Scientific Journal of the Croatian Defence Academy

STRATEGOS

ZNANSTVENI ČASOPIS HRVATSKOG VOJNOG UČILIŠTA DR. FRANJO TUĐMAN

Volume VII, Number 1, 2023
Godina VII., Broj 1., 2023.
Zagreb

ISSN 2459-8917 (Online)
ISSN 2459-8771 (Print)
UDK 32
UDK 355/359

UDK 32
UDK 355/359

ISSN 2459-8917 (Online)
ISSN 2459-8771 (Print)

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Znanstveni časopis Hrvatskog vojnog učilišta
"Dr. Franjo Tuđman"

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Scientific Journal of the Croatian Defence Academy

Volume VII, Number 1, 2023

Hrvatsko vojno učilište "Dr. Franjo Tuđman"
Ilica 256b, HR-10000
Zagreb, Croatia

Published twice a year
100 pcs

STRATEGOS

Znanstveni časopis Hrvatskog vojnog učilišta "Dr. Franjo Tuđman" /
Dr. Franjo Tuđman Scientific Journal of Croatian Defence Academy

Izdavač / Publisher

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Dr. Franjo Tuđman Croatian Defence Academy

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Strategos publishes original scientific papers, scientific reviews, professional papers and preliminary reports, which are subject to at least two double-blind peer reviews and professional proofreading service. Each issue may also include book reviews, perspectives, opinion articles, commentaries and replies, symposium pieces, interviews, and annotated bibliographies. Strategos is dedicated to a wide interdisciplinary area of military-, defence-, security- and intelligence-related sciences and arts. It is published in printed and electronic format.

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Riječ uredništva za prvo izdanje 2023.

Poštovani čitatelji,

pred vama je novo izdanje časopisa Strategos. Unatoč nizu izazova prvo ovogodišnje izdanje pripremljeno je na vrijeme i u željenoj kvaliteti. Svaki urednik i uredništvo znanstvenog časopisa suočava se s različitim izazovima. Na prvom je mjestu kvaliteta znanstvenih članaka koje autori nude stručnoj javnosti kao rezultat svog znanstveno-istraživačkog rada kroz znanstvene časopise. Drugi je izazov dobiti kompetentne znanstvenike za recenzente koji, osim svojih redovitih obveza, imaju vremena i volje posvetiti se razmatranju ponuđenih znanstvenih radova. Interdisciplinarni znanstveni časopis, kao što je Strategos, kada prihvati na recenziju određeni rad, redovito se suočava s izazovom traženja recenzenata. Evo, na kraju smo u tome i ovoga puta uspjeli.

U ovom je izdanju pred vama šest novih i zanimljivih radova, od kojih su dva vrlo kompetentni recenzenti ocijenili i uvrstili u vrlo visoku kategoriju izvornih znanstvenih radova.

Prvi rad, Examining the opportunities and potential of Artificial Intelligence in national security and defence, rezultat je istraživanja koje je proveo dr. Smiljanić u vrlo izazovnom i aktualnom području umjetne inteligencije predstavljajući inovativne tehnologije koje se brzo razvijaju u različitim područjima ljudskog života i poslovanja. Tako nove i inovativne tehnologije imaju utjecaj i u području nacionalne sigurnosti i obrane. Autor ovdje raspravlja o izazovima koje predstavlja umjetna inteligencija.

Dr. Ščavničar je ponudio rad pod naslovom Streamlining the delivery of military education through the distance learning method. Recenzenti su ga ocijenili visokom ocjenom kao izvorni znanstveni rad koji piše o vojnoj

izobrazbi, s posebnim naglaskom na učenje na daljinu kao alatom koji je posebno došao do izražaja u vrijeme pandemije COVID-19. Rad obrađuje isplativost primjene učenja na daljinu, odnosno elektroničkog učenja kao vrste učenja u kojem se koristi računalna tehnologija i elektronički mediji u svrhu poboljšanja kvalitete učenja. Oni su brz, pouzdan i učinkovit način poučavanja.

Još jedan izvorni znanstveni rad, Use Of Unmanned Aerial Vehicles In Support Of Artillery Operations, rezultat je zajedničkog napora tri autora, Bartulović, Trzun, Hojić. Izvorni i ključni autor i kreator ideje je kadetkinja Bartulović, polaznica pete godine diplomskog studija i 16. naraštaja na Hrvatskom vojnom učilištu. Rad je još jedna aktualna i suvremena tema o primjeni bespilotnih letjelica u topništvu s naglaskom na primjenu u Hrvatskoj vojsci kroz analizu hipoteza kao vrijedne isplative potpore u modernim sukobima i pravodobnosti primjene. Profesori Trzun i Hojić svojim iskustvom i kompetencijama imali su ulogu stručnog usmjeravanja i definiranja znanstvenog pristupa radu.

Stručnim radom na temu The Role of The "Rudolf Perešin" Training Center In The Military And Defense Segment autorica Boltužić iz Hrvatskog ratnog zrakoplovstva izvrsno je predstavila obuku i izobrazbu časnika i dočasnika Hrvatskog ratnog zrakoplovstva kroz cjeloživotno obrazovanje. Ovakvim se obrazovanjem usvajaju znanja i vještine radi postizanja visoke obučenosti za rad na vojnim materijalnim sredstvima. Radom autorica želi istaknuti važnost usavršavanja djelatnih vojnih osoba koje se znatno razlikuje od modela koji se primjenjuje u civilnom društvu.

Svojim drugim radom pod naslovom Umjetna inteligencija – cilj, način ili sredstvo strateškog natjecanja? u ovom izdanju dr. Smiljanić raspravlja o umjetnoj inteligenciji i daje pregled kako SAD, Rusija i Kina kao vodeće nacije prednjače u njenom razvoju. Autor ispituje čimbenike koji motiviraju globalnu potragu za razvojem umjetne inteligencije i raspravlja o prilikama i rizicima povezanima s proliferacijom AI tehnologije u međunarodnoj politici.

Na kraju je rad dr. Brkića na temu Dostupnost geomagnetske informacije. Ovaj rad raspravlja o javnoj dostupnosti i regulativi podataka o magnetskom polju Zemlje. Autor iznosi prijedlog da se geomagnetske informacije proglase javno dostupnima nakon što njihova pouzdanost padne na pouzdanost trenutno najboljeg javno dostupnog globalnog geomagnetskog modela.

Na taj način i postavljeni kriterij, praćenje i predviđanje nepouzdanosti trenutnog geomagnetskog informacijskog modela sugerira razdoblje pouzdanosti izvorne geomagnetske informacije.

Uredništvo na kraju preporučuje objavljene radove s vjerom da će i ovi radovi naći svoju čitateljsku publiku i poslužiti kao motivacija drugim autorima da nam se jave sa svojim istraživanjima i autorskim proizvodima.

Uredništvo

A word from the editors

Dear readers,

The new issue of Strategos Journal is in front of you. Despite a series of challenges, this year's first edition was prepared on time and in the desired quality. Each editor and editorial board of a scientific journal faces different challenges. The first place is the quality of the scientific articles that the authors, as a result of their scientific and research work, offer to the professional public through scientific journals.

Another challenge is to get competent scientists as reviewers who, in addition to their regular duties, have the time and willingness to devote themselves to considering the scientific papers offered. An interdisciplinary scientific journal such as Strategos, when it accepts a certain paper for review, regularly faces the challenge of finding reviewers. In the end, we succeeded in that this time too.

In this edition, you will find six new and interesting papers, two of which were evaluated by very competent reviewers and included in the very high category of original scientific papers.

The first paper, "Examining the opportunities and potential of Artificial Intelligence in national security and defense", is the result of research conducted by Dr. Smiljanić in the very challenging and current field of artificial intelligence, presenting innovative technologies that are rapidly developing in various areas of human life and business. Thus, new and innovative technologies have an impact in the field of national security and defense as well. Here, the author discusses the challenges posed by artificial intelligence.

Dr. Ščavničar offered a paper entitled "Streamlining the delivery of military education through the distance learning method", which was highly rated by

the reviewers as an original scientific paper that writes about military training with a special emphasis on e-Learning as a tool that came to the fore during the COVID-19 pandemic. The paper deals with the profitability of the application of e-Learning, i.e. electronic learning as a type of learning in which computer technology and electronic media are used for the purpose of improving the quality of learning. They are a fast, reliable and effective way of teaching.

Another original scientific work "Use of Unmanned Aerial Vehicles In Support Of Artillery Operations" is the result of joint efforts of three authors Bartulović, Trzun, and Hojić. The original and key author and creator of the idea is Cadet Bartulović, a fifth-year graduate student of the 16 class at the Croatian Military Academy. The paper presents another current and contemporary topic on the application of unmanned aerial vehicles in artillery with an emphasis on application in the Croatian Army through the analysis of hypotheses as a valuable cost-effective support in modern conflicts and the timeliness of application. Professors Trzun and Hojić, with their experience and competences, had the role of professional guidance and definition of the scientific approach to work.

With her expert work on the topic "The Role Of The "Rudolf Perešin" Training Center In The Military And Defense Segment", the author Boltužić from the Croatian Air Force excellently presented the training of officers and non-commissioned officers of the Croatian Air Force through lifelong education. This type of education aims to gain knowledge and skills in order to achieve high training for working on military material assets. With her work, the author wants to emphasize the importance of the training of active military personnel, which is significantly different from the models applied in civil society.

In his second paper in this issue entitled "Artificial intelligence - goal, method or means of strategic competition?", dr. Smiljanić discusses artificial intelligence and gives an overview of how the USA, Russia and China are the leading nations in its development. The author examines the factors motivating the global pursuit of artificial intelligence development and discusses the opportunities and risks associated with the proliferation of AI technology in international politics.

At the end, dr. Brkić's offers paper on the topic "Availability of geomagnetic information". This paper discusses the public availability and regulation of Earth's magnetic field data. The author proposes geomagnetic information to be declared publicly available after its reliability drops to that of the currently best publicly available global geomagnetic model. In this way and the set criterion, monitoring and prediction of the unreliability of the current geomagnetic information model suggests the period of reliability of the original geomagnetic information.

Finaly, the editorial board recommends the published works with the belief that these works will also find their readers and serve as motivation for other authors to contact us with their research and author's products.

Editorial office

Strategos, 7(1), 2023, 13-31
UDK 32
UDK 355/359
Review scientific paper

STRATEGOS

Examining the opportunities and potential of Artificial Intelligence in national security and defence

Dražen Smiljanić

Abstract

Artificial Intelligence (AI) is recognised as a disruptive technology that rapidly changes a wide range of businesses and industries. It also can transform functions (processes and systems) related to national security and defence. Although it is not primarily being developed in the defence sector, AI is poised to change the character of future conflict by improving the effectiveness, efficiency and speed of defence-related activities. However, while AI has enormous potential to replace or assist human factors in decision-making, it still cannot replace humans in strategic thinking.

The paper first reviews the meaning, current developments, and challenges related to AI technology. It then scrutinises the impact of AI on national security and defence in three areas: defence capabilities, decision making and strategic thinking. The article concludes with a prospect on AI in general and in the security and defence domain, expecting its most significant value in support of decision-making.

Keywords

artificial intelligence, national security, defence, Russia, China

Introduction

Artificial intelligence (AI) is one of the most debated and, apparently, one of the least understood technological breakthroughs of our time. It both fascinates and frightens at the same time. It fascinates by its potential, observable already in its everyday use and in the determination of the great powers to assert their superiority in this field. It also often worries people because further progress may lead to overcoming human capacities. The latter is particularly emphasised in popular culture.

Although often discussed concerning its future abilities, AI is "the present" in the business world and already permeates our lives in many spheres. It, among other things, translates texts, recognises objects and faces on digital media, identifies spam emails, drives cars, replaces customer services with *chatbots*, plays the role of personal assistant, creates artworks, and plays games.

AI has become a "hype" word whose impact is sometimes seen as overly optimistic or even esoteric. Therefore, it is necessary to analyse this technology's development trends and anticipate its full impact on our societies and lives.

All the possibilities and potential applications of AI have yet to be explored. Some expectations are very high. It remains to see if AI will be able to bring to us what several technologies in the late 1800s brought to the lives of our ancestors. The Second Industrial Revolution brought technologies such as electrification, railroads, telegraphs, and the automobile impacted human lives in many ways. These technologies contributed to raising living standards, made lives faster and more connected, richer with possibilities and created new social relations and life patterns. As part of the Fourth Industrial Revolution, AI is expected to improve the quality of life and increase income levels for people universally (Schwab, 2016).

Expectedly, AI will create, like many other disruptive technologies throughout history, opportunities but also challenges. It may provide economic opportunities (Tegge, 2018) and can be beneficial with many positive applications. Along with advanced robotics and other emerging

technologies, it may advance human endeavours and even replace humans in manufacturing, transportation, health care and education.

The further development of AI will arguably create new disruptions and bring about considerable economic, social, legal, ethical, and security challenges. They could span from economic security, because AI will expectedly replace humans in many areas (taking human jobs), to a potential reduction of the achieved human rights (individual and political freedom). This may create pervasive economic inequality or widespread and intrusive government surveillance of the population.

In international relations, AI has already become an aspect of strategic competition. The major powers, particularly China, consider that being at the forefront of AI technology is critical to the future of global economic and military power competition. While "killer robots" developments remain in the Sci-Fi zone, AI has already found applications in defence capabilities. Currently, its use is seen as a prospective tool, particularly in processes and systems focusing on reducing time to decide (i.e. decision-making) in an environment overwhelmed with data.

The analyses in this paper are limited to the potential implementation of AI in the national security and defence area. The paper first examines what AI is and why it matters, followed by a review of AI-related challenges. The central part of the article is the scrutiny of the AI's impact on national security and defence. Finally, the article provides conclusions and considerations about the expected future developments and use of AI technology.

AI between myth and reality

Currently, the commonly agreed definition of AI does not exist. AI is a concept, or better, a field, encompassing "*logic, probability, and continuous mathematics; perception, reasoning, learning, and action*" (Russell and Norvig, 2003, p. vii). In describing AI as an entity, it is more precise to call it an "intelligent agent". In that sense, AI is "*the study of agents that receive percepts from the environment and perform actions*" (Russell and Norvig, 2003, p. vii).

Gartner, Inc. defines AI simply as "*technology that emulates human performance, typically by learning from it*" (Andrews, 2018, p. 6). To be more descriptive, AI makes it actionable for machines to "learn" from "experience", adjusting to new inputs, and perform human-like tasks.

