an autonomous machine. It is not clear, however, how a machine will be operated. DARPA claims that the most probable scenario is controlling robots with the use of the brain. Another goal of the Avatar Programme is to create a powerful laser whose task would be to protect equipment and establish details of immediate threats.

One example of the Avatar Programme is reflected by an invention earlier developed by Boston Dynamics, i.e. a humanoid robot called PETMAN (Protection Ensemble Test Mannequin). The machine took the shape of a 90-kilo automatic dog that can move quickly, copes well with gunfire, transporting heavy equipment, and deterring the enemy. Ongoing research on the AlphaDog is carried out in close cooperation between DARPA and Boston Dynamics[8]. The robot can navigate through difficult and dangerous terrain when carrying the load of up to 181 kilograms and can cover 32 km on a single charge. It has its own combustion engine, which powers hydraulic legs. It is equipped with LS3 sensors (Lagged Support System Squad), which can track a specific target while registering obstacles and correcting its heading by itself. Additionally, as the released documents indicate, the research aims to develop voice sensors, which will allow crew members to issue commands. An AlphaDog has one more merit. It can act as an additional power source, since it can charge the batteries of portable devices during patrols.

7 Daily Mail, *Wojsko przyszłości może składać się z żołnierzy o nadludzkiej sile..,* www.tech.wp.pl.

8 M. Sznajder, *Mechaniczny muł pomoże wojsku*, https://www.tvn24.pl/wiadomosci-ze-swiata,2/mechaniczny-mul-pomoze-w-armii,276309.html.

Another innovative solution is an anthropomorphic exoskeleton, which was created in order to enhance the combat mobility of infantry units and avoid injuries to soldiers caused by carrying heavy equipment. The solution was developed by Lockheed Martin laboratories and is called HULC[9]. Thanks to it, human beings can transport 200 kg and, most importantly, their mobility is not limited. Soldiers' movements are not restricted and they are fully operational. One advantage is that it is not necessary to additionally control an exoskeleton, and the synchronisation of human movements is guaranteed by a microcomputer.

The most popular system for the soldier of the future is Land Warrior, thanks to which a soldier can see through walls, obstacles, determine the location of another soldier with an accuracy of 10 m, navigate through darkness, or shoot at a target without taking aim. Land Warrior is controlled by a minicomputer, which is stitched into a soldier's vest[10]. It is Windows or Linux based and is equipped with an Intel processor. It coordinates communication between the headquarters and soldiers on a battlefield. Also, it provides access to satellite maps and a view of a battlefield. Additionally, it supports GPS. A view, command, map, or a weather forecast for an area of military activity is transmitted to a screen-eyepiece, which is positioned over a soldier's eye. 'A computer eye' is not the only way a soldier can receive desired information. The other is a helmet with a head-mounted camera. The monitor displays a picture from a thermographic and infrared camera. The helmet has one more merit. It can act as a GPS receiver because it has a built-in antenna and allows a soldier to be located with an accuracy of 10 m. In the event of a GPS receiver breakdown, it has a pedometer, which indicates a direction and place where a soldier can go after a receiver breakdown.

The weaponry is also innovative and was enriched with a laser that allows targets for rockets to be pinpointed and for shooting on target. Arms also have cameras which allow video recordings to be transmitted and feature a zoom that enlarges a target. Additionally, a thermographic camera enables the enemy to be observed in darkness or when a person is hidden behind an obstacle.

Unmanned combat air vehicles are not a novelty, and they are being introduced by armed forces around the world. Notwithstanding their small size, they have enormous capabilities. Their 'pilot' is safe at a military base. A remotely controlled robot, or rather a drone, can take high quality photos and send them to the headquarters thanks to the equipment it has. Some drones that are better suited to combat operations can carry arms.

That is why global military concerns do not exclude developing this technology, and DARPA has already begun constructing the TERN (Tactically Exploitative Reconnaissance Node)[11]. They will act as destroyers, for instance, whose task will

9 Ibid.

10 M. Borycka, *Czwarty wymiar nadchodzi, poszerz swoją rzeczywistość,* www.pcformat.pl.

11 K. Artheron, *DARPA's new drone wants to cover the sea with air suport,* https://www.popsci.com/darpa-new-naval-scout-drone.

be to relay information between planes and ships. This is an important issue for the Pentagon.

Another example are air vehicles, which have existed for years and are now becoming more popular again. Lockheed Martin have developed a few innovative projects; the first one is a Hybrid Air Vehicle. This vehicle was conceived as a multipurpose unit that can act as a manned transport vehicle and an unmanned spy air vehicle. The machine can hover at an altitude of 6,000 metres for three weeks, and, thanks to numerous sensors cameras, it can conduct observations from any place. A more sophisticated example, however, is ISIS (Integrated Sensor Is Structure). It is powered by energy generated from renewable energy sources. Placed in the stratosphere, it is supposed to track ballistic targets that are 1,500 km away, targets in the airspace within 520 km, and ground targets within 260 km. A control unit will become standard in the American Armed Forces in approximately 10 years' time[12].

Another idea to be implemented between 2025 and 2030 pertains to the creation of supersonic aircrafts and bombers. Created for the sole purpose of destroying ground targets and fighting with other planes, these unmanned and manned machines are supposed to be invisible to radar. Two concerns are involved in the project: Boeing and Northrop Grumman. One brilliant example is X–47B[13], which will be able to take off and land on board an aircraft carrier. In order to reduce the radar cross section, it was designed as flying wings that can be folded. A plane's fuselage has bomb bays and hardpoints under its wings to carry additional armaments and fuel tanks. The first test of this machine was carried out in 2011; it was highly successful.

At present, DARPA conducts research on constructing a large electromagnetic (kinetic) cannon placed under an upper part of the machine. Its task would be to destroy supersonic missiles and launch military satellites into orbit. A cannon will become an essential element of the American fleet's artillery. The principle of its operation consists in transmitting electricity to a barrel, which will create an electromagnetic field, which will affect rails and any missile they carry. A missile will weigh a few kilograms and will not contain any explosives. Kinetic energy itself is supposed to be enough to destroy targets, and its force will be overwhelming. The weapon is safe for ships because it does not contain explosives.

Tanks are also evolving. These are no longer mere steel shells but vehicles equipped with numerous computers, able to connect to the Internet, and automated with remotely controlled armaments. The most digitalised tank in the world is Abrams M1A2 with the TUSK (Tank Urban Survival Kit) modernisation package.This tank is equipped with an optically stabilised system of observation that can be used during the day as well as at night and functions in visible light and in infrared. The data on a distance and a currently tracked object received from a ballistic computer is

12 Ibid.

13 J. Plaza, *Amerykańska bitwa o przestworza: czy drony zastąpią F-35?*, http://nt.interia.pl/raporty/raport-wojna-przyszlosci/lotnictwo/news-amerykanska-bitwa-o-przestworza-czy-drony-zastapia-f-35,nId,1548732.

inputted into this system. All information necessary to perform tasks is displayed on the screen, and satellite as well as radio connections are used to relay data between vehicles and headquarters. When identifying a target, one can count on the software that detects enemy vehicles while a controlled cannon sets itself on the target. The observational system of a driver allows a night vision image to be displayed on the screen, relaying a picture of the surroundings to a commanding officer. A tank that is equipped with terminals of a battlefield management system enables visualisation of a current tactical situation.

The principles of the most state-of-the-art military technology are supposed to facilitate soldiers' actions and ensure their safety. The examples presented above are aimed at revolutionising the equipment that will be used by the army of the future. We cannot run away from robotisation of the armed forces. However, it must be remembered that this project is time-consuming and outstandingly expensive. We have to wait until all the planned technological novelties will be introduced in the army. Still, it must be remembered that the army needs to be innovative. First of all, it is part of the modern battlefield and the principle of the art of warfare which states that the number of victims should be minimised on both sides. Secondly, it challenges the stereotypes of wars involving heavy-armoured troops and opens armies to technological novelties and cooperation with scientific centres and industry. Such actions stimulate the economy and improve the security of a country.

Summary

Innovative technologies are the most important element of the contemporary battlefield. The activity of American scientific-research centres and military organisations supports the thesis that innovative technologies have a great impact on the development of the contemporary battlefield. I strongly believe that these works are connected with technological solutions of the highest quality. Developing new plans, modernisation of the present equipment moves towards automation and eliminating threats to soldiers' lives. It is important to note that the development of the contemporary battlefield is influenced by technology.

Technological development, changing global trends, and the global economic situation triggered transformations in the art of warfare. Changing strategies for waging wars, the development of weaponry and technology originated new laws of war, according to which the number of victims on both sides must be reduced. This idea gave birth to conceptions and strategies for managing the contemporary battlefield. Skilful handling of information and managing knowledge led to technological progress in military science. The leader of the arms race is undoubtedly the United States. The authors of contemporary battlefield management are developing a conception of automating a battlefield. The consortium of the largest American armament companies and scientific-research centres is working on plans and principles that will improve the position of the American army and ensure

soldiers' safety. If these principles are successfully implemented, new technologies will be ground-breaking. The above examples prove how convenient and safe this equipment is supposed to be. Full automation will not only help human beings but also will ensure effectiveness. Furthermore, soldiers will be so well-equipped that they will perform their tasks in a more effective and safe manner.

Innovations have considerable importance in military science. They make the army more prestigious, facilitate the work of a human being, and, first and foremost, they are safe. Modernising old equipment and introducing new armaments is unavoidable. In order to face global challenges and prevent increasing threats, countries need to invest in new technologies that will ensure safety in every area of the contemporary battlefield.

Bibliography

Bartosik-Purgot M., *Zachowania konsumentów. Globalizacja, nowe tecnologie, aktualne trendy, otoczenie spoleczno-kulturowe,* PWN, Warszawa 2017.

Ficoń K.*, Sieciocentryczność idzie na wojnę*, Kwartalnik Bellona, 2011.

Kott Alexander, *Battle of cognition; the future information- rich warfare and the mind of the commander*, Preager Security International, London 2008.

Kręcikij J., *Działania sieciocentryczne. Wybrane problemy*, Akademia Obrony Narodowej, Warszawa 2008.

Milarczyk Z., *Nowoczesne technologie systemu uzbrojenia*, WAT, Warszawa 2011.

Nowak A., Wrzosek M., *Projekt organizacyjny systemu rozpoznania w działaniach sieciocentrycznych: praca naukowo-badawcza: kryptonim „RECESYS",* Akademia Obrony Narodowej, Warszawa 2010.

Wrzosek M., *Przyszły konflikt zbrojny- założenia teoretyczne*, Przegląd Wojsk Lądowych 2009, no. 1.

Internet sources

Artheron K., *DARPA's new drone wants to cover the sea with air suport,* https://www.popsci.com/darpa-new-naval-scout-drone.

Borycka M., *Czwarty wymiar nadchodzi, poszerz swoją rzeczywistość,* www.pcformat.pl.

Hazen Ben M., Implications for Structural Design and Information Flow, http://www.au.af.mil/au/awc/awcgate/transformation/oft_implementation_ncw.pdf.

Magnuson S., *Future Combat Systems Didn't Truly Die*, http://www.nationaldefensemagazine.org/articles/2017/9/26/future-combat-systems-didnt-truly-die.

Daily Mail, *Wojsko przyszłości może składać się z żołnierzy o nadludzkiej sile..,* www.tech.wp.pl.

Plaza J., *Amerykańska bitwa o przestworza: czy drony zastąpią F-35?,*http://nt.interia.pl/raporty/raport-wojna-przyszlosci/lotnictwo/news-amerykanska-bitwa-o-przestworza-czy-drony-zastapia-f-35,nId,1548732.

Stręk T., *Nowe podejście do działania dzieła kinetycznego* ,http://www.strek.strefa.pl/students/mes/mesopr101214f.pdf.

Sznajder M., *Mechaniczny muł pomoże wojsku,* https://www.tvn24.pl/wiadomosci-ze-swiata,2/mechaniczny-mul-pomoze-w-armii,276309.html.