

## ON ASSESSING THE IMPACT OF EMERGING TECHNOLOGY ON THE ARMED FORCES OVER THE NEXT 10 YEARS

*The article outlines the main emerging technologies that will have the greatest influence on the Armed Forces of the advanced countries over the next 10 years. Based on the analysis of the main areas of development of these emerging technologies, it is concluded that the most probable is the further improvement of existing technologies with the parallel increase of the influence on the Armed Forces of such technologies as cyberspace, autonomous (robotic) systems, and weapons of direct energy transmitter of energy. It is concluded that over the next ten years, further transformation of combat operations from the classical, built on the theory of the war of Clausewitz, into non-traditional, hybrid combat operations, which more closely correspond to the theoretical works in the field of military art had expressed by Sun-Tzu, will take place.*

**Keywords:** Armed Forces, emerging technologies, doctrine, balance of power.

### The introduction

Over the next 10 years the emerging technologies such as cyberspace, autonomous systems, direct energy transmission technologies and even the combination of existing ones will greatly affect the military capabilities and the doctrines of the Armed Forces, and even the balance of power in the world. However, for transferring the emerging technologies into weapon systems needs takes some time.

Based on an analysis of existing trends, it can be assumed that over the next 10 years period the armed struggle grounded on the transfer of kinetic energy will remain the main form of rivalry, but, on the other hand, emerging technologies and combinations of existing ones, due to the reduction in mass-dimensional characteristics of weapons, to simultaneously increasing destructive ability of new types of weapons will lead to improve tactical and technical characteristics of weapons.

**Formulation of the problem.** At present, considerable attention is paid to assessing the possible impact of the emerging technology on the Armed Forces and the nature of future conflicts. However, these studies do not assess the possible impact on a certain period of time. Therefore, the article seeks to assess the possible impact of the emerging technology on the Armed Forces and the nature of future conflicts over the next 10 years.

**Analysis of literature.** Today, the great attention of the leading arms manufacturers of the world (the USA, China and Russia) is focused on creating new weapons that will allow them to dominate over the world. The achievement of this goal is possible through the creation of new weapons or the improvement of the existing one. We can predict about the enormous impact of emerging technologies on the Armed Forces in the near future. Already today, emergent technologies change the ways in which combat operations are conducted by the Armed Forces, the doctrines of their use and the balance of power. However, in their publications, the authors do not consider the impact of technology on the Armed

Forces in the next 10 years, nor does it fully assess the possibilities to improve the characteristics of existing weapons.

**Purpose of the article.** To define the idea of emerging technologies, the sufficiency of a ten-year period for the emerging technologies to radically change the Armed Forces. Assess the impact of emerging technologies on the combat potential of the Armed Forces, on the doctrines and the influence of emerging technologies on the balance of power.

### FIELDS OF EMERGING TECHNOLOGY

For an assessment of the impact of emerging technologies on Armed Forces during the next 10 years, it is necessary to define what type of technologies are emerging (give the definition of the emerging technologies and identify the most important part of them). Moreover, it also would be interesting to gauge the possibilities for the implementation of such technologies in armament over the next 10 years.

When it comes to emerging technologies it is implied, that these technologies are completely new, their impact on the character of future conflicts is unpredictable and the dynamics of their development indicate their rapid growth and possible significant consequences over a considerable period (Daniele Rotolo, 2015)[9].

If we analyze the emerging technologies that are consistent with the above-identified assets and that might have impact on the nature of Armed Forces in the foreseeable future, we would highlight some of the most important parts of them: (Raytheon, 2016) [27], (Jitendra S. Tate, 2015)[15]:

- Cyberspace;
- Autonomous systems (Robotic systems);
- Direct energy transmission technologies;
- Nanotechnology;
- Biotechnology;
- Artificial Intelligence and Intellect.

In addition to these above-mentioned technologies, it is also interesting to note the issue of existing technologies and combination of them, that with their

complex use and with relatively insignificant resource costs can considerably improve the qualitative characteristics of existing weapons.

Cyberspace (a space that exists in the virtual world and is built on information) has significantly changed the conduct of combat operations and has a huge impact on real aspects of the world now. Covering all spheres and management processes of human life Cyberspace allowed achieving huge effects with low costs. Cyber-attacks undermine the confidence in the banking system of many states, break down nuclear plants, turn off electro stations, and affect the minds and hearts of entire nations. The influence of cyberspace and conducting operations on the armed forces in it for the next 10 years will only be increased (Geers, 2015)[12].

Among the technologies that directly transfer energy, various kinds of electromagnetic energy emitters (laser and electromagnetic guns) are being used. Today manufacturers have announced the creation of different armament based on this technology. The leading developers (General Atomics, BAE Systems) are testing weapon samples on new physical principles of land, air and sea-based aiming the destruction of mines, shells, un-manned aircraft, marine and ground systems and deactivating of all existing electronic systems. Electromagnetic munitions were used in the Gulf War to suppress virtually all radio electronic facilities operating on the principle of receiving and converting electromagnetic waves (Nass, 2007)[22]. Within the future 5-6 years period Electromagnetic rail-gun fires is believed to go into service with the US Navy (O'Rourke, 2017)[24]. General Atomics Aeronautical Systems announced the creation of a tactical combat solid-state high-energy laser which is capable of destroying drones and small marine boats and which will be a base for short-range defence system for military ships (Warwick, 2015) [32].

Autonomous systems (Robotic systems) are fully capable of performing the functions of a soldier (human presupposition is necessary only for the performance of management and control functions) during warfare. Such robotic systems, as unmanned aircraft, marine and ground systems have already significantly changed the nature of combat operations. If on the one side, we have an ordinary soldier with his fragile biological structure, which does not allow increasing speed, acceleration, maneuverability, depth and height of the use of military systems, the modern autonomous robotic systems on the other side don't have this shortcoming. The robotic systems enable to increase the depth of reconnaissance on the enemy territory, significantly improve the speed of obtaining intelligence information, and accelerate the accuracy of fire support and, most important-ly, the ability to reduce the number of losses among own forces and the population. The significant influence of robotic systems on the character of contemporary conflicts will be kept up in the next 10 years (Кричевский, 2016) [40].

To replace a person in the decision-making process, robotic systems must possess the required intelligence. The ability of machines 'to think', 'judge' and 'behave' like a human is the main task of

arms manufacturers all over the world. Today, most advanced Armed Forces are using decision support systems that are able to offer best solutions in accordance with the current situation. If during the next 10 years period, this technology will be able to shift to the level of creating an artificial intelligence, this would represent invaluable military means. However, in connection with the huge demands on the computing power together with its expensiveness the number of such funds in the Armed Forces will be limited.

Nanotechnology, that is used to create materials with required structure at the level of nanometers had already allowed to generate materials with qualities that are not inferior to exist; some of them such as hardness, resistance to rupture and thermal conduction are better than existing natural analogues (Wiśniewski, 2007) [36], (V́ctor M. Castaño, 2013) [34]. During the period of 2010-2012 armoured vests with the use of materials based on nanomaterials (carbon nanotubes) were created, which by their characteristics significantly exceed existing analogues (Tiwari, 2012) [31]. In the next 10 years, nanomaterials will create an ability to produce weapons with much smaller weight and dimensional characteristics. However, the estimated price of such materials together with their limited number, will not allow a significant influence on the Armed Forces during the upcoming years.

Technology aiming to improve the quality of living organisms, with assistance of other living ones (biotechnology) is already used in modern medicine. Regeneration of non-functional limbs is one of the successful achievement. (Bionics, 2009). Working process of how to create other parts of human body is still ongoing and this is believed to allow the full restoration of lost or damaged parts of human organism within the next 10 years period. However, as in the case of nanomaterials, the price of such technologies is enormously high and therefore the possibilities for their implementation are limited so far.

Over the past few decades, the significant shift of thinking in modern science and technology made it possible to improve existing technologies. Mobile phones, these smart de-vices with implemented technologies in of transmission and reception of electromagnetic waves, information processing, coding and decoding and displaying them on the screen are the most significant example of the symbiosis of existing technologies with their highly improved quality characteristics.

A brief look at the 'life cycle' of armament enables us to assess the impact of emerging technologies on Armed Forces. It is a time from the moment, where technologies emerged to the time of arriving of the new weapons built on these emerged technologies to the arsenals of Armed Forces (Daniele Rotolo, 2015)[9]. The implementation of achievements of emerging technologies in exciting armament or the creation of new type of weaponry needs a time. For example, the creation and placement on the Global Positioning System that allowed the implementation of navigation technology took about 15 years (Mai, 2015)[20]. Only after 22 (from creation to its mass production) years the F-22 fighter aircraft could use

the "STEALTH" technology (Boeing, 2014).[6] The creation of anti-tank missile system AT-14 "Spriggen", with its implemented laser targeting technology took exactly ten years, and the creation of a bulletproof vest on the basis of nanotechnology took about 9 years. Consequently, a ten-year period is the minimum requirement and in most cases insufficient for systemic changes in the Armed Forces.

Thus, from the technologies listed above, the cyberspace, robotic technologies, weapons of direct energy transmitter, as well as a combination of existing technologies (Mattsson, 2015) will have the most potent quantitative, qualitative and cost indicators. Mutual penetration and additions of existing technologies will create new quality and improve the tactical and technical characteristics of weapon systems, although the emergent technologies will affect the Armed Forces only if they will be successfully implemented in new weapon systems and armament.

### MILITARY CAPABILITIES

The technological level of armament is one of the components of the military capabilities, together with the structure of the Armed Forces and their readiness to conduct combat operations. In the future 10 years perspective, as a result of the introduction of new systems on the basis of emerging technologies there definitely will be changes in the military capabilities of the Armed Forces (Ashley J. Tellis, 2000). [1]

During the Second World War, the possession and availability of radar technology enabled the Royal Air Force, with information on take-off and flight direction together with significantly fewer aircraft to inflict considerable damage to the Luftwaffe and ultimately win The Battle of Britain. De-ciphering the codes of control channels allowed Allies to sink a considerable number of the Kriegsmarine submarines during The Battle of the Atlantic. The possession of computer technology and the creation of advanced automated computer-based control systems contributed to NATO, winning the Cold War with the USSR. The possession of nuclear weapon technology and its usage resulted in changing the balance of power in the world and forced imperial Japan to sign an agreement of capitulation.

The tactical and technical characteristics by using existing technologies and their new combination will be greatly improved in the next 10 years period. However, the main method of struggle will remain a physical armed struggle based on the transfer of kinetic and electromagnetic energies for the destruction of enemy troops by its weapons, military equipment, facilities and environment (Slipchenko, 1999) [29].

Further increase of combat capabilities concerning the accuracy of the target acquisition, due to the use of global positioning systems, unmanned systems, new nanomaterials, should lead to a reduction the number of de-vices to be engaged to destroy a target, to a significant increase in its payload and destructive power, to a higher survivability and protection (Lambeth, 1997)[17]. It is planned, that for 2027 in the arsenal of the USA, Russian and Chinese Armies will be a significant number of robots that will operate before and on the frontline with the soldiers.

The development of microelectronics will

significantly expand the possibilities for further development of new types of precision weapons and weapons on 'new physical principles'. They will be built on the most advanced ultra-high-speed, ultra-large integrated circuits and ultra-sensitive sensors of different frequency bands. The new nano-materials with the new element base of radio electronics will allow creating control and guidance systems and of high-precision armament much less and easier than now, and thus several times to increase the effectiveness of the warhead without increasing the power of the rocket's power plant.

New weapons and military equipment will not only sharply increase the combat capabilities of the Armed Forces, but also radically decrease the quantity of them, change their composition, structure, the character of conducting combat operations and the nature of possible wars (Loo, 2009)[18]. Participation in the armed struggle with a large number of different offensive and defensive weapons based on the emerging technologies will complicate the nature of this struggle (Gerasimov, 2013)[13].

In order to change military capabilities the emerging technologies, in case of their realisation, should have the same significant consequences and impact as it was the case of nuclear technology. Besides this, the numbers of new weapons of destruction need to be significantly large as for example it was the case with tanks and aircraft. Besides, the development of appropriate methods for the use of new armament bears high importance as the lack of understanding and possibilities of new technologies leads to catastrophic effects. In the beginning of World War II, for example, the Soviet army in spite of having a large quantity of high-tech armament lost all initial battles.

The impact of emerging technologies on the military capabilities of the Armed Forces is not limited. In the next 10 years, new weapons systems, in which today's emerging technologies will be implemented, will significantly change the doctrine, but the latter in turn will significantly affect the emerging technologies (Blasko, 2011).[5]

### ARMED FORCES, EMERGING TECHNOLOGIES AND DOCTRINES

The US and Russia set themselves the task of being able to conduct an operation anywhere in the world and strike on any object within a timeframe one hour after taking the decision to engage (Woolf, 2017) [37]. Being the second largest economic power after the United States, China has a huge gap in high-tech weapons compared with the US. Understanding its considerable gap with the advanced powers in high-tech weapons, China is trying to implement Anti Access Anti denial (A2/AD) based on the existing technical level of weapons (Ou, 2014) [25]

Today the US is the world leader in the economy and politics. The US military budget in 2016 exceeded the military expenditures of the five states following it taken together (SIPRI, 2017) [28]. As the world leader, the United States set itself a global goal to dominate all corners of the world. For achieving this ambitious goal, the US must have the most advanced Armed Forces in the world that in turn is a result of equipping them with the most advanced systems of

armament. These goals set new tasks for the scientific and industrial complex of the US to develop new types of weapons and, accordingly, the development of new technologies. To meet these requirements, the country is developing the Conventional Prompt Global Strike pro-gram, which will be based on hypersonic de-livery and defeat systems (a combination of existing technologies resulting to creation of new weapons systems with new qualities) (Blasko, 2011) [5], (Woolf, 2017) [37]. New systems (the X-37B, the RQ-4 Global Hawk) have been already tested. Adopting such systems in the Armed Forces within the next 10 years will create the possibility to implement the requirements for applying a precision strike anywhere in the world.

Russia with its army modernization plan until 2025 is the second example of mutual impact of doctrine and emerging technologies. Setting itself the task to be back to the world leader's club, Russian leadership is considering the possibility of realizing this task through deep military reform, using a military modernization program like locomotive of economy, and the creation and rearmament of its Armed Forces with new weapons (Bukkvoll, 2011).[7] The development of technologies is a consequence of growing demands of Armed Forces. To the end of 2020, Russia's Armed Forces will possess nearly 70 % of modernised armament and by 2025 all Armed Forces will be modernized. (Petraitis, 2015) [26].

The basis of the military doctrine of Beijing is inseparable from the theoretical works of Sun-Tzu and traditional Chinese culture who aim to win the war without a single battle. Achieve victory even before the first shot is the main desire of the modern Armed Forces. To accomplish this, it is planned to widely use cyber operations and new high-tech weapons (Newmyer, 2010)[23]. In accordance with the views of the military leadership of China, in future wars the knowledge and the skills of the soldier will be the decisive factor of victory. In China's military thinking the future war will be technological and be accompanied by the massive application of modern radio electronic means and precision weapons. Having only advanced technologies would not be enough to win in the future war. Unconventional thinking, the ability to make quick and non-standard decisions will always defeat the enemy's high-tech forces, because no matter how high-tech the enemy is, he might have weaknesses on which it is necessary to strike (Blasko, 2011). [5]

China's political and military leadership is carrying out a series of measures aiming to develop and create new weapons (aircraft J-20, aircraft carrier Liaoning), with the high use of technologies obtained from Russia (successful production of the Russian Su-27 clone) (Cheung, 2016)[8]. So, the creation a new J-20 fighter and aircraft carrier Liaoning similar to which the Chinese People's Army has never had before, will take at least 5-6 years to change and develop the doctrine, to assess possible changes and to take into account the new capabilities of these systems (Кривопапов, 2016) [39]. New technologies, being the driver of military reforms, lead to optimizing the number of the Chinese Armed Forces, changing their structure from quantitative indicators to qualitative

ones, influencing on command and control system and changing the doctrine of the Chinese Armed Forces (Blasko, 2011) [5].

Mutual impact of emerging technology and doctrine of China can be seen on its A2/AD concept. Having bitter experience of the negotiation with Taiwan in 1996, when American's aircraft carriers were sent to the area to improve this relationship (Ou, 2014) [25], the basis of the China's A2/AD will be the anti-aircraft ballistic missile DF-21D (Кривопапов, 2016), which is an example of using existing technology to change and improve submarine's ballistic missiles for new purpose. Realizing the existence of a huge gap in military technology compared to the US, China's political leadership tasked of the industry to decrease this gap by modernizing existing armaments and creating new ones (Ou, 2014) [25].

Having a significant backlog in the development of military science and technology, China's leadership relies on the development of domestic emerging technologies and the receipt of emerging technologies from other countries (Defence, 2016)[10], primarily from Russia (Cheung, 2016)[8]. New high-tech weapons systems define China's modern doctrine and in the next 10 years period with the introduction of new, high-tech systems and complexes, this trend will carry on.

Within the next 10 years, the mutual influence of emerging technologies and doctrines will be strengthened and will be determined by the geopolitical goals of the state and the level of development of science and technology of these countries. The US and Russia are setting themselves the goal of geopolitical domination, developing doctrines in accordance with which the Armed Forces are tasked to carry out an operation anywhere in the world. For the implementation of these goals, the Armed Forces of both countries will try to receive the most advanced weapons in the next 10 years period. Thus, the Doctrines of the United States and Russia determine the requirements for the capabilities of the Armed Forces and, in turn, the Armed Forces determine the requirements for emerging technologies.

However, as in the case of the Chinese nuclear program, when, as a result of technology diffusion from the USSR, China obtained the technology of creating nuclear weapon and became a member of the nuclear club, the emerging technologies can not only affect the doctrine but can also influence on the balance of power in the world.

#### **ARMED FORCES, EMERGING TECHNOLOGIES AND THE BALANCE OF POWER**

Today, the world order is determined by the Westphalian system of international relations in which the state-nation is the basis of the system. The relations between states are built on the principles of national state sovereignty and non-interference in internal affairs of other sovereign states, on the priority of national interests and the principle of the balance of power (Beaulac, 2004). [3] Possession of technologies for creating nuclear weapons is the main driving force of the existing world order.

Attack on the US on 9/11 showed that in-

ternational terrorism, concentrated in the Islamic countries, challenged the world dominated by the US. With the outbreak of the war in Afghanistan, the US Armed Forces started fighting with an adversary whose organization did not have a hierarchical structure. The nature of the fighting in Afghanistan and Iraq showed that the US and its allies faced with such non-linear adversaries. It can be certainly said that, the Armed Forces of the US started the first non-linear war between the state and non-state organization. (Иванов, 2008) Traditionally, the military is organized in accordance with a strict hierarchy from the general and down to the soldier. Unlike them, networks straighten the command structure. This proves the growing strength of networks as a threat to the USA national security and the existing balance of power in the world (Baluyevsky, 2012) [2].

The terrorist organizations conducted asymmetric military operations and targeted the political will of the enemy, rather than his military power (Иванов, 2008). They are distributed, dispersed, active and mobile, acting impromptu, widely used the Internet for propaganda, searched for the new recruits and realized the concept of the asymmetric war. Asymmetric warfare is the battle of numerous and organized small units, against conventional military forces, which are structured into large formations (Иванов, 2008). This makes them effective and difficult to track and destroy. Losing the conventional war, the international terrorist organizations launched the operations in the battlefields of cyberspace.

The 10 years' experience of using cyber-space (perhaps the most significant one from emerging technologies) illustrates this technology has significant advantages over the conventional means of destruction. Today the cyberspace has changed the course of military operations and in the next 10 years, its impact on the Armed Forces and therefore on the balance of power will only be increased with an effect not less than the effect of creating nuclear technology.

'[...] cyber technology have allowed to create a completely new type of weaponry, which has no analogues in world history and the next war will begin in cyberspace' (Kissinger, 2014) [16].

For example, in November 2009 American and Israeli military specialists conducted an attack using the malicious computer program Stuxnet against the Iranian company in Natanz, which resulted in the disruption of more than 20% of the functioning centrifuges (Wirtz, 2015) [35]. In the opinion of Israeli experts, the damage caused was no less than if the physical operations for the destruction of centrifuges using conventional weapons had been carried out (Wedermeyer, 2012) [33].

In case of Russia, Gerasimov's doctrine defined new forms and methods of warfare in which cyberspace has priority (Gerasimov, 2013) [13]. During the operations by Russian cyber special services to stop the provision of power supply systems for the population of western Ukraine in 2015, two out of three electricity supply stations were put out of operation, as a result 230,000 people were without electricity for a considerable period of time (Geers, 2015)[12].

In contrast, even with nuclear deterrence, cyber-

attacks cannot be prevented. Their results are visible only after a successful attack on vital objects. Today, a small organization of well-trained professionals located in different parts of the world, with relevant knowledge and skills can be a very powerful fighting unit. In such a situation it is extremely difficult to agree on common rules (as it was done in the case of nuclear weapons) and deterrence principles. But what is happening now makes us think about fundamentally new principles of organizing the world order.

Given the fact that North Korea and Iran widely support all kinds of terrorist organizations around the world, the likelihood of such technologies to be disposed into the hands of leaders of such entities is high.

Thus, emerging technologies such as cyberspace and the proliferation of nuclear technologies will make it possible in the next 10 years to shift the focus of strategic rivalry between states in the field of competition between the state and non-state (semi-state organizations).

The importance of cyberspace as a means of achieving their geopolitical goals and therefore aiming to at change the existing world order is perfectly understood by Russia and China.

Accordance to Gerasimov's doctrine '[...] it is necessary to carry out asymmetric actions for remote impact on the enemy, to destroy his facilities throughout the entire territory, to neutralize the enemy's superiority in the armed struggle' (Gerasimov, 2013) [13].

Right now, Russia is waging wars for the minds and hearts of the Russian and other population using computer networks («in contact», «odnoklassniki»), aiming to realize the concept of victory without a battle (Crimea).

The leadership of the Chinese People's Army also attaches great importance to the ability to influence the balance of power in the world and especially in the Indo-Pacific region. Deterrence of China, is reduced to the resolution of military situations by non-military means and the implementation of concepts of victory without a battle and victory before entering the battle (Newmyer, 2010)[23], which were voiced by the Chinese philosopher Sun-Tzu. Cyber deterrence of China is a strategic tool, and because of the significant consequences that may result from attacks on vital systems of support for society and control systems, the initial phase, hidden in cyberspace, will have the decisive role in achieving victory over the enemy (Ou, 2014) [25].

At the same time, the consequences of the cyberspace clashes will even exceed the consequences of conventional military operations using high-precision weapons and their destructive power. Given that such clashes will not lead to direct human losses, it is possible to assume with a high probability that such operations will precede in the foreseeable future, and subsequently supersede conventional military operations.

## CONCLUSION

The Armed Forces, prepared and trained to war using the means and methods of conducting past wars, are doomed to failure before the outbreak of hostilities. The high technological level of the Armed

Forces is one of the conditions for creating superiority over the enemy. Emerging technologies will make it possible to conduct almost contact-less operations, in which Armed Forces should be prepared for conducting operations in all relevant dimensions, air, land, sea, space and cyberspace.

Over the next 10 years, emerging technologies such as cyberspace, autonomous (robotic) systems, weapons of direct energy transmitter and the combination of existing technologies might lead to increasing numbers of high-tech weapons and a reduction of numbers of Armed Forces. As in the case of nuclear weapons technology, the emerging technologies and especially the cyberspace will have a significant potential to change military capabilities, doctrines and influence on the balance of power in the world.

Win the war without a single battle; achieve victory even before the first shot it is the main goal of future Armed Forces. To achieve these goals, Armed Forces should be ready to conduct conventional operation on the full depth of the enemy's space, prepare for conduct the cyber-operation in cyber-space

aimed to disrupt the command and control systems of enemy (these actions will have a hidden character, the consequences of which the enemy will understand after the outbreak of hostilities). They should be ready to use new high-precision armament, much less, much easier, with several times increasing the destruction power, based on the transfer of kinetic and electromagnetic energy with the wide use of autonomous systems of sea, land and air. In addition, they should be prepared to conduct network-centric operations against conventional and not-conventional adversary in the virtual and real world, aimed primarily at suppressing the enemy's will for resistance.

However, possession of high-tech weapons does not guarantee victory in a future war.

Unconventional thinking, the ability to make quick and non-standard decisions will always defeat the enemy's high-tech forces, because no matter how technically advanced the enemy is, he would always have weak-nesses on which it is possible to strike (Blasko, 2011).

### References

1. **Ashley J. Tellis, Janice Bially.** 2000. Measuring National Power in the Postindustrial Age. RAND corporatio. 2000.
2. **Baluyevsky, Yury.** 2012. Security Index of A Globalized World: The Russian Dimension. 1(81), 25 Apr 2012, Vol. 13, pp. 27-38.
3. **Beaulac, Stéphane.** 2004. The westphalian model in defining international law: challenging the myth. 2004.
4. **Bionics, Touch.** 2009. Touch Bionics unveils world's first bionic finger. Touch Bionics. [В Інтернеті] 6 Dec 2009 г. [Цитировано: 26 Apr 2017 г.] <http://www.touchbionics.com/news-events/news/touch-bionics-unveils-world%E2%80%99s-first-bionic-finger>.
5. **Blasko, Dennis J.** 2011. 'Technology Determines Tactics': The Relationship between Technology and Doctrine in Chinese Military Thinking. 2011 г., Т. 34:3, стр. 355-381.
6. **Boeing.** 2014. **F-22 Raptor.** <http://www.boeing.com>. [В Інтернеті] 2014 г. [Цитировано: 26 Apr 2017 г.] <http://www.boeing.com/history/products/f-22-raptor.page>.
7. **Bukkvoll, Tor.** 2011. Iron Cannot Fight – The Role of Technology in Current Russian Military Theory. 2011, Vol. 34:5, pp. 681-706.
8. **Cheung, Tai Ming.** 2016. Innovation in China's Defense Technology Base: Foreign Technology and Military Capabilities. 11 Sep 2016, Vols. 39:5-6, pp. 728-761.
9. **Daniele Rotolo, Diana Hicks, Ben Martin.** 2015. What Is an Emerging Technology? 7 July 2015.
10. **Defence, US Department of 2016.** Military & security developments involving the People's Republic of China 2016. May 2016 г.
11. **Engels, Marx.** 1843-44. Selected works of Marx and Engels. s.l. : Lawrence & Wishart Electric Book, 1843-44. p. 211. Vol. 3. ISBN-13: 978-0717804146.
12. **Geers, Kenneth.** 2015. Cyber war in perspective: Russian aggression against Ukraine. Tallinn : NATO CCD COE Publications, 2015. ISBN 978-9949-9544-4-5.
13. **Gerasimov, Valeriy.** 2013. The Value of Science is in the Foresight. *Voyenno-Promyshlenny Kuryer.* 2013 г.  
— 2013. The Value of Science is in the Foresight. *Voyenno-Promyshlenny Kuryer.* 2013 г.
14. **Isserson, G.S.** 2016. G.S. Isserson and the War of the Future: Key Writings of a Soviet Military Theorist. s.l. : McFarland & Co Inc, 2016. 1476662363.
15. **Jitendra S. Tate.** 2015. Military and national security implications. 2015 г., Т. 41, 1.
16. **Kissinger, Henry.** 2014. World order. Reflections on the character of nations and the course of history. New York : Penguin Press, 2014. p. 200. ISBN 978-0-698-16572-4.
17. **Lambeth, Benjamin S.** 1997. The technology revolution in air warfare. 1997, Vol. 39:1, pp. 65-83.
18. **Loo, Bernard Fook Weng.** 2009. Decisive Battle, Victory and the Revolution in Military Affairs. 2009, Vol. 32:2.
19. **Macaulay, Thomas.** 2017. The future of technology in warfare: From AI robots to VR torture. [Online] 13 Jan 2017. [Cited: ] <http://www.techworld.com/security/future-of-technology-in-warfare-3652885/>.
20. **Mai, Thuy.** 2015. Global Positioning System History. [www.nasa.gov](http://www.nasa.gov). [В Інтернеті] 31 July 2015 г. [Цитировано: 04 05 2017 г.] [https://www.nasa.gov/directorates/heo/scan/communications/policy/GPS\\_History.html](https://www.nasa.gov/directorates/heo/scan/communications/policy/GPS_History.html).
21. **Mattsson, Peter A.** 2015. Russian military thinking – a new generation. 2015, Vol. 1, 1.
22. **Nass, Meryl.** 2007. Meryl Nass, MD, Director of Pulmonary Rehabilitation, Mount Desert Island Hospital Bar Harbor, Maine. U.S. Senate Committee on Veterans' Affairs. [В Інтернеті] 25 September 2007 г. [Цитировано: 26 Apr 2017 г.] [https://web.archive.org/web/20071103025251/http://www.senate.gov/~veterans/public/index.cfm?pageid=16&release\\_id=11326&sub\\_release\\_id=11373&view=all](https://web.archive.org/web/20071103025251/http://www.senate.gov/~veterans/public/index.cfm?pageid=16&release_id=11326&sub_release_id=11373&view=all).
23. **Newmyer, Jacqueline.** 2010. The Revolution in Military Affairs with Chinese Characteristics. 2010, Vol. 33:4.
24. **O'Rourke, Ronald.** 2017. Navy Lasers, Railgun, and Hypervelocity Projectile: Background and Issues for Congress. Congressional Research Service. 2017.
25. **Ou, Si-Fu.** 2014. China's A2AD and Its Geographic Perspective. 2014.

26. **Petraitis, Daivis.** 2015. The New Face of Russia's Military. 2015, Vols. 2014-2015, Volume 13.
27. **Raytheon.** 2016. Securing tomorrow, future warfare, cultivating emerging technologies. 2016.
- Sanchenko, O. 2014. The structures, methods and models use of consciential weapons in the social communication. 2014 г., Т. 7.
28. **SIPRI.** 2017. World military spending: Increases in the USA and Europe, decreases in oil-exporting countries. 24 April 2017.
29. **Slipchenko, Vladimir.** 1999. Voyna budushchego. Nongovernmental Science foundation. 1999 г.
30. **The National Academy of Sciences.** 2010. PERSISTENT FORECASTING OF DISRUPTIVE TECHNOLOGIES. N.W. Washington : s.n., 2010. ISBN: 978-0-309-11660-2.
31. **Tiwari, Anupam.** 2012. Military nanotechnology. 2012 г., Т. 2, 4, стр. 825 – 830
32. **Warwick, Graham.** 2015. General Atomics: Third-Gen Electric Laser Weapon Now Ready. aviationweek. [В Интернетe] 20 Apr 2015 г. <http://aviationweek.com/technology/general-atomics-third-gen-electric-laser-weapon-now-ready>.
33. **Wedermyer, Landon J.** 2012. The Changing Face of War: The Stuxnet Virus and. 2012.
34. **Víctor M. Castaño, Rogelio Rodríguez.** 2013. Nanotechnology for ballistic materials: from concepts to products. [ред.] Universidad Nacional Autónoma de México, Boulevard Juriquilla 3001, Santiago de Centro de Física Aplicada y Tecnología Avanzada. 2013 г., Т. 47, 3.
35. **Wirtz, James J.** 2015. Cyber War and Strategic Culture: The Russian Integration of Cyber Power into Grand Strategy. 2015.
36. **Wiśniewski, Adam.** 2007. Nanotechnology for body protection. 2007.
37. **Woolf, Amy F.** 2017. Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues. Congressional Research Service. 2017.
38. **Иванов Олег.** 2008. Американская революция в во-енном деле и ее влияние на военно-политическую стра-тегию. 2008 г.
39. **Кривопапов.** 2016. Kitayskaya voennaya mosch kak faktor mirovoy politiki. 2016 г.
40. **Кричевский, Герман.** 2016. НБИКС-технологии и концепция современной войны. [В Интернетe] 2016 г. <http://www.nanonewsnet.ru/articles/2016/nbics-tekhnologii-dlya-mira-voiny-anons-knigi-german-evseevich-krichevskii>

## ОЦІНКА ВПЛИВУ ТЕХНОЛОГІЙ, ЩО ЗАРОДЖУЮТЬСЯ НА ЗБРОЙНІ СИЛИ ПРОТЯГОМ НАСТУПНИХ 10 РОКІВ

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*У статті проаналізовані основні технології, що зароджуються, які будуть мати найбільший вплив на Збройні Сили розвинутих країн світу на протязі наступних 10 років. Спираючись на аналіз основних напрямків їх розвитку, робиться висновок, що найбільш імовірним є подальший розвиток існуючих технологій передачі кінетичної енергії, за рахунок зменшення маса-габаритних характеристик зброї та одночасно зростання деструктивної здатності нових типів озброєння та подальше підсилення впливу на Збройні Сили таких технологій, як кіберпростір, автономні (роботизовані) системи та озброєння прямої передачі енергії. Зроблено висновок, що на протязі наступних 10 років відбудеться подальша трансформація бойових дій від класичних (теоретичні роботи Клаузевица) до нетрадиційних, гібридних бойових дій, що відповідає теоретичним роботам Сан-Цзи.*

**Ключові слова:** технології, що зароджуються, Збройні Сили, доктрина, баланс сил.

## ОЦЕНКА ВЛИЯНИЯ ЗАРОЖДАЮЩИХСЯ ТЕХНОЛОГИЙ НА ВООРУЖЕННЫЕ СИЛЫ В ТЕЧЕНИЕ СЛЕДУЮЩИХ 10 ЛЕТ

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*В статье проанализированы основные зарождающиеся технологии, которые будут иметь наибольшее влияние на Вооруженные Силы развитых стран в течение следующих 10 лет. Основываясь на анализе основных направлений их развития, делается вывод, что наиболее вероятным является дальнейшее совершенствование существующих технологий передачи кинетической энергии, за счет уменьшения масса-габаритных характеристик оружия и одновременного роста деструктивной способности новых типов вооружения, с параллельным усилением влияния на Вооруженные Силы таких технологий, как киберпространство, автономные (роботизированные) системы и оружие прямой передачи энергии. Сделан вывод, что в течение следующих десяти лет произойдет дальнейшая трансформация боевых действий от классических (теоретические работы Клаузевица) к нетрадиционным, гибридным боевым действиям, соответствующим теоретическим работам Сан-Цзы.*

**Ключевые слова:** зарождающиеся технологии, Вооруженные Силы, доктрина, баланс сил.