Multiple new technologies have become broadly categorised under the label Artificial Intelligence. Most AI applications today rely heavily on their subfields, Machine Learning (ML) and Deep Learning (DL), to name some of them. These technologies allow computers to be "trained" to accomplish specific tasks by processing large amounts of data and recognising patterns.

It is, in fact, Machine Learning that enables AI systems to learn without being explicitly programmed. AI systems "learn" by recognising patterns that had not been previously defined. Machine Learning also allows an AI agent to absorb and digest feedback rapidly. The result of it is that the systems to which AI is connected become better at what they do than those based on traditional human-based feedback systems. However, AI agents do not "understand", at least currently, and will not in the near future, the tasks they perform, and there is no way to know how they reach their conclusions.

The charm of AI may lie in that it is not something we can expect to "behave" according to a predetermined set of algorithms. We can take as an example *Sophia*, a social humanoid robot developed by the Hanson Robotics company that is frequently interviewed and even became a Saudi Arabian citizen. Another reason may be that AI differs from other technological advances because it does not require us to adapt by learning how to use them, as we do with computers. AI is, actually, about creating technologies that adapt to us rather than the other way around.

In this article, we tackle the term Artificial Intelligence interchangeably, as a concept (a technology or a field), and as a capacity (an AI agent, regardless of the interface).

Theoretical framework

In general, AI is "*the capability of a computer system to perform tasks that normally require human intelligence, such as visual perception, speech recognition and decision-making*." (Cummings, 2017, p. 2)

he Organisation for Economic Co-operation and Development (OECD) involves knowledge and behaviour in its definition. OECD defines AI "*as the ability of machines and systems to gain and apply knowledge and to carry out intelligent behaviour*" (OECD, 2016, p. 86). When it comes to knowledge, AI, at the current level of development, can gain and apply but cannot transfer its knowledge.

Teradata's "*State of Artificial Intelligence for Enterprises*" report (Bourne, 2017, p. 3) defines AI as "*the ability to automate enterprise decisioning using human-to-machine cognitive interactions where machines are able to augment and assist human capabilities by sensing and continuously learning, reasoning and inferring, and deciding and acting to drive a business outcome*." This definition provides a description of AI capability and its purpose in augmenting and assisting human capabilities related to business.

Finally, AI technology is of interest for use in defence. The U.S. Department of Defense describes AI as "*the ability of machines to perform tasks that normally require human intelligence – for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action – whether digitally or as the smart software behind autonomous physical systems*" (USA DoD, 2018, p. 5). This definition also involves the use of autonomous systems. Autonomy is of particular interest in defence since it enables systems (platforms) to be automatic (e.g. to decide autonomously), within programmed boundaries, or even "self-governing". AI is essential for autonomous systems as it facilitates decision-making in dealing with large amounts of data.

When we think about AI, it is important to distinguish what AI is or can do now and what it may or will be able to achieve in the future. Currently, there is a distinction between Artificial Narrow Intelligence (ANI), which is a machine intelligence equal to or greater than human intelligence for specific tasks; Artificial General Intelligence (AGI) – machine intelligence able to meet the full spectrum of human performance across any task; and Artificial Superintelligence (ASI) – machine intelligence that exceeds human intelligence across any task (Spiegeleire, Maas & Sweijs, 2017).

All existing AI applications, without exception, currently belong to ANI. ANI is already among us in various appearances. It is often unnoticed, as in our search engines, a language translator, or personal assistants on our devices. There are currently four frontrunners in the AI assistant space: Amazon's "Alexa", Apple's "Siri[1]", Google's Assistant, and Microsoft's "Cortana". And, since the beginning of 2023, ChatGPT, developed by OpenAI company, has become widely popular in natural language processing.

The timing of the arrival of AGI remains controversial, although, according to current trends, experts predict that it will happen by the middle of this century. Many experts expect ASI to emerge relatively quickly after that, although few anticipate this to spark "artificial consciousness".

The AI's evolution

The factors that have contributed to key advances in AI that we see today are the improving quality of algorithms (thanks to the progress of research in computer science, new programming languages, etc.), the increasing computing power, and the ubiquity of data.

In general, the evolution of AI has been based on different technologies since its conception; from the 1950s to the 1970s on Neural Networks, from the 1980s to the 2010s on Machine Learning and, at the present day, on the Deep Learning. In fact, the early work, done primarily on academic institutions and research and development organisations, laid the foundation for the AI applications we see today.

The late 1950s was the time when the United States was in the middle of the Cold War. Congressional representatives, at the time being, were willing to invest heavily in AI as part of a larger security strategy. A particular emphasis was given to language translation, primarily Russian to English and English to Russian. The period from 1954 to 1966 was known as "the decade of optimism," However, the breakthroughs did not come as quickly as promised. Machine translation was slower, more expensive, and less accurate than human translation, so investments in machine translation were abruptly cancelled. These periods of stalled development that occurred

1 "Siri" is an intelligent assistant on Apple devices.

during the beginning of the 1970s and the end of the 1980s, are often referred to as "AI winters".

The new enthusiasm for AI came with the power of computer hardware, namely high-powered microprocessors. In addition, new techniques, specifically those related to Deep Learning, and Neural Networks that can learn tasks after being "trained" on existing examples, opened a new era of AI. Consequently, AI has moved from prototyping at research institutes and universities to industry and real-world application within a decade.

Despite advancements in the field, some argue, including Gary Marcus, a psychology professor at New York University and a longtime sceptic of AI, that "*six decades into the history of AI, our bots do little more than play music, sweep floors and bid on advertisements*" (Marcus, 2018, p. 5). Others, such as Luc Julia, the co-author of *Siri's* core patents, claim that AI does not even exist yet (Cagan, 2019). The fact is that AI development is still lacking a cohesive, overreaching theoretical basis and is explored in an *ad hoc* manner.

In terms of its future development, AI will probably go hand in hand with the development of the Internet of Things. Namely, AI (via Machine Learning) can quickly derive meaning from data. It may identify patterns and detect anomalies in smart sensors and devices' data. This potential to be closer to where the data is collected will probably steer the future of AI towards smaller systems.

An essential characteristic of development and use of AI is that the size of an investment is not the key to getting the benefits of the technology. In business, developing AI solutions very often require only data and machines to solve specific problems, and most importantly, a "business case". So, the key to success is clarity of vision in defining the case. This allows countries and organisations that invest seemingly less money in AI development to achieve significant benefits.

AI development also provokes "doomsday" scenarios in the imagination of many. However, despite the scenarios portrayed in SciFi books and movies, the materialisation of "superintelligence" that is able to self-sustain, self-improve, and potentially dominate over the human race remains, at least in the near future, an esoteric possibility.

AI-related challenges

Not all the outcomes of the introduction of AI in society are expected to be beneficial. Disruptions that will go hand in hand with the implementations of this technology will have implicit or explicit implications on security.

For instance, in the economy, AI systems are expected to affect the job market, potentially creating unemployment and increasing inequalities (see the jobs potentially affected by computerisation at: https://willrobotstakemyjob.com/rankings). Along with social and economic challenges, some other issues should be analysed to assess the potential impact of AI. Nowadays, we may identify several AI-related issues, such as its relevance (in terms of functionality and applicability) and its responsible use (regarding the autonomy of its decision-making and access to data).

Relevance of AI

Regarding its relevance, an essential aspect of the use of AI is the availability of data sources needed to "train" AI systems. Since AI needs data, the greater the volume of data is available, the more algorithms it can "learn", and the better deliveries from AI will be. Data creation is continually growing. For example, in 2013, 90% of all available data had been created in the two previous years (Jacobson, 2013)[2], which represents a very favourable condition for AI development. This requirement for data makes large companies in cloud services, social media, e-commerce or other sectors with access to a large collection of data naturally positioned to lead in a variety of AI fields. It includes voice recognition, facial recognition, and natural language processing.

The availability of data and the relevance of AI are, therefore, closely connected. The use of AI in dealing with data has its limitations in the current state of the art. AI is useful as long as data of interest lie within a narrow scope. In other words, AI requires a dataset characterised by a fairly well-defined signature, including a type of shape or a family of patterns. At present, the biggest impediment to using AI in support of decision-making

2 The statistics is still valid since we generate 10 times as much data every two years.

is AI's potential "subjectivity". More specifically, the bias in data supplied to AI systems can reproduce or amplify bias in their decisions. The functioning of AI greatly depends on the availability of data that is reliable and selected to be carefully in tune with the targeted objective (Poussart & Wyman, 2018).

Control over AI

The processes that AI uses to reach conclusions are not under the direct control of users. Namely, a "conclusion" made by AI is not necessarily the result of an initial, sequential algorithm or predicted steps because the AI agent "learns". Therefore, the further development of AI and its introduction into society must not be mishandled. Another concern is privacy in the cyber sphere. The question of control also includes the issue of the use of AI for disinformation practices, such as *deepfake* (Villasenor, 2019). Practices such as automated surveillance of private data and the challenges mentioned above might drive public distrust or even strong societal criticism of AI. Therefore, the development of data-driven AI systems will have to ensure the adaptation of legal frameworks for the collection, use, and storage of data (see, for example, European Parliament, 2018).

Finally, the level of autonomy given to AI systems to make potentially life-changing decisions remains a critical issue. Ideally, it should be ensured that AI agents are only able to provide recommendations rather than autonomously make decisions. However, it is not always feasible, especially when AI is used in some defence platforms where the speed of decision is crucial.

Efficiency vs human inclusiveness

Two of the vast advantages of AI are its scalability and availability. AI systems may operate 24 hours, 7 days per week, and they do not get tired, sick, or stressed. Therefore, while AI is not more intelligent than humans, it is considerably more productive. These characteristics make it easier to source at a lower cost.

Noah Harari perfectly described the possibility for people to become "irrelevant" (e.g. not needed) in the new economy heavily based on new technologies, including AI (Harari, 2018). This is an evolution of the problems of "traditional" capitalism, where many felt "exploited". Besides that, Harari warns that the desire to concentrate all information and power in one place, which was the main handicap of authoritarian regimes in the 20th century, may become their decisive advantage in the 21st century. AI makes it possible because it can process enormous amounts of information centrally, making centralised systems far more efficient than diffuse ones.

AI and its impact on national security and defence

The use of AI in national defence (i.e. in military affairs) has yet to be conceptualized, and its development is expected to evolve along with its implementation. AI may be compared, hypothetically, with some other inventions that have found its use in the military, bringing a significant advantage to those who use it. One example is the Global Positioning System (GPS). The precursors of the modern internet and handheld GPS were developed by U.S. researchers in the 1970s. Twenty years later, during the First Gulf War (Operation Desert Storm), the U.S. military astonished the world with its extensive use of information technology and precision munitions. The success in that Operation helped cement the status of the USA as the preeminent military power for decades.

While the use of AI in the defence domain has yet to be conceptualized, strong economic and military powers, others than the USA and China, do not wait. As a former French defence minister Florence Parly (Parly, 2019) put it, the potential benefits of AI for the French Ministry of Defence are strong and numerous. While the armed forces of the major powers are already sharpening their algorithms, France cannot take the risk of missing this technological shift. It is simply the imperative of staying relevant today and in the future.

AI in defence capabilities

AI has already been implemented in many new platforms, for example in the F-35 jet, in modern surface warfare ships, in the fire control of the missile

defence, and in cyber defence. It may be applicable to many emerging systems where the speed of decision is a trait. The use of AI tools to set strategic and operational level courses of action is yet to be developed.

One area where AI may have a significant role in the future is unmanned warfare (in autonomous systems). Over the last decades, the conceptualization of warfare has evolved and included capability development for a battlefield of high technology. Platforms, such as drones, hypersonic missiles, autonomous systems (i.e. weaponized robots), swarms of surface weasels (ships), and the use of AI contribute to imagining the change in the nature of warfare. One of the main characteristics of this "new" warfare is the increased autonomy of weapon systems to reduce, or avoid, the dependence on scarce, slow, and expensive human presence on the battlefield. In this scenario, humans are removed from navigation, control, and decision-making processes. The battlefield of the future, if it becomes highly technological, will contain fewer and fewer human individuals on the ground and at the centre of the battle (e.g. decision making).

At present, AI development mostly takes place in the commercial sector (private companies). The current significant disparity in commercial versus military research and development spending on the development of autonomous systems could have a cascading effect on the types and quality of autonomy incorporated into military systems. A critical issue related to using AI and autonomous systems in defence is whether the defence sector can develop and test safe and controllable autonomous systems, particularly those that fire weapons (Cummings, 2017).

AI in decision-making

Currently, the main use of AI for national security and defence is expected to make sense of the incredible amount of data collected by more and more sensors. One example of AI's use for national security purposes is the U.S. *Defense Advanced Research Projects Agency's* (DARPA, 2019) attempt to develop schema-based AI capability (see more in: Pezzulo & Butz, 2012) to enhance reasoning about complex world events and generate actionable insight. The outcome should be the ability of rapid comprehension of world events, found to be critical to informing national security efforts (i.e. decision making).

The changes in international relations, human society and even the natural world (physical environment) can significantly impact national security on their own or may form part of a causal chain that produces broader impact. Very often, these events are not simple occurrences but complex phenomena composed of a web of numerous secondary elements, including actors and timelines.

Faced with the challenge of the growing volume of available but unstructured data, it becomes evident for national defence (intelligence) that there is a need for a tool to uncover and understand different events, possible relations between them, and their underlying elements. This is where AI comes into play, because the defence that will create AI agents that can provide better decisions, more quickly than an adversary, will have an advantage.

However, the challenge is that AI needs data, and data may be biased. To ensure the reliability of decisions, it is important to understand the negative impact of bad or faulty ("poisoned") data on decisions, and how to detect and isolate bad data. It a system problem that the commercial sector is not currently addressing, but the defence has to.

The implementation of AI in the military may be conceptualized through the OODA (Observe, Orient, Decide, Act) loop (see more in: Poussart & Wyman, 2018). AI is now mostly used in the Observe phase, due to a current level of development of technology. Confidence in the applications (e.g. image recognition, data mining techniques) is essential but can be difficult to achieve at the moment. The *Decide* aspect brings up legal concerns, particularly when autonomous systems are involved. The implementation of autonomous systems capable of making decisions is feasible, but it requires standards and agreements (legal aspects of control). The need to implement an automatic response (*Act* phase) can arise when the time available to react is shorter than the human reaction time frame. This aspect, along with *Decide*, is certainly the most sensitive and will require a very mature level of development of AI and autonomous systems. In general, AI is poised to change the nature of the future conflict, by potentially improving the effectiveness, efficiency and the speed of defence-related activities, across the OODA loop.

An assessment of the impact of AI on national defence is not possible without anticipating the depth of transformation that AI will bring to the very notion of national security and defence. Previous industrial revolutions have brought significant changes not only to means of production, but also to the ways people live. Having that in mind, we can certainly expect that AI, as part of the Fourth Industrial Revolution, will provoke changes in the structures, relations and values in societies that implement it.

Currently, AI and new technologies are often seen only as an augmentation to existing institutional frameworks, including defence. NATO's booklet "Visions of Warfare: 2036"[3] is one of the examples where the future weapons and military capabilities are superposed to existing political, social and military structures (Phillips & Cole, 2016). The use of AI in the defence sector, particularly in autonomous systems, may also lead to certain complacency on the part of decision-makers as it is expected to eliminate or minimize the risk of having (human) casualties among own forces.

AI in strategic thinking

AI capabilities still need to be improved in its use in strategic thinking. While humans may seemingly use AI for generating content and answering questions, the tool still cannot "think" in terms of geopolitical analysis and understanding the behaviours of actors. In short, AI still has no "strategic culture".

One research related to U.S. national strategies is indicative of that regard. Elena Wicker (2021) used machine learning to create the "bernardcodie" program, an artificial recurrent neural network. She trained it with data comprising the entire corpus of the U.S. National Security Strategy. That means all 17 U.S. national security strategies published since the document's creation were mandated in 1987[4]. The author used an AI tool to create the

3 The booklet contains SciFi stories and is intended to incite inventive thinking and discussion about future possibilities, and to contemplate how NATO will undertake operations in the coming decades.

4 The documents are available in Historical Office, Office of the Secretary of Defense at: https://history.defense.gov/Historical-Sources/National-Security-Strategy/

new U.S. National Security Strategy, based on the set of the previous 17. The results seemed relevant but showed that the choice of words had been central to the analysis, indicating that the tool skilfully identified patterns and consistencies in strategic language. Elena Wicker, therefore, claimed that the approach to developing strategy with AI still needed improvement and could not replace the intuition of the human mind. Nevertheless, AI turned out to be useful when considered in combination with human analysis because it may provide a fresh perspective (connections among agents in complex systems) and expand human understanding of strategy.

In a similar way, we tested AI abilities with some short questions related to global security and national defence. These are the two questions "discussed" with ChatSonic (at https://writesonic.com/chat), an on-line AI-based tool, on 13 January 2023:

Drazen Smiljanic: "*What is the best strategy to defeat Russia in Ukraine?"*

ChatSonic: "*The best strategy to defeat Russia in Ukraine is for Ukraine to deny encirclement to Russian forces. This can be achieved by launching spoiling attacks against Russian forces to prevent them from building up their forces, as well as conducting defensive and offensive operations to create opportunities for counterattacks. Ukraine must also continue to receive assistance and training from the US and its allies, and continue to invest in and develop cutting edge military technology in order to maintain a technological advantage over Russia*."

DS: "*What should be the best defence strategy for Croatia*?"

ChatSonic: "*The best defense strategy for Croatia is to maintain a strong military presence in the region, while also investing in and developing cutting edge military technology in order to maintain a technological advantage over potential adversaries. Croatia should also continue to strengthen its ties with NATO and other regional allies in order to ensure a collective security approach. Croatia should also make clear that it will not send any troops in case of an escalation, to demonstrate its commitment to a peaceful resolution of regional tensions and conflicts*."

While the answers seem relevant, they are not a product of any methodology generally used in strategy development, geopolitical analysis or similar fields. The results showed that regarding current developments in text

generation and language translation, AI may still be understood as a series of algorithms with natural language processing, which is central to its abilities. Not more. However, AI may offer a unique opportunity to assess the "genre" of strategy documents as a whole, and identify patterns and consistencies in the language used.

Conclusions and considerations about the future use of AI

Hardly a day passes without new articles and discussions about AI, about what it promises to revolutionize in our daily lives, and about massive investments made by major economic powers. However, AI-related topics and its future development might seem controversial. Doomsdayers with their dystopian visions of the future potentially governed by AI and intelligent machines are on the other side of the spectrum from techno-idealists and utopians who believe that AI-related technologies only promote humans wellbeing. Between them are yawning sceptics who either claim that it took too long to make any significant improvement in the AI domain (cost-benefit aspect) or even argue that the real AI does not yet exist at all. The truth is, AI technology is already among us, and its potential is growing.

Currently, there is no slowdown of this mega trend AI development to be expected in the near future. This caution, however, is not without reason. AI development has already experienced two "AI winters", so this possibility should also be taken into account some time in the future.

The real concerns associated with AI are its future application. In an optimistic scenario, AI will provide an economic opportunity and, if balanced and handled properly, may be beneficial with numerous positive applications. AI is expected to have an impact nearly on all aspects of society: the labour market, transportation, healthcare, education, and national security. At best, it will be the technology that adapts to people and will be profoundly transformational for humans and humanity.

There is a growing trend of the use of AI in defence capabilities. It may also be expected that AI will be used as a tool of a weaker (in terms of military power) in the strategic competition. Consequently, a predominantly asymmetric

competition or a conflict may arise. In that case, AI may be applied as a means to reach and address individuals in targeted countries and communities more precisely, as well as their attitudes and emotions. This way, AI could be used to attempt to distract and even destabilise the opponents' societies and, more precisely, their public opinion. Some countries, particularly non-democratic, may also decide to use AI to observe and control the attitudes and behaviour of their citizens.

AI, as a potential game-changer in the security and defence domain, will probably find its most beneficial use in decision-making. Deep learning algorithms offer unprecedented opportunities for improved situational awareness and understanding of the informational environment, making AI services incredibly beneficial for the highest levels of decision-making. In the future, AI is expected to provide uniquely deep insights in identifying trends and drivers, as well as potential outcomes of various types of human endeavours. This will make it perfectly useful for the foresight analysis, and dealing with uncertainty and complexity.

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Dijagnosticiranje mogućnosti i potencijala umjetne inteligencije u području nacionalne sigurnosti i obrane

Sažetak

Umjetna inteligencija (UI) prepoznata je kao remetilačka tehnologija koja brzo mijenja širok raspon poslovanja i industrija. Isto tako, ta tehnologija ima potencijal transformirati funkcije (procese i sustave) vezane uz nacionalnu sigurnost i obranu. Iako se primarno ne razvija u sektoru obrane, umjetna inteligencija je spremna promijeniti karakter budućih sukoba povećavajući učinkovitost, djelotvornost i brzinu aktivnosti koje se provode u području nacionalne obrane. Međutim, iako umjetna inteligencija ima veliki potencijal zamjene ili pomoći ljudskim čimbenicima u donošenju odluka, još uvijek ne može zamijeniti ljude u strateškom razmišljanju.

Rad prvo daje pregled značenja, trenutačnog razvoja i izazova povezanih s UI tehnologijom, nakon čega se analizira utjecaj umjetne inteligencije na nacionalnu sigurnost i obranu u tri područja: obrambene sposobnosti, donošenje odluka i strateško promišljanje. U zaključku se daje perspektiva daljnjeg razvoja i uporabe UI, općenito i u domeni sigurnosti i obrane, očekujući njezinu najznačajniju vrijednost u podršci donošenju odluka.

Ključne riječi

umjetna inteligencija, nacionalna sigurnost, nacionalna obrana, Rusija, Kina

Strategos, 7(1), 2023, 33-69
UDK 32
UDK 355/359
Original scientific paper

STRATEGOS

Streamlining the delivery of military education through the distance learning method

Darko Ščavničar

Abstract

The purpose of the research is to analyse the current data and experience of the Slovenian Armed Forces' E-Learning Centre, and to examine the possibility of increasing the positive impacts of distance education by introducing it into the regular forms and programmes of education in the Slovenian Armed Forces. Based on the results of the data analysis and the experience of the E-Learning Centre and the estimated financial impacts, it can be confidently stated that the introduction of distance education has been financially beneficial for the Slovenian Armed Forces. The savings achieved so far have more than justified the development and construction of the SAF's own e-learning capabilities. The results of the US analysis also speak in favour of the use of the distance learning method in military education. The introduction of the distance learning method in the military education system shows the positive impacts of e-learning in its integration into the regular forms and programmes of education in the Slovenian Armed Forces. It increases the likelihood of the successful implementation of digital transformation of education programmes, and guides education providers to address key content challenges.

Keywords

distance learning, e-learning, education methods, streamlining, positive impacts, information technology

Introduction

Information technology and the media are an essential part of modern society. Therefore, modern information and communication technology (ICT) has an impact on modern education. With the advancement of ICT development, e-learning is emerging as a new paradigm of modern education. E-learning is a flexible learning model based on interactive access to knowledge such as learning resources via the web. Current trends show a rapid growth in online enrolment in higher education. Many universities and higher education institutions are expanding online education and considering offering online education courses and programmes. Online education programmes offer participants an extended, flexible forum to network and discuss whenever they want. E-learning can best be defined as the science of distance learning. Traditional universities are beginning to integrate distance learning into their course offerings. New universities, however, are being established that use of e-learning exclusively; they are essentially virtual universities (Plut, 2009). The world's first successful distance learning university was the Open University in the UK, founded in 1960, believing that communication technology could bring high-quality learning to people who were unable to attend educational institutions (Katz, 2008, pp. 60-64). In the late 1980s, distance education was taken up by Victoria University in New Zealand, the University of Hawaii, Ohio State University and Waseda University, which attempted to deliver lectures and courses internationally via telecommunications (Rajasingham, 2003).

The Slovenian Armed Forces (SAF) are not lagging in the field of education and state-of-the-art information systems. With the help of this project, the SAF was among the first in Slovenia to successfully introduce an e-learning system with the establishment of the E-Learning Centre. The beginnings were difficult and, like any innovation, the e-classroom took some time to establish itself. Today, the E-Learning Centre and its e-classroom is an indispensable capability of the SAF, as it is used by almost all members of the SAF and the Ministry of Defence. It facilitates the required regular or on-the-job training for members and saves the organization and the state a great deal of money. It is a fact that the number of users of the e-Learning Centre

is increasing year by year. The latest analysis of the number of users of the e-learning course shows 16,894 users, of which 9,629 are from the defence system and 7,265 from other public administration bodies. Therefore, 43% of all users are the so-called external users from various public administration bodies (Horvat, 2020, p. 47).

The Covid-19 pandemic significantly affected the lives of individuals and all societal processes, including education. Covid protocols forced educational institutions to use available technology and distance learning methods. All the above has, of course, also affected the entire SAF system of military education, which has prompted exploration of the ways in which the existing capacity of the E-Learning Centre could be better used to support the existing SAF educational programmes and processes.

E-learning

"E-learning has become an increasingly important part of education in the world and in Slovenia, as more and more educational institutions offering formal education programmes are utilizing it, and, above all, it is becoming established as a way of educating employees in companies, public administration and other organizations." (Radovan, 2012, p. 28)

Although e-learning represents a relatively small proportion of education delivery, it has been known for some time in most parts of the world. It has developed in parallel with the growth of modern technologies that have enabled new forms of education. It is unlikely to replace traditional education for some time, but it is increasingly gaining momentum as a form of education complementary to older versions. It does require learners with a little more self-discipline and motivation than displayed by those who are just starting on the long path of lifelong learning.

Networked technologies such as the internet and the World Wide Web have revolutionized educationand training, allowing people to access information globally and to communicate with others with few limits. They offer the potential to share high-quality learning resources, exchange information, and work in learning groups. The computer with WWW access has

become the primary tool for accessing online classrooms. As more people acquire their own computers with WWW access, or access to the necessary equipment in libraries, workplaces, educational institutions or public access points, this form of education is also becoming more accessible and more important (Allan, 2002, p. 2).

Terminology

When we want to discuss something with someone, or collaborate with them for work purposes, for example, we need to use common terminology. We must ensure that what we mean, say, and understand is the same for all participants. Just as new forms and methods of learning and teaching have emerged throughout history, so too have new terms. However, in all definitions, it is important to understand that education is a broader concept that includes learning and teaching. Most often, only learning is referred to in the literature, which often leads to the equation of learning andeducation, which is not true from a professional point of view. To help understand the topic and the content, here are some alternative characterizations of e-Learning.

E-learning covers a wide range of activities and processes, such as:

- Using interactive learning packages including text, graphics, sound, video and animations;
- Enhancing traditional programmes by providing access to additional resources and information;
- Enhancing programmes by providing additional support through the use of synchronous and asynchronous communication applications such as email, discussion groups, chat rooms and video conferencing;
- Providing an integrated programme where most learning takes place through online activities supported by communication tools (Allan, 2002, p. 3).

Online education means delivering lessons partly or entirely via the internet. Increasingly, e-education, or e-learning in the narrower sense, is being used to refer to this form of education. E-learning is just one form of distance

learning. The term can be used to describe any form of learning that does not involve a traditional classroom setting, where the students and the teacher are in the same place at the same time (Ko & Rosen, 2010, p. 3). In line with this definition, this article uses the term e-learning.

Stages in the development of e-learning

Throughout history, different forms of education have emerged to help people overcome various barriers and to bring them closer to, or enable them to have, further education. Of course, these new forms have always been linked to the technology available at the time. As noted by Radovan, e-learning is only the latest stage in the evolution of distance education, the origins of which date backas far as the 18th century. It is generally accepted that distance education has evolved alongside new teaching methods and developments in technology. Distance education has existed since at least the first half of the 19th century. Over time, distance education has been widely used in vocational, professional, and technical education (Radovan, 2012, p. 29).

In the UK, Isaac Pitman taught shorthand by the classic postal correspondence method as early as 1840, and *Skerry's College* began teaching and preparing candidates for civil service examinations in the 1880s. Soon, specialized companies saw an opportunity to make money, and offered specialized distance learning courses. For example, the *Foulkes Lynch Correspondence Tuition Service*, which specialized in accountancy, began as early as 1884. The United States was not far behind, and soon began to benefit from the advantages of the post office and even newspapers. Thomas J. Foster of Pennsylvania began using his newspaper as a means of improving safety in the mines. Between 1870 and 1891, he published articles in the newspaper such as lessons on mining and related topics to increase safety. In Sweden, Hans Hermod, the founder of today's Hermods-NKI Skolan, offered correspondence courses in double-entry bookkeeping until 1898. The 20th century also saw an increase in distance vocational education on both sides of the Atlantic, thanks to the involvement of various professional associations (for example, the *American Association of Medical Record Librarians* in the US, and the C*ertified Accountants*

Educational Trust on behalf of the Chartered Association of Certified Accountants in the UK). There was also a marked increase in the number of private correspondence schools offering various vocational training courses, as well as publicly funded educational institutions at secondary and tertiary levels offering a wide range of vocational programmes, including professional training for teachers, and complementary courses for engineers, health professionals and, already, management studies. Distance learning also proved to be beneficial for mass teaching in areas where traditional teaching had trained too few staff. Distance learning retrained or further educated and trained a sufficient number of the professional staff needed at a given time to launch or accelerate the development of a particular industry, especially older staff and staff who had already received basic education. Two outstanding examples are the former German Democratic Republic and the People's Republic of China. Each used this method to kick-start and stimulate the post-war economy in their countries. There are even more examples of the use of distance learning to modernize national economies in the developing world to include Venezuela, Tanzania, Taiwan, and others.

Pedagogical and technical developments enabled educational radio in the 1940s, educational television (ETV) in the mid-1950s and 1960s, audio and videotapes for learning in the 1970s and early 1980s, and computer-assisted instruction (CAI) in the late 1970s and 1980s. Technological innovations also allowed for the gradual integration of new media and resources into traditional education programmes, which eventually blurred the distinction between distance and traditional education, as a growing number of education systems used distance learning as a supplementary pedagogical strategy (Rumble & Oliveira, 1992, pp. 3-5).

The success of several distance education institutions led to renewed professional debate and reflection on the appropriateness of this form of education. It became clear that students could study successfully at a distance and that high drop-out rates were not related to the inferior quality of the student experience in this form of education (Rumble & Oliveira, 1992, pp. 6-7).

Higher education is an important part of education systems around the world. The number of students enrolled in the tertiary sector worldwide has reached 170 million, a 160% growth since 1990 (Sharma, 2012). Statistics from the 2020 e-Learning Usability Survey report also clearly shows that distance education is growing at an unstoppable rate, namely that by 2020, 98% of universities will have moved classes online, and by 2021, 75% of schools are planning to operate online (Roberts, 2021). Moore and Kearsley have thus identified some macro factors that influence and interact with all the immediate parts of the distance education system. Their conceptual working model includes the following components: technology, learning, teaching, course design, management, policy and organisation. All these separate systems influence and interact with each other in a distance learning programme (Moore and Kearsley, 2005, p. 10). These elements – content/ knowledge, design, communication technologies, interaction, learning environment and governance – are essential subsystems in any distance education organisation (Moore and Kearsley, 2005, p. 18).

Radovan (2012, p. 29) summarized the evolution of distance education into four distinctivegenerations or technological models:

- The first generation is based on two-way written communication between teacher and learner, characterized by correspondence models;
- The second generation is characterized by multimedia as a tool for knowledge delivery;
- The third generation is characterized by distance learning systems such as audio- and videoconferencing;
- The fourth generation is characterized by flexible learning based on the use of modern information and communication technologies.

Schreiber (Berge, 2001, pp. 15-16) wrote about the stages of technological maturation in an organization. When thinking about distance education and training in relation to organizations, it isalso necessary to consider the stages that organizations typically go through, which are analogous tothe learning maturation processes of individuals. For example, a brief model describing

the maturation stages of an organization or capability regarding the delivery of distance education could be:

Stage 1: Separate or occasional distance learning events occur in an organization.

Stage 2: The organization's technological capabilities and infrastructure can support distance learning events. These events are managed by an interdisciplinary team that responds to staff and management needs and makes recommendations on the organization and management of distance learning among the staff.

Stage 3: The organization has established a distance learning policy, procedures are in place, and planning is underway. This means that there is a stable and predictable process for the identificationand selection of content and technology for distance learning delivery.

Stage 4: Distance training and learning is institutionalized in the organization, which is reflected in policy, communication and practice that are aligned and lead to the achievement of the organization's objectives. The business unit has established a distance learning identity and systematically evaluates distance learning events from an organizational perspective.

Advantages and disadvantages (pitfalls)

As with everything else, there are factors in distance learning and e-learning that can be identified as advantages or disadvantages. E-learning also has its supporters as well as those who oppose it or do not want to integrate it into traditional forms of education.

Most often, the opinions for and against e-Learning are based on the interpersonal interactions between teacher and learner, and the connections between learners. This also relates to the common space in which the education takes place and which allows for direct, synchronous interaction between the participants.

Time is another crucial factor. Traditional education specifies exactly when the content will be delivered, so it is clear when the training will start and when it will end. The same is true of student assessments – they take place at a specific time and place. With e-learning, these aspects are more flexible. The start and end times can be fixed, and the activities in between can be tailored to individuals and groups. Each individual has greater influence and control on the learning process.

Intricately linked to this is individual student motivation. If an individual is in the same room as a learning group with the same educational goal, their motivation is different from the individual in an asynchronous learning environment, which also requires greater learner responsibility. It is immediately clear that an individual's motivation must be evident and, in principle, greater than in a group environment.

We can conclude that e-learning is not equally suitable for all age groups. Like other forms and methods of education, e-learning needs to be used or implemented for appropriate content and target groups.

Distance education has shown some advantages, especially for educating dispersed populations who, for various reasons, have not been able to attend a traditional school or whose local educational institution does not teach the subject or field they wish to study. This flexibility made distance education particularly attractive for adults who could not attend traditional educational institutions because of family and work. At the same time, the first questions and reflections on distance education began to emerge.

The first question was related to the appropriateness and quality of such education, and the second was the question of the content suitable for distance learning. For a long time, many saw distance education as an inferior form of education, mainly because of the bad business practices of entrepreneurs who offered inadequately prepared courses with deficient lecturer support and little or no resources in return for up-front fees. Motivated by profit, students dropped out of such courses as soon as possible. Distance education, or correspondence education as it was often pejoratively called, thus gained an undeserved reputation and traditional educators tended to reject this methodology.

One prevailing belief suggested that quality education was only possible when the teacher was in control of the learners and he or she was the source of knowledge and learning. Ideas associated with independent learning and learner autonomy came much later. In this sense, distance learning emerged as a more effective approach in the 1990s. Cultural patterns that dictated the importance of face-to-face interpersonal communication and respect for the power and experience of elders remained barriers. Over time, however, it has become clear that almost anything can be studied at a distance. This realization has been helped by the increasing recognition by traditionalists that their (traditional) methods are often too inflexible, too limited in time and place, and too expensive to meet the demand for education, especially for those who have already completed their initial education. In addition to individuals, employers have also recognised the need for on-the-job training and the opportunities offered by various forms of distance learning (Rumble & Oliveira, 1992, pp. 4-7).

Bregar, Zagmajster & Radovan (2020, p. 21) saw the most significant advantages of e-learning from the perspective of the participants as greater flexibility in terms of place, time, pace, and content of education; greater interactivity and faster access to knowledge from different sources; the possibility of adapting learning approaches to individual needs; transparency of the conditions of education; and the development of new knowledge and skills. For educational organizations, the main advantages are the reduction of certain cost categories; the possibility of better quality services;the transparency, documentation, and consistency of the delivery of programmes; the possibility of more tangible assessment; the accessibility of quality learning resources; the introduction of modern pedagogical models and improvements in the teaching process; and the better possibility of marketing and internationalization of educational programmes.

The e-learning centre

Development of e-learning in Slovenia

"E-learning as a manner of education supported by information and communication technology (ICT) has been in use for less than two decades. The spread of e-learning has been uneven across educational fields and geographical areas, and varied according to implementation models" (Bregar, Zagmajster & Radovan, 2020, p. 25). Bregar et al. (2020, pp. 25-27) also noted that the growth of e-learning in Asia has been driven mainly by projects to increase literacy in rural areas. In the Middle East, for example, government incentives to introduce digital learning materials as a methodsuitable for all categories of learners are important. In Africa, the rise of mobile telephony and socialnetworks is an important factor for change in education, but poor infrastructure is also a barrier. "InEastern Europe, the most important factor in the growth of e-education is public investment and a large number of start-ups" (Bregar, Zagmajster & Radovan, 2020, p. 25).

Despite its prominent place in the European Union's development documents, the development of e-learning or technology-supported education, as it is called in the documents, "has been much slower, below expectations, and accompanied by a number of project failures in the European Union, despite political support, which has been confirmed by the funding of a number of projects. The European Commission's report *The Use of ICT to Support Innovation and Lifelong Learning for All* noted that ICT has not transformed educational processes in a more visible way, as was the case with other activities" (Bregar, Zagmajster & Radovan, 2020, p. 27).

In Slovenia, the beginnings of ICT integration in education date back to the 1990s. "In 1994, Slovenia joined the international *Phare Programme Multi-Country Cooperation in Distance*

Education, which, through a series of educational and promotional activities and pilot projects, had a significant impact on the development of distance learning and e-learning at all levels of education.The project ended in 2000" (Bregar, Zagmajster & Radovan, 2020, p. 29).

"Putting e-learning into practice is fraught with difficulties. The basic prerequisite for the introduction of e-learning, technological infrastructure, which was initially the main obstacle to theintroduction of e-learning, is now becoming a less important limiting factor. The main obstacles and the cause of many failed attempts lie in the professional staff untrained for this form of education, inadequate management, and in the superficial and insufficient knowledge of e-learning in general" (Bregar, Zagmajster & Radovan, 2020, p. 22).

E-learning in the SAF

In line with its mission, the Military Schools Centre is the provider of military education and training programmes. The mission of the Military Schools Centre includes, among other things, research and development in the field of military sciences and related disciplines; production of military literature; production of textbooks and study materials; development of teaching aids and learning infrastructure; programming and programme development; planning of the delivery of education andtraining; evaluation of education and training; e-learning; ,cooperation with educational and researchinstitutions; cooperation and exchange with other institutions; and library, information and publishing activities. With the creation of the E-Learning Centre as an organizational unit of the Military Schools Centre, whose task was to establish a virtual classroom, the Military Schools Centreis also responsible for the introduction, delivery, and development of e-learning throughout the defence system (Ščavničar, 2020, p. 5). The organization and placement of e-learning within the SAF is illustrated in Figure 1.

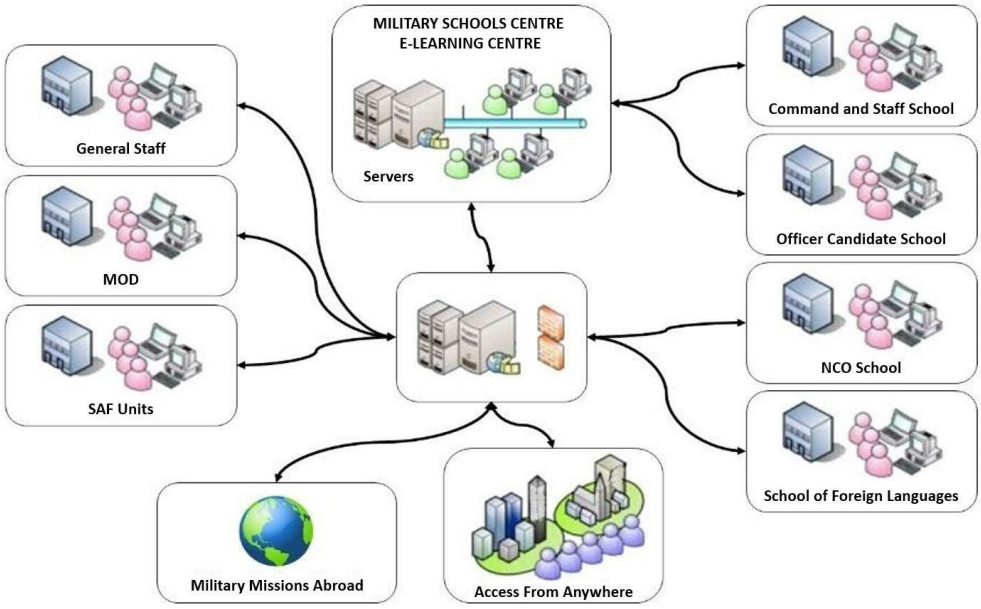

Figure 1: Organization of e-learning within the SAF
Source: Ščavničar, 2014, p. 2

The SAF introduced E-learning based on a targeted research project *E-learning and Training Systems of the Slovenian Armed Forces and Research and Possibilities of Introducing Distance Learning*. The Ministry of Defence of the Republic of Slovenia (MoD) and the Slovenian Research Agency funded the project. It was a challenging project, as it was one of the first of its kind in Slovenia. The SAF executed the programme in three phases. These phases included the preparation of a concept for the introduction and delivery of e-learning in the SAF and MoD, the preparation and delivery of training of personnel involved in the delivery of e-learning in the SAF and MoD, and the development and integration of the existing content into the SAF and MoD e-learning system. In the selection and development of the e-learning system, it was taken into accountthat the e-learning system is only a prerequisite or a tool for the delivery of distance education, thatit should meet the requirements and be easy to use, and that it should allow for the

introduction of new systems in such a way that the users should not feel the difference (Ščavničar, 2014, pp. 1-2).

The main objective was to establish a virtual classroom accessible 24 hours a day, 7 days a week, and to establish a systematic approach to the transformation of the programme of Military Educationand Training (MET). This would allow for the delivery of a large part of the military education content at a distance, ensuring the continuity of the MET process even in situations similar to those during the Covid-19 pandemic, when traditional forms of MET in classrooms, teachers' offices and training centres were disrupted or rendered impossible (Ščavničar, 2020, p. 5).

E-Learning Centre – the SAF capability and procedures

In cooperation with the SAF Force Command, a special programme has been developed to maintainand upgrade the training of members who were deployed on missions or working from home during the pandemic. An analysis of the delivery of e-courses in the form of independent education showedthat this form of training was both successful and useful in terms of content (Ščavničar, 2020, p. 5).

E-learning is now used in the defence system for the delivery of blended learning, for self-study (Slovenian and NATO courses[1]), and for the preparation of e-courses. Blended learning comprises both traditional learning and e-learning. Blended learning is tutor-led and is suitable for those who prefer face-to-face learning in a shared space, as well as those who prefer the flexibility of e-learning. This form of education is already being used successfully in some military schools (for instance in: Command and Staff School, Officer Candidate School, Non-Commissioned Officer School and School of Foreign Languages), facilitated by thecurrent IT infrastructure (Ščavničar, 2010, pp. 30-31).

1 North Atlantic Treaty Organisation

In addition to education and training of the SAF members, the E-Learning Centre also offers its services to the MoD staff and other public administration bodies. Currently, the Ministry of Finance, the Financial Administration of the Republic of Slovenia, and the Office for the Protection of Classified Information are also using the capability, which aims to provide public employees with the skills they need to perform their work requirements. We must be aware that public employees are obliged by state legislation to receive on-the-job training and to improve their knowledge. The e-learning method in this context undoubtedly means education at minimum cost and at a time that best suits the users – even in their free time (Ščavničar, 2020, p. 6). When looking at access to the different content in the E-Learning Centre e-classroom for both combined and self-paced learning, we found that users of both modes of learning complete more than 30% of the work in the e-classroom in their own time and have no problems in doing so. This means that they are engaged in education at their convenience, and at the same time, this percentage suggests that they are tackling tasks and their obligations during their working hours, which benefits the employer both in terms of productivity and it also benefits them financially (Horvat, 2020, p. 55).

In the light of the above, it can be stated that the project has been successfully implemented in the defence system and that it now enables MoD members and other public administration employees to acquire skills and competences, while at the same time allowing for greater responsiveness and flexibility in terms of location, timing, and content of training, which canbe tailored to the individual user. In this way, the basic objective has certainly been achieved or, as things stand today, exceeded.

During the COVID-19 pandemic, 34 courses of study were taught in the Officer Candidate School and Command and Staff School. The educational process was already supported by the use of online classrooms in the open-source Moodle system (SAF Centre for Electronic Education), through which teachers submit materials, weekly assignments, conduct quizzes, receive solutions to assignments and communicate with students. After the analysis of the use of distance learning, teachers and students of both schools positively evaluated the use of the system and stressed that the quality of

the educational process using new technologies is not inferior to traditional forms of education (Cebek, 2020, p. 1).

Individuals cannot self-enrol in the E-Learning Centre e-classroom. All participants are enrolled individually. However, a user has the possibility to enrol themselves in individual courses (after they have logged in to the e-classroom). Only the e-classroom administrators have the right to enrol users in the e-classroom. After their e-classroom enrolment, users have access only to those courses for which they have expressed a desire to take and/those that are available to all SAF or MoD users. One of the conditions for the enrolment of a user is the MoD ID number. Some courses have 'guest' access options. In this case, the user can freely access the course, but the system does not record their progress. Military students are only granted access to those subjects required by their syllabus and to those subjects that are available to all SAF or MoD employees. Users who are notpart of the SAF or MoD are also granted access, but a cooperation agreement must be signed. Once enrolled in the e-classroom, they are subject to the same rights, rules, and restrictions as SAF and MoD users – they have access only to specific subjects. The results of the work and use of e-learning in the SAF over the past three years confirms the good work and the value of the introduction of the E-Learning Centre e-classroom for the needs of the defence system, and more recently also more widely in the public administration (Ščavničar, 2020, p. 5-6).

The number of users of the E-Learning Centre e-classroom is increasing every year. At the end of2020, the e-classroom had 18,546 registered users, of which 12,873 were active users in 2020 – those who visited the e-classroom at least once in the current calendar year viewed specific content. In thepast five years, the number of users has practically tripled. Both the number of users and the numberof active users also clearly indicate the visibility and usefulness of the capability outside the SAF and MoD (Lepenik, 2020).

According to the analysis carried out in 2020, 78% of all users of the E-Learning Centre e-classroom were very satisfied. There were 4.5% dissatisfied users. Even fewer were very dissatisfied, namely 3.9%. If we add up all the users who were satisfied or very satisfied with the implementation of education via

the e-classroom, we get a very high percentage, namely 91.6%. We believe that these are data that justify the introduction of the e-classroom into the defence system (Horvat, 2020, p. 67).

Impact of Covid-19 on e-learning

The Covid-19 pandemic has affected all areas of our daily lives, including the course development and delivery of educational processes. No one was really prepared for this contingency, so different social (sub)systems reacted and adapted with different speeds and success rates. Educational institutions, not only in Slovenia, but also in Europe and globally, closed their doors and organized distance learning classes because of the drastic measures taken to contain the pandemic. The military education system suffered a similar fate, which is why the E-Learning Centre's capability was particularly important. For the E-Learning Centre, this was a challenge that no one could have imagined, but the capability proved to be sufficiently powerful and stable to function virtually flawlessly in the face of a sudden increase in the number of users and especially in the number of activities in the e-classroom.

We believe that the number of activities alone does not tell us much, but when we compare it by month or period, the picture is different. Figure 2 illustrates that E-Learning Centre activities increased significantly during the Covid-19 pandemic between 16 March 2020 and 11 May 2020. The educational process and other functional training courses (self-study) of the SAF and MoD members and staff of other public administration bodies in the form of e-courses during the Covid-19 pandemic ran smoothly (Ščavničar, 2020, p. 6).

DATE	NUMBER OF ACTIVITIES BY WEEK
02.02.-09.02.2020	39.540
09.02.-16.02.2020	31.086
16.02.-23.02.2020	32.219
23.02.-01.03.2020	27.223
01.03.-08.03.2020	30.361
08.03.-15.03.2020	23.434
15.03.-22.03.2020	**39.772**
22.03.-29.03.2020	**64.571**
29.03.-05.04.2020	**120.499**
05.04.-12.04.2020	**177.014**
12.04.-19.04.2020	**206.091**
19.04.-26.04.2020	**252.005**
26.04.-03.05.2020	**117.100**
03.05.-10.05.2020	**137.334**
10.05.-17.05.2020	**140.406**

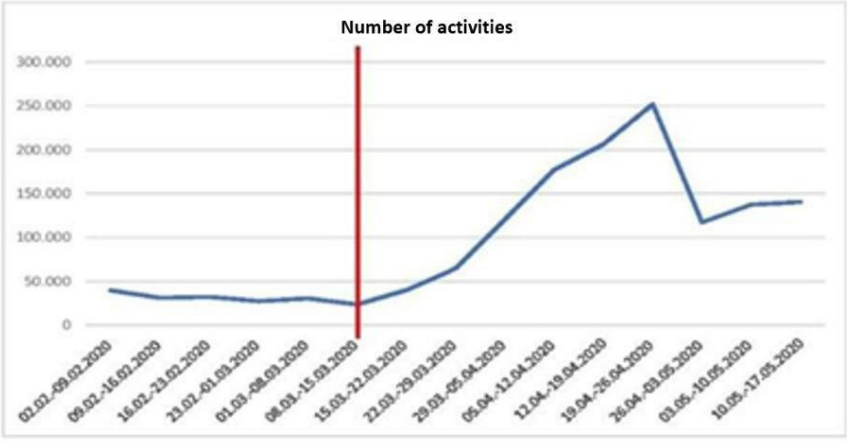

Figure 2: Number of activities in the E-Learning Centre e-classroom before and during the Covid-19 epidemic

Source: Ščavničar, 2020

Activity status before and after the Covid-19 pandemic outbreak: the average number of activities before the Covid-19 pandemic outbreak (before 15 March 2020) was 30,644 per week, or an averageof 122,575 activities per month. The average number of weekly activities after the Covid-19 pandemic outbreak was 139,421.33 (Ščavničar, 2020).

The weekly number of activities began to increase exponentially after the outbreak of the Covid-19pandemic. After 1 May 2020, the number of activities approached that of the third week after the Covid-19 pandemic outbreak. The total number of activities in the E-Learning Centre e-classroom for the duration of the pandemic between 15 March 2020 and 17 May 2020 was 1,254,792. The analysis suggests that the E-Learning Centre's performance, both for the defence system as a wholeand more broadly within the public administration, has fully met the users' expectations and requirements. Not only did the number of users of the E-Learning Centre online classroom increase during the pandemic, but the number of activities also increased and grew exponentially. Activities increased more than fivefold (Ščavničar, 2020, p. 6).

The pandemic was an exceptional opportunity to show and demonstrate theadvantages and disadvantages of e-learning and distance learning. The National Education Institute played a vital role during the pandemic and, among other things, coordinated a campaign to support vulnerable groups, distributing computers and other communication equipment contributed by various donors to all students in the country who did not have access to a computer.A total of 148 online teacher training courses were also organized and delivered, and these were attended by more than 11,600 teachers. During this period, the technical capabilities of the national distance education platforms were also upgraded due to a sharp increase in concurrent visits due to school closures, and the content of syllabus materials at all levels of education was updated to better achieve educational objectives (Rupnik et al., 2020, p. 10).

An analysis by the National Education Institute shows, among other things, that distance learning is more challenging for teachers. While it is more demanding and more stressful, teachers believe that distance learning allows them to be just as creative as classroom teaching, if not more so. An analysis of the results of the data on the experience of distance learning shows that the majority of teachers believe that they can be as creative as in classroom teaching (49.8%), while a third (34.1%) believes that distance learning allows them to be more creative than classroom teaching (Rupnik et al., 2020, p. 15). Regarding the achievement of learning objectives, it is

interesting to note that, although not all learning objectives were achieved, older students achieved a significantly higher percentage of objectives (these are students of the last triad of elementary education and students). The analysis showed that teachers spent much more time on consolidation than on assessment. As a result of consolidation, the grades were better, because the feedback the students received helped them to improve and upgrade their product, which resulted in better grades (Rupnik et al., 2020, p. 39).

Teachers saw the reasons for this in the fact that some of the objectives simply cannot be achieved remotely, but also in the lack of preparedness for distance learning. For example, it is not possible to reach out socially or interact socially; despite the technological communication support that allows us to see and hear each other, we remain at distance. Therefore, by reducing the level of human interaction, the level of emotional engagement of learners (either learner-to-learner or learner-to-teacher) is reduced when moving from a traditional to an online learning environment (Krajnc, 2022, pp. 10-11). Similarly, an analysis of the first wave of the COVID-19 epidemic showed that teachers at all levels of education agreed that socio-emotional goals could not be achieved through distance education. The analysis also suggests that teachers did not systematically promote social-emotional learning during the first wave of the Covid-19 epidemic. This raises the question of to what extent and how teachers promote social-emotional learning in normal situations and how it is (or can be) promoted in distance education (Rupnik et al., 2020, p. 75). Another example of a goal that cannot be achieved at a distance is practical knowledge. The fact is that certain parts of the study content of different programmes cannot be delivered qualitatively at a distance, especially those parts related to the acquisition of practical expertise (Možina, 2021, pp. 103-104).

There has also been a decrease in the proportion of students working in groups, with an increase in individual work with a focus on creative thinking, exploratory learning, analysis and interpretation (Rupnik et al., 2020, p. 13).

Distance learning can be highly successful, especially with slightly older students, as confirmed by theencouraging statement of an unnamed teacher who said that there is no drop in knowledge because students have taken

responsibility for their own knowledge (Rupnik et al., 2020, p. 30). This statement can be confirmed by the fact that the largest number of all users of the E-Learning Centre e-classroom is aged 41 to 50, or 36.6%, and a significant number are aged 51 to 60, or 33.8%. The third age group is the 31 to 40 age group, with 19% users. 7.1% of respondents are aged between 20 and 30 years, while the smallest group is made up of respondents aged over 61 years, 2.8%, which is understandable as this is the working population (Horvat, 2020, p. 62).

Positive impacts of e-learning for the SAF

In this section, the positive effects of e-learning are emphasized. The two most significant are the financial benefits and the time savings that contributed to better time management and system usage. In the United States of America (USA), the field of e-learning is well-developed; it was introduced into the American armed forces at an early time, where it is now used extensively and its benefits are clear. The SAF, both within the Alliance and in other venues, is inspired by and guided by the American approach. This includes the training of SAF personnel. The US Armed Forces, especially the US Army, e-learning experience has informed the SAF's approach to e-Learning. They have taken a very systematic approach to introducing e-learning into their military education system. First and foremost, of course, are the direct financial savings due to technology-enabled training methods, followed by time savings, thus increasing the availability of personnel in the units, the possibility to (re)deploy personnel more quickly according to current needs, and to train a large number of members at the same time more quickly and easily.

Research in the United States' Armed Forces

The research, discussed below, was conducted at the request of the US Army by the non-profit and impartial research institution RAND (Santa Monica, California, USA). It focuses on research in the areas of public services, such as defence, health, and education, among others. One of the research and

development centres funded by the federal government is theArroyo Centre, which conducts research for the US Army (RAND Corporation, 2020).

The research project, entitled *Personnel Policy Implications of Army Distance Learning*, was conducted at the turn of the millennium, when the US Army was in the process of implementing the *Army Distance Learning Program* (TADLP). The programme began with the overallobjective of improving the effectiveness of military education and training. Distance learning allowed soldiers to be trained where they are stationed, making it easier for the armed forces to deliver training while reducing the time spent on traditional training at military school sites. These changes are significant and can have a variety of impacts on how the armed forces train and develop their leaders.

One of the objectives of the study was to find out how distance learning can overcome the problemsof staff shortages and frequent redeployment, which also requires staff retraining. Since armed forces today are constantly in the process of transformation and building new capabilities, it is impossible to provide sufficient qualified personnel in time. All professional armed forces face an influx of fresh recruits, and there is a need to continually retrain available personnel and redeploy them as needed. The result led to units without personnel who cannot be redeployed without adequate training, and, on the other hand, a proportion of personnel who are not sufficiently or adequately trained for the job they are doing. The analysis has shown that the use of distance learning methods can reduce the cost of retraining by 30%. Shortening the course from ten to seven weeks also brought significant savings in training costs.

Another benefit was the improvement in cross-training and consolidation. Both processes seek to create a more versatile soldier who can operate with a wider range of skills. The findings about the impacts are like those of retraining. Training (or part of training) can be delivered at the soldier's unit location, thus reducing training costs. Short refresher courses are available at any time when a member encounters a knowledge gap. Such content can also significantly reduce the duration of traditional courses, with trainees at the same location.

What is most interesting, however, are the findings of the research on the possibilities that distance learning can provide for more effective delivery of leadership development training or career education (specifically the *Captains' Career Course*, which is comparable to the SAF OfficersStaff Course). E-learning allows interested members to complete certain parts of the training at their home unit before attending traditional training (in a lecture room, teacher's office, or training ground) that is inevitable due to the nature of the profession. In addition, e-learning can improve self-study and speed up the institutional process of education and training (Winkler, Leonard & Shanley, 2001, pp. xi-xiii).

The analysis above assumed that the benefits of distance learning can be fully exploited in many military education and training programmes without compromising the quality of training. This means that careful choices need to be made as to which parts of a given programme can be delivered by distance learning. The benefits of traditional learning should also be maintained where appropriate. Decisions on the conversion of content to distance learning should also consider some of the intangible but still important benefits of traditional learning, such as the opportunity to network and connect with professionals in an academic environment (Leonard et al.,2001, p. 6). The *Captains' Career Course* study analysed four variations of course conversion which are related to the possibility of referring candidates to courses and which are not applicable to the SAF situation. This study focuses only on the version that is most like our system of education, namely that the student is present in the school or institution providing one of the forms of training throughout the entire period of the course. This version is called PCS (*Permanent Change of Station*), with a reduction in the time at the institution due to the use of distance learning for one quarter of the duration of the programme (total number of hours). Although this version has the smallest increase in available days, it has other advantages. This is the simplest adaptation of traditional education by reducing the time that attendees must spend in an educational institution. In the US case, this version also proved to be the best in terms of reducing the adverse impacts on the family, while at the same time significantly improving the stability of the units by making officers (commanders) available to their unit for longer

periods (Leonard et al., 2001, pp. 28-32). A comparison between the variables in terms of the increase in the number of days officers were available at their unit barracks (bases) is shown in Figure 3.

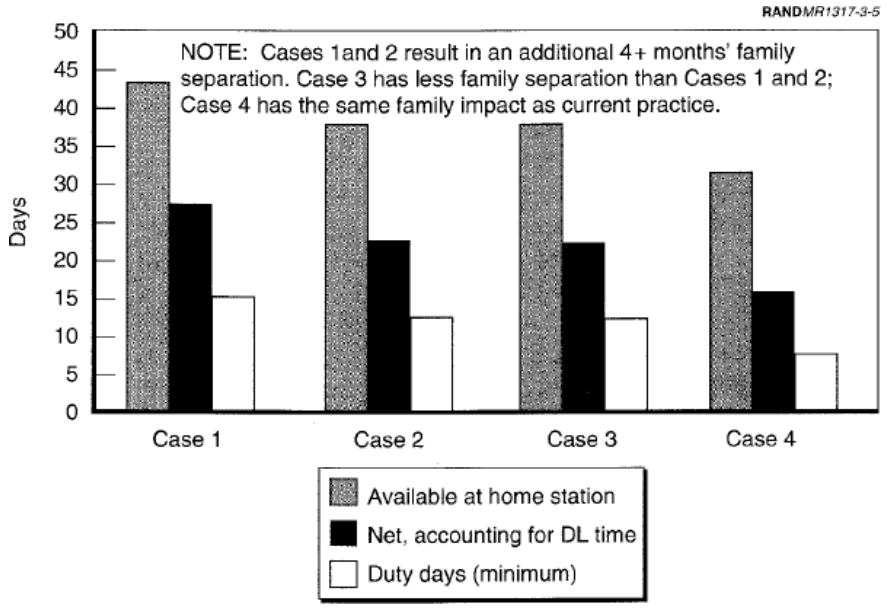

Figure 3: Increase in days available.
Source: Adapted from Leonard et al., 2001, p. 32

The study also analysed the dependence of the increase in days available on the increase in the proportion of programme delivery by distance learning. As expected, there is a linear relationship between the number of days an officer is available (across all three criteria) and the size of the distance learning share. The higher the proportion of distance learning, the higher the availability of the officer in the unit, as illustrated in Figure 4. This assessment supports the conclusion that the higher the proportion of content delivered by distance learning, the better. This is of course not always the case; there is a limit to how far we can go with converting content into e-learning. This limitation comes from deciding how much of the content, which includes tactics, leadership, planning, and decisions support processes and a range

of other potentially complex content, can be converted and delivered as distance learning or e-learning. The analysis indicated the potential benefits of further content conversions to e-learning if they can be supported in terms of training effectiveness. Since the use of e-learning reduces training time, it is important to carefully select which content and how much of the curriculum can be effectively taught using e-learning or distance learning (Leonard et al., 2001,pp. 32-34).

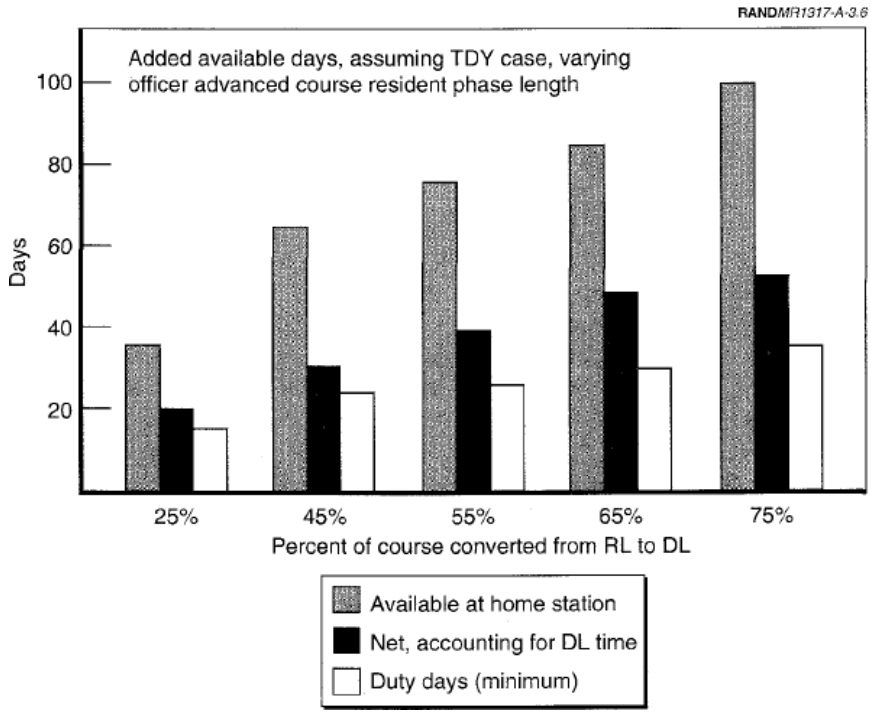

Figure 4: The link between availability and distance learning
Source: Adapted from Leonard et al., 2001, p. 33

The summary of the research provides findings that are partially applicable to the SAF and Slovenian military education and training system. The first such finding is that the conversion of parts of the curricula into e-learning and distance learning formats increases the availability of soldiers in their

units and, in the case of officers, the leadership stability of these units. In most of the cases under consideration, the availability to their families is also increased, which is important from the perspective of the members' morale and welfare. The second finding points to the maintenance of the current patterns for officers' career courses, with a corresponding shortening of certain phases of the programme where this is made possible by the conversion to e-learning with distance learning. The summary concludes with the observation that e-learning has enormous potential to harness technology in ways that are beneficial to the armed forces. The research demonstrated that distance learning can reduce absence from units and separation from families for training by shifting some education and training requirements to unit locations. This is generally feasible at comparable or lower costs than traditional education. Other areas where e-learning can help include tailoring to the needs of the individual learner or the unit and providing introductory or refresher courses for additional skills. However, e-learning is not the solution to all the training challenges. Care should certainly be taken in the choice of content, as a large part of the training required by the armed forces (in general) is not suitable for this form of training (Leonard et al., 2001, pp. 57-60).

Another important aspect is the officers' career course, which was highlighted as an example of a good practice in the training of armoured unit officers, both from the active forces and from the reserve. In the case of permanent structure, the impacts of converting 25% of the curriculum into e-learning or distance learning were analysed. This also considered the fact that 44% of the curriculum is already delivered by asynchronous distance learning in reserve officer training. In other words, 44% of the content is available or delivered without direct interaction with the lecturer or instructor. The authors concluded that 25% of the content is feasible or not a problem, even assuming that all the instructor-led training must be completed at the institution in the traditional way. In mentioning this course, it is also important to highlight how it shows the potential of how comparable education and training can be organized and delivered, and that in 1999 it received an award for excellence from the *U.S. Distance Learning Association* (Leonard et al., 2001, pp. 19-22).

E-learning and distance learning benefits are not limited to prospective cost savings and increased time or availability at unit locations. The main advantage of e-learning is the ability to efficiently deliver training in a way that can be tailored to the individual learner's needs in terms of time, content, focus, and speed of study. This feature can be useful in almost any educational setting, but it is even more valuable in today's environment of rapid technological growth, frequent deployments, and other distractions for military members regarding their assigned tasks, and broader leader knowledge and skills requirements. A common belief stressed in the educational literature is that continuous education is more valuable than education at discrete intervals. Distance learning allows the member to focus on areas where they need improvement or additional skills at the right time and the right place. These general benefits of e-learning and distance learning are available in almost any platform – self-motivated and committed members can use distance learning capabilities to improve their performance, add to their general education, and broaden their professional perspectives. For military education and training, one of the greatest potential contributions is the possibility of providing "training on demand". Distance learning can also be used as just-in-time skills training. This is particularly useful when members are performing jobs for which they are not formally trained and in preparing officers for service in selected functional areas.

E-learning also makes refresher training more readily accessible, which has important implications for a military that is increasingly dependent on skills that can quickly become obsolete due to technological advances (Leonard et al., 2001, pp. 51-52).

Financial impacts of e-learning in the saf

The financial impacts of e-learning in the SAF are expressed in terms of savings and therefore may not be as tangible at first sight as, for example, the earnings of a company marketing e-learning. These savings are reflected in the time spent by staff on training as part of their official duties, and travel and course costs that the SAF would potentially have to pay to an external training provider.

In accordance with the data of the E-Learning Centre, on average users complete more than a third of their e-learning (between 34 and 39%) in their free time (Figure 5). A careful analysis and calculation would yield many hours spent by users in the defence system (and public administration) in their free time for various forms of training in the context of their official duties.

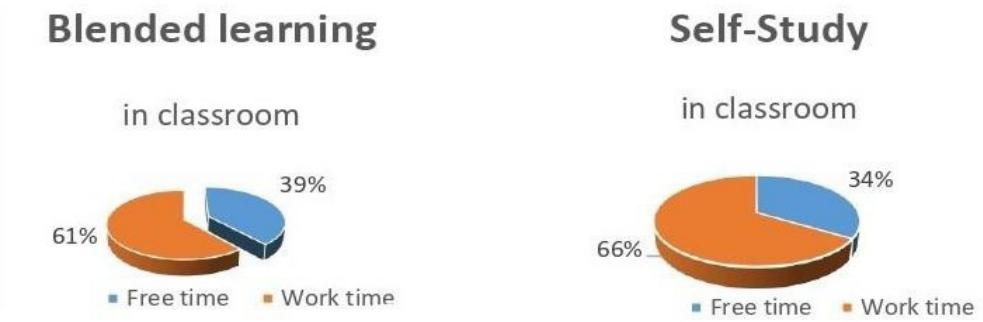

Figure 5: User time in blended and independent learning
Source: Ščavničar, 2020

Multiplying the calculated hours by the average hourly rate of a public administration employee would allow us to calculate the cost savings for the training budget. Additionally, travel costs saved when studying from home can be added. We also need to add to this the cost in value of each e- course to get an estimate of the positive financial impacts of the SAF's use and delivery of e-learning. For illustrative purposes, Table 1 shows average prices for some of the courses in the wide range of e-courses offered by different providers in the Slovenian e-learning market.

Table 1: Prices of some e-courses on the market (in Slovenia)
Source: Adapted from Omisli.si, 2021.

Distance learning	Distance learning price
Online distance programming course	20-30 €/h
Online English course	€100-2000
Online German course	€100-2000
Online private lessons in mathematics	10-20 €/h
Online private lessons in physics	10-15 €/h
Online private lessons in English/German	15-30 €/h
Online guitar lessons	10-25 €/h
Online course in graphic design	€270-500
Online course in photography	10-15 €/h
Online course in accounting	€130-900
Online course in Excel	20-40 €/h
Online course in computing	€100-400
Online course in speed-reading	€9-100
Online course in rhetoric	€200-600
Online massage course	€40-100
Online cooking course	€10-50

The estimated saving in travel costs is calculated only for those users who have taken any of the self-study courses in the current year. In calculating the travel cost savings, we considered the costof one return bus journey from the place of work to Ljubljana (in Ljubljana, a return journey on public urban transport), based on data from the E-Learning Centre database. To calculate the value of e-courses, we used an estimate of the average price based on the publicly offered e-courses online (Omisli.si, 2021). Added to these costs could be the so-called "dead hours" incurred during transportfrom the place of work to the place of delivery of education and back. A simulation of the value of the courses, the travel costs saved, and the overall positive budgetary impact is shown in Table 2.

Table 2: Simulation of financial impacts of the E-Learning Centre
Source: Ščavničar, 2020.

Year	Number of courses	Value of the course	Travel costs	Total
2010	118	€11,800	€844.58	€12,644.58
2011	374	€37,400	€2,676.90	€40,076.90
2012	2788	€278,800	€19,955.07	€298,755.07
2013	7207	€720,700	€51,584.00	€772,284.00
2014	5710	€571,000	€40,869.24	€611,869.24
2015	12094	€1,209,400	€86,562.63	€1,295,962.63
2016	14053	€1,405,300	€100,584.15	€1,505,884.15
2017	19562	€1,956,200	€140,014.74	€2,096.214.74
2018	23203	€2,320,300	€166,075.14	€2,486,375.14
2019	24557	€2,455,700	€175,766.38	€2,631,466.38
2020	48440	€4,844,000	€346,708.61	€5,190,708.61
Average price		€100	€7.16	€107.16

The overall simulation of the positive fiscal impact over the last ten years of the E-Learning Centre e-classroom clearly shows that the savings are increasing every year. This is why we can say with a high degree of certainty that the financial investment in the introduction of e-learningin the SAF has already been repaid many times over. Unfortunately, we have not been able to obtain the cost of its introduction for a more precise calculation.

Time as a positive impact of e-learning in the saf

Time is one of the most principal factors influencing people's lives and activities. We are active throughout our lives to achieve goals we set for ourselves or that others set for us. As a rule, we needto achieve a goal within a certain timeframe in order to benefit from it – in the short or even the long term. The faster we achieve these goals, the more successful we are. If we achieve a goal faster than others or faster than expected, we are happier and usually have more time for the activities we love and that make us happy – our free time, which has its own value. A similar story exists within the business community. Time is money is a long-established adage that is becoming more relevant every day in a global, information-rich world interconnected through the internet.

Even when something happens on the other side of the world, the moment the information hasreached us we react. To put it a little tongue-in-cheek, there is no timeto sleep. This is why it is even more important to manage our time wisely and prudently. It is therefore a question of time management. While we cannot control time, we can manage ourselves and the way we use the time we have available.

Conclusion

Humans have evolved owing to their unique ability to learn and to change thingsin their favour. Technology provides new opportunities and conditions for change. We may or maynot take advantage of these opportunities. Without the development and use of innovative technologies, there is no progress. Today, thanks to the incredible development of information technology,

change is rapid and profound. Keeping up with change is difficult but necessary. To change for the better, we need to compare ourselves only with those who are more productive and more efficient than we are.

Based on historical experience, distance learning has successfully complemented traditional education and benefited individuals, businesses, educational institutions, and societies (countries) as a whole. Distance learning has evolved over time, depending on the possibilities and technologies then available. Like all novel approaches to learning, distance learning has always had (and still has) its opponents. Nevertheless, it has evolved and improved with the development of new technologies, and its positive effects on individuals, educational institutions, businesses and societies have steadily consolidated its place in modern education.

The Slovenian experience also shows that building an organic e-learning capability was the justifiably correct decision. It is up to us to make the best use of this capability and to keep pace with the development of effective military education. The need for trained personnel is also increasing due to constant transformation and development, and we need to train personnel as quickly as possible. We must make use of all the available skills and capabilities at our disposal.

Based on the results of the analysis of the data and E-Learning Centre experience and the estimated financial impacts, the introduction of distance education is financially beneficial for the SAF. The savings achieved so far have more than justified the development and establishment of an in-house e-learning capability.

The results of the US analysis, which are also validated by the results of a survey of SAF officers, favour of the use of distance learning in military education. The streamlining of time resulting from the use of distance learning is important not only from the point of view of the units sending officers for training, but also from the perspective of the training institution (Military Schools Centre). They all benefit from increased availability of personnel, which for units means the presence of commanders or leaders, and for the Military Schools Centre the increased availability of lecturers, who are usually involved in several courses running in parallel. This means

easier and better coordination of schedules and additional time for updating and supplementing the teaching content and for further training of lecturers.

Today, we are facing major challenges in human resources, and streamlining is particularly relevant in this context. Changes in the environment dictate modifications within the organization, new responsibilities mean new challenges and usually require new skills, and we need effective knowledge management. Experience from abroad (the US Army study) as well as domesticexperience (the Covid-19 study) teaches us that change needs to be implemented rationally and to an appropriate degree. It is also important to consider the fact that technology alone will not have the desired effect unless we develop the personnel using the technology.

The SAF possesses the technology in the form of its E-Learning Centre capability, so it makes sense to invest more effort in training staff to use the existing capability. It is important to realise that future generations of students will be more technologically advanced than their lecturers, and that our collective future and national security rely on education in all its modalities.

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Optimizacija provedbe vojne izobrazbe metodom učenja na daljinu

Sažetak

Svrha je istraživanja analizirati trenutne podatke i iskustvo Središta za e-učenje Slovenske vojske te ispitati mogućnost povećanja pozitivnih učinaka izobrazbe na daljinu njegovim uvođenjem u redovite oblike i programe izobrazbe u Slovenskoj vojsci. Na temelju rezultata analize podataka i iskustva Središta za e-učenje te procijenjenih financijskih učinaka, može se pouzdano tvrditi da je uvođenje izobrazbe na daljinu bilo financijski korisno za Slovensku vojsku. Dosadašnje uštede više su nego opravdale razvoj i izgradnju vlastitih sposobnosti e-učenja Slovenske vojske. U prilog primjeni metode učenja na daljinu u vojnoj izobrazbi govore i rezultati američke analize. Uvođenje metode učenja na daljinu u sustav vojne izobrazbe pokazuje pozitivne učinke e-učenja u njegovoj integraciji u redovite oblike i programe izobrazbe u Slovenskoj vojsci. Njime se povećava vjerojatnost uspješne provedbe digitalne transformacije programa izobrazbe i usmjerava se obrazovne institucije na rješavanje problematike ključnih sadržaja izobrazbe.

Ključne riječi

učenje na daljinu, e-učenje, metode izobrazbe, optimizacija, pozitivni učinci, informacijska tehnologija

Strategos, 7(1), 2023, 71-92
UDK 32
UDK 355/359
Original scientific paper

STRATEGOS

Use of Unmanned Aerial Vehicles in Support of Artillery Operations

Valentina Bartulović, Zvonko Trzun, Matija Hoić

Abstract

Unmanned aerial vehicles (UAVs) recently gain more importance due to their use in military operations and the fight against terrorism. Military forces must follow and encourage the development of modern technologies to improve their tactical and strategic capabilities. It has been shown that in the 21st century, the countries that more extensively use UAVs typically dominate in military operations. The UAVs development announces a significant change in the concept of warfare. An analysis of the UAVs' employment in the Croatian Armed Forces (CAF) shows poor usage of the UAVs. This paper analyses the application of UAVs in the role of the forward observer for artillery operations, based on the experience of the armed forces worldwide. It is proposed to introduce UAVs into the artillery fire support system to increase the capabilities of artillery weapons, including the suggestion to equip the CAF with contemporary UAVs to match capabilities that the armed forces of some other countries have already achieved.

Keywords

unmanned aerial vehicle, Croatian Armed Forces, artillery, forward artillery observer, classes, artillery armament, structure

Introduction

UAVs are aircraft controlled remotely, autonomously, or through a combination of both. They are typically used for operational and strategic reconnaissance and battlefield monitoring. They can also intervene on the battlefield directly by using on-board weapons or indirectly by identifying targets for precision-guided ammunition. Compared to traditional manned aircrafts, their use reduces overall costs, increases task efficiency, and avoids human losses.

The development of UAV technology is one of the fastest-changing trends in history, comparable perhaps only to the earlier, unprecedented spread of personal computers in the early 1990s or mobile phones a few years later. Therefore, it is difficult to keep up with the latest news and changing numbers. For example, data from the analysis (Sayler, 2015) stating that "ten countries currently possess armed UAVs, with at least 20 more openly reported to have active development programs" is already outdated – although this report was produced just eight years ago. And really, the more recent report (from 2019) states that 18 countries have armed UAVs (Gettinger, 2019) and this data is also outdated by now.

The same report also states that the number of countries with military UAV capabilities rose from 60 to 95 in less than 10 years (from 2010 to 2019) and that there are 21,000 confirmed unmanned aircraft currently in service around the world, although the actual number is likely more than 30,000. Further development is expected, as at least 24 countries are currently developing new military unmanned aircraft. The People's Republic of China appears to have the most active UAV development programs of any country, with at least 11 parallel projects underway as of this writing (Adnan Khasan, 2019).

Types of UAVs are reconnaissance, attack, radio-relay, electronic warfare, and multirole. Depending on the equipment, UAVs can be used for reconnaissance and surveillance, observation of land and sea borders, electronic jamming of radio and radar facilities, target detection and identification, nuclear, biological and chemical reconnaissance, camouflage and concealment.

During armed conflicts in recent years, the use of UAVs as instruments of tactical psychology has become apparent. The application of tactical

psychology on the battlefield is about making the other side fight less, or even give up. The use of armed UAVs (which infallibly find opposing troops, no matter how well they are hidden) is aimed at breaking the enemy's will to fight (Prakash, 2021). One of the most prominent psychological effects described by the attacked party is a pervasive sense of anticipatory dread of impending UAV attacks (Amnesty International, 2013). UAVs can hover over target areas for hours as part of continuous surveillance missions, leading to stress, emotional breakdowns, outbursts of anger, increased fear, and the desire to hide or run away when an individual sees or hears UAVs (Hijazi *et al.*, 2019).

This paper provides a brief analysis and addresses two research questions: 1) could UAVs be valuable low-cost systems that create multiple new opportunities for modern armies, including the role of UAVs in extending the capabilities of artillery; and 2) whether the Croatian Armed Forces exploit the full potential of UAVs, or they lag behind to integrate them with all services (especially with the artillery). The selected UAVs will be compared according to the following criteria: flight characteristics (maximum flight time, speed and altitude), control signal range, and price.

General Classification of UAVs

Regarding the classification of military UAVs, the most commonly used is the NATO standard (NATO, 2019), where UAVs are assigned a classification ranging from I to III based predominantly according to their maximum take-off weight: Class I (less than 150 kilograms), Class II (150 to 600 kilograms), and Class III (more than 600 kilograms).

Class III aircraft are sometimes referred to as "medium-altitude long-endurance" (MALE) or "high-altitude long-endurance" (HALE) UAVs. A typical Class III system has an endurance of up to 24 hours or more and a payload capacity of several hundred kilograms. Some Class III UAVs can be operated at a range of several thousand kilometres. Also, many Class III UAVs are capable of carrying a mix of weapons, while others in this class are designed solely for intelligence gathering. The NATO definition of Class III includes three sub-categories – MALE, HALE, and Strike/Combat (Gettinger, 2019).

Such a classification is also in line with the Brooke-Holland preposition (Brooke-Holland, 2012), where the smallest Class I is subdivided into four weight-based subclasses: UAVs weighing less than 200 g are classified as Class (Ia), heavier UAVs are Micro (Ib) and Mini (Ic), while the heaviest are the so-called small UAVs (Class (Id), 20 – 150 kg).

There are other classifications, such as the one in (Arjomandi, 2006) or (Weibel and Hansman, 2004) and others. There is also a good overview shown in (Hassanalian and Abdelkefi, 2017) together with a division into classes carried out according to dominant characteristics, such as propulsion systems and actuators, power supply and endurance, different types of guidance, navigation, and control, etc. As for propulsion, the majority of today's UAVs are equipped with propeller propulsion, while only a few sophisticated ones use a jet propulsion. Also, systems powered by electric motors in combination with fuel cells and solar panels are currently under development.

Classification of military UAVs based on capabilities (and not necessarily the weight) can be found in (Kunertova, 2019), where UAVs are divided into Small UAVs (SUAV), Tactical UAVs (TUAV), Medium Altitude Long Endurance (MALE), and High Altitude Long Endurance (HALE). What this study clearly shows is that the European industry is significantly lagging in terms of UAV development and production. Competitiveness is only good in the category of small aircraft, but weaker in the TUAV category, poor in the MALE category, and virtually non-existent in the HALE category where there is a strong monopoly of American platforms. This 2019 study also mentions "future procurement of Triton by Germany and the United Kingdom", referring to the potential purchase of several U.S. Navy MQ-4C Triton Global Hawk UAVs after abandoning the customized EuroHawk version. The classification proposed in (Kunertova, 2019), despite the different names, does not deviate from the NATO classification. Therefore, HALE and MALE categories correspond to NATO Class III, the TUAV category belongs to Class II, and SUAV belongs to NATO Class I. As for the use of armed UAVs, the United Kingdom is the only European country that operates the armed version of Reaper, while other European countries remain reluctant to arm their UAVs and use them exclusively for ISR (intelligence,

surveillance and reconnaissance) purposes. However, experiences from the Russo-Ukrainian War suggest that such thinking may be outdated.

Table 1 shows the characteristics of different categories of UAVs and some examples of frequently used UAVs.

Table 1. Classification

CLASS	CATEGORY	LEVEL OF USE	OPERATIONAL ALTITUDE	OPERATIONAL RADIUS	EXAMPLES OF UAVS
ClassI (below 150 kg)	MICRO (below 2 kg)	Individual (one operator)	Up to 60 m	5 km	Black Widow
	MINI (2-20 kg)	Tactical Unit (manual operation)	Up to 1000 m	25 km	ScanEagle Raven Skylark
	SMALL (over 20 kg)	Tactical Unit (launch system)	Up to 1500 m	50 km	Hermes 90 Luna
Class II (150-600 kg)	TACTICAL	Tactical formation	Up to 3000 m	200 km	Aerostar Hermes 450
ClassIII (over 600 kg)	Air strike	Strategic / National	Up to 20000 m	Unlimited	/
	HALE	Strategic / National	Up to 20000 m	Unlimited	Global Hawk
	MALE	Operational	Up to 14000 m	Unlimited	Predator B Predator A Harfang Hermes 900

Regarding the comparison of UAVs and manned aircraft, the advantages of the former are multiple: without a human element on board, UAVs have greater endurance and are ideal for surveillance missions. They can collect an unparalleled amount of data and are even better than satellites in this regard. A UAV can serve as a communication relay. In combat missions, they show great accuracy and thus reduce the risk of collateral damage, even compared to guided missiles. It must not be forgotten that the cost of procurement and its use is two or three orders of magnitude lower than the cost of manned aircraft. Even the largest UAVs cost significantly less than fighter aircraft: a Predator system costs $20 million, and a Reaper system costs $53 million. For comparison, an F-22 fighter jet costs about $150 million. It should also be taken into account that with UAVs, there is no longer a risk of losing a pilot (Mosco, 2017), and today a point has been reached where the F-35 Joint Strike Fighter is predicted to be the last manned fighter aircraft. There is more and more evidence in favour of this belief: ever since 2009, the Air Force has been training more UAV operators than fighter pilots, and the proportion of manned aircraft is decreasing year by year. This trend is unlikely to stop in the future (Enemark, 2013). According to a report by the US Department of Defense, four services (including the National Guard) currently operate more than 11,000 unmanned aerial vehicles. These UAVs range in size from the small RQ-11B Raven to the largest RQ/MQ-4 Global Hawk/Triton, which weighs more than 32,000 pounds (U.S. Department of Defense).

Role of UAVs in artillery

Initially, unmanned aerial vehicles were intended for general data collection and reconnaissance, while over time they have found their role in artillery either as part of the Fire Control System (FCS) or as an artillery system on their own. The UAVs were introduced into the FCS of the artillery in the role of the Forward Artillery Observers (FAO). When used as a complete artillery system, the UAV uses weapons carried on-board to destroy the target. A contemporary example is the war between Armenia and Azerbaijan. The combination of Azerbaijani artillery and their UAVs (used as either FAO or as an artillery weapon) proved highly effective in the war (Kohl, 2022).

More recently, following the Russian invasion, Ukrainian artillery inflicts significant damage on the aggressor thanks to the use of low-cost UAVs (Hambling, 2022). UAVs capture and transmit high-resolution images and videos in real time over a radio link to command posts, allowing for precise guidance of artillery fire on enemy formations and objects.

Therefore, in the context of conventional artillery operations, UAVs could be used for artillery reconnaissance, accelerating the decision-making process, achieving greater accuracy in artillery fire, protecting and monitoring the fire position area from enemy attacks, creating 3D digital maps of the area (including the position of enemy formations), and reconnaissance of enemy activities. The UAV can perform the tasks of the FSO far deeper within the enemy-held territory and typically with increased accuracy compared to the human counterpart who is located on the ground.

The introduction of UAVs into the artillery units does not disrupt the function of the forward artillery observer (FAO) (Katsev, 2021). The FAO retains the tasks of determining the target and providing information about it, calling for fire on the target, assessing the fire correction according to the observed miss of the previous projectile or the movement of a target, and sending the information related to the battlefield to which the artillery fire is deployed. It is necessary to provide as much information about the enemy as possible, determine high-value targets, and monitor the enemy's movement. Following the previously mentioned capabilities, the UAV, therefore, does not become a "competition" for the FAO, but a valuable help for faster and better task performance.

It should be noted that UAVs have an advantage due to their increased capabilities with respect to range, high technical resistance, and reliability in operation. Therefore, the first significant difference between UAVs and FAOs is that UAVs have the capability of long-term continuous operation, while human beings get tired over time and the quality of their work decreases. Furthermore, the forward artillery observer is not always able to determine the difference between the target and the point of impact (due to incorrect assessment, poor visibility, blind spot, etc.) – and thus the FAO can never achieve the same level of accuracy in its assessments as the UAV can.

On the one hand, UAVs can overfly the target and gather much more information about the enemy while avoiding the problem of target concealment. When directing the artillery fire, they provide accurate target coordinates and corrections with an accuracy of one metre or less. On the other hand, some targets (e.g. bunkers) are more easily spotted by a human observer from the ground than from assets in the air as they are typically concealed from air raids by conventional airplanes.

As for the weaknesses of UAVs, it must be emphasized that in use (which involves deep penetration into enemy territory), they become targets for potential destruction. Their navigation system could also be disrupted, or they could be shot down by conventional air defence systems. Depending on the level of complexity, they would be expensive and difficult to replace if they get shot down.

However, when considering all the advantages and disadvantages, adding the UAV to the existing FAO significantly increases the capabilities of conventional artillery.

For the use in artillery, the most interesting (within Class I) are small, unmanned aircraft used by the army in most cases to find targets. Their weight ranges from 20 to 150 kg. Usually, a crew of two or more is required, and they use simple launch systems.

Greater possibilities could be obtained by using Class II UAVs: they have a range of up to 200 km, fly at altitudes of up to 5,500 m, and can stay in the air for several hours. They can usually carry a load of up to 100 kg. They generally operate outside the operator's line of sight.

The greatest possibilities are given by Class III UAVs, which have the greatest range and can be controlled using satellites and data links such as mobile networks. The drawback is their low speed, which makes them easy targets for air defence if it has not been previously destroyed or is inadequate (e.g. cannot act on targets at higher altitudes). Also, due to their size, they require a runway for take-off and landing and significant logistical support and infrastructure (United Nations, 2015).

Usage of UAVs in the war between Armenia and Azerbaijan

On 27 September 2020, the war between Armenia and Azerbaijan began over the disputed region of Nagorno-Karabakh. According to (Modebadze, 2021) this was the first war in modern warfare history to be won entirely through the use of UAVs. This example illustrates the value of UAVs in support of artillery operations. Armenia had infantry weapons, artillery, tanks, and air defence systems in its arsenal, while Azerbaijan had additional armed and unarmed UAVs (the Turkish Bayraktar TB2 and the Israeli Kamikaza).

At the beginning of the war, the Armenian forces made a mistake by revealing their artillery positions and air defence systems to Azerbaijani UAVs over Nagorno-Karabakh. After their positions were revealed, they were subjected to attacks. Their supply lines, logistics, and air defence system were destroyed, and they could not withstand the incoming attacks due to the technological deficiency of their air defence. Armenia had UAVs as well, but they were of much lower quality than those in Azerbaijan. The innovative tactical use of advanced UAV technology allowed for dominance over Armenian forces, which relied heavily on conventional Russian weaponry and traditional tactics. Due to heavy losses, Armenian forces were finally forced to sign a ceasefire under unfavourable conditions. This conflict has proven the effectiveness of the use of new technologies in war (Amirkhanyan, 2022).

From the outcome of this war, it can be concluded that the use of UAVs in combination with other weapons leads to dominance over the enemy and ultimately victory. Of course, Azerbaijan's victory could be attributed not only to the technical capabilities of its UAVs, but also to its tactical and professional advantages, or the lack of readiness and capabilities of Armenian forces. But even if Azerbaijan did not achieve victory only thanks to UAVs, most authors agree that they played a key role (Chaari and Al-Maadeed, 2021). This claim can be confirmed by the analyst F. S. Gady (the research fellow on the future of conflict at the International Institute for Strategic Studies), who says that it is not entirely true that tanks and armoured vehicles will become obsolete... but Nagorno-Karabakh has shown the increasing importance of using armed UAVs along with other weapons and highly trained ground forces, and the exponentially more devastating consequences of failure in modern warfare (Dixon, 2020).

An extensive analysis (Mitzer and Janovsky, 2020) reports destroyed war equipment and also estimated losses for each side. The report estimates that Armenian and Nagorno-Karabakh forces, and ethnic Armenians living in the disputed region, lost 185 tanks, 45 armoured combat vehicles, 44 infantry combat vehicles, 147 towed artillery pieces, 19 self-propelled artillery pieces, 72 multiple rocket launchers, and 12 radars. Azerbaijan's losses were only one-sixth of this. Azerbaijan's losses were significantly lower due to the use of UAVs, not only due to their characteristics and capabilities, but also due to the strong psychological impact.

Michael Kofman of the Center for Naval Analyses (CNA), analysing the war between Armenia and Azerbaijan, reached the following conclusion: "Drones offer small countries very cheap access to tactical aviation and precision-guided weapons, allowing them to destroy the enemy's much more expensive equipment, such as tanks and air defense systems." (Dixon, 2020)

All these findings, resulting from the direct combat experience, clearly indicate the importance of UAVs in modern warfare.

Use of UAVs in the war in Ukraine

The conflict in Ukraine further highlights the value of the use of UAVs in artillery. In February 2022, Russia enters Ukraine and begins an attack. The deployment of UAVs in conjunction with artillery represents one of the many twists and turns that the battle has experienced. Unlike Russia, which has degraded its ability to use UAVs, Ukraine utilizes its UAVs to launch effective attacks without wasting material resources and personnel. The UAVs have enabled Ukraine to disrupt Russian supply lines and disable air defence systems. It is a combat that would be regarded as the first real UAV war, providing a glimpse into future battlegrounds (Dijkstra *et al.*, 2022).

Ukraine has been studying UAVs since the Crimean War in 2014. In that operation, the Russian military integrated UAVs into ground tactics to destroy Ukrainian forces with artillery strikes. During the period of eight years, Ukraine formed a small fleet of 300 UAVs based on reconnaissance

UAVs such as the A1-SM Fury and Leleka-100, and later the Bayraktar was added. In addition, Ukraine had large reconnaissance UAVs such as the Tu-141 from the Soviet era, and small American UAVs like the Switchblade.

UAVs have allowed the use of artillery to be more accurate, precise, and cost-effective, accelerating the pace of the war and shifting the initiative to the Ukrainian side. Previously, carrying out an artillery attack could take up to 30 minutes, but now it takes no longer than three minutes. Furthermore, Ukrainian commanders can simultaneously observe multiple approaches and positions, and assess the situation in a much shorter time. UAVs can be in a state of readiness for a designated area, ready to neutralize defence and, when needed, destroy it. They play a significant role in the war in Ukraine, collecting intelligence, correcting artillery fire, and dropping bombs (Gray, 2022). The commander of Ukraine's UAV unit for Khartia, Yaroslav Markevych, says that artillery and UAVs together represent the "most important pair" in offensive operations.

In the following, the detailed use of UAVs in Ukraine is given. A fully equipped UAV (with a camera, transmitter, receiver, etc.) is operated by an operator from a base towards a predetermined point where it flies over Russian positions, records them, and returns to the base. The recorded data is read on computers in the base. Then the process of identifying the locations of Russian vehicles and bases begins. Artificial intelligence, which can also recognize square artificial objects, is primarily used to find Russian positions and equipment, even if they are well camouflaged. Even small deviations from the environment indicate a possible target (e.g. dry leaves in a certain area compared to the surrounding fresh leaves). After discovering the target, the command decides which targets the artillery units will shoot at. Before firing, operators fly again to make sure the target is still in the same place. This double confirmation serves to avoid wasting Ukraine's limited artillery ammunition. During the firing, the command directly monitors the firing of targets and communicates with the artillery unit as needed for fire coordination (Beaubien, 2022).

Special value is seen in the use of laser-guided artillery shells, which allows the Ukrainian artillery to achieve exceptional precision and creates conditions for inflicting significant damage on the enemy. Therefore, Ukraine, by using a combination of unmanned aerial vehicles and smart ammunition, gains a great advantage over Russian forces that do not have or are not trained to use such a combination.

Unmanned aerial vehicles in the Croatian Armed Forces

UAVs were used by the Croatian Armed Forces (CAF) almost during the all stages of the Homeland War. Through the examination of UAV footage, it was determined that the Croatian Army did not excessively utilize its artillery in the areas of Knin and the Dalmatian Zagora during Operation *Storm*. During the same Operation, a UAV platoon from the Sinj area scouted Serbian positions near Knin and monitored the movement of their forces, and lines of communication. Additionally, UAVs were used to adjust and direct artillery fire at the *Red Earth* training ground, where Serbian artillery was concentrated in an attempt to prevent CAF units from advancing closer to Knin.

For all these purposes Class I UAVs were used. They were launched manually and controlled by an individual flight controller. UAVs had a range of less than 50 km and flight duration of up to 2 hours. Their main advantages were mobility and adaptability.

Today, there are several models of unmanned aerial vehicles in operational use in the CAF:

- BL M-99 Bojnik (domestic UAV, actively in use since the Homeland War)
- Skylark Mk I (a UAV of Israeli production)
- Orbiter 3 (also an Israeli UAV).

The mentioned UAVs are currently mostly used for reconnaissance and data collection. However, they are not used in artillery support.

Bojnik M-99

The M-99 Bojnik system is a UAV of Croatian production. The idea to create such an unmanned aircraft emerged at the beginning of the Homeland War, as a result of the need to reconnoitre enemy-occupied territory. The characteristics of the aircraft are as follows:

- weight 36 kg and a wingspan of 4 m
- equipped with TV and photo cameras 6x6 cm
- durability in the air for about 6 hours and a range of up to 120 km.

It is launched from a launch pad mounted on a customized army vehicle and controlled by a radio signal from a ground station. Today, it is assigned to the Centre for Unmanned Aircraft Systems, part of the Intelligence Regiment of the CAF.

Figure 1. The M-99 Bojnik UAV

Skylark I

The mini unmanned aerial vehicle Skylark I has a relatively low weight of 5.5 kg and is launched by hand. Its range is 40 km and it can stay in the air for approximately 2 hours. When operating, it sends a real-time video to a portable ground station. Its main purpose is tactical observation and reconnaissance. It is used in the Centre for Unmanned Aircraft Systems of the CAF Intelligence Regiment, and in the military intelligence companies of the CAF Guards Brigades.

Figure 2. Skylark 1

Orbiter 3B

Orbiter 3B is a UAV used for reconnaissance and surveillance, and is currently the largest unmanned aircraft in the Croatian Armed Forces.

Figure 3. Orbiter 3B

Orbiter 3B has a mass of about 30 kg and is launched from the launch pad. It can spend 6 hours in the air and has a maximum operational range of up to 150 km. It is not visible on radars because it can switch to "stealth" mode due to its delta wings, carbon composite construction, very quiet electric motor, and almost non-existent thermal reflection. Stealth mode also involves interrupting the real-time video signal flow toward the ground station to reduce the electromagnetic reflection, but the recording function continues without interruption. As for the civil service, this system is intended for surveillance and control of fisheries, fire protection, and help during search and rescue missions.

The described aircraft can also be used for military purposes, but in the CAF their capabilities are not fully made use of. Orbiter 3 is predominantly used in intelligence missions, for terrain reconnaissance and data collection. On the other hand, these UAVs have limited capabilities which shows that the CAF is lagging behind compared to the armed forces of neighbouring countries. They have more powerful UAVs, and use them for artillery support and even for offensive operations. The mentioned lag shown by the CAF is all the more dangerous because some neighbouring countries already have Class III UAVs.

Preposition for the selection of new UAVs

This chapter presents an analysis of the available UAVs and their characteristics, which, according to the criteria of price and potential types of use, could compete for introduction into the CAF and then be used for reconnaissance operations, locating targets, and directing fire at the enemy.

Only Class I unmanned aerial vehicles, subclass I(d) "small aircraft", were taken into account. Class II UAVs were excluded from the analysis because of their unnecessarily long range of over 200 km, and Class III UAVs were discarded because of their high cost, large mass, and high radar reflection that make them easy targets. Note: Class II and III aircraft were only discarded if used as an aid to artillery, but they could be extremely useful for other purposes (e.g. anti-armour operations).

As for the UAVs already used in the CAF, Skylark I was not considered due to its short range, and Bojnik M-99 due to its obsolescence compared to new systems (e.g. Orbiter 3B) that offer more advanced functions. After the analysis, three UAVs were selected: Luna, Hermes 90, and Orbiter 3B.

Table 2. Potential UAVs characteristics

NAME	LUNA[1]	HERMES 90[2]	ORBITER 3B[3]
NATO Class	I	I	I
NATO Subclass	I(d)Male UAV	I(d)Male UAV	I(d)Male UAV
Mass (kg)	37	115	30
Max. Flight Time (h)	6 - 8	15	7
Max. Speed (km/h)	70	45	93
Max. Altitude (m)	3 500	4 500	5 500
Cost ($ million)	0.310 (no addit. equipment)	/	0.8 (with addit. equipment)
Range of Data Link (km)	80 - 100	Up to 100	Up to 150
Launch Mode	Pneumatic launcher	Integrated launcher	Pneumatic launcher

Comparing the values shown in Table 2, it may be concluded that the Orbiter 3B achieves an excellent compromise between cost and flight capability. Although it can spend less time in the air compared to the Hermes 90, it makes up for it with a higher maximum flight altitude and range. In addition, it is a smaller aircraft (and therefore a smaller target) which gives it a higher

1 https://web.archive.org/web/20110717032819/http://www.emt-penzberg.de/index.php?id=15

2 https://elbitsystems.com/media/DAVINCI.pdf

3 https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-3-stuas/

survival probability, especially when faced with an enemy that has a strong air defence. Considering the size of the terrain where UAVs are likely to be used and the maximum range of Croatian artillery, we estimate that a stronger system is not required – at least from the aspect of artillery support.

Conclusion

Unmanned autonomous vehicles are expected to play an increasingly important role in future armed conflicts. Recent conflicts have demonstrated that the side that employs UAVs more extensively is likely to gain a significant advantage. This paper presents two case studies that support this conclusion (the war between Armenia and Azerbaijan, and the Russo-Ukrainian war).

As for the use of artillery support, the standardized introduction of UAVs would be a great step forward. Despite their current high cost, this investment proves to be justified as they offer improved terrain reconnaissance, faster and safer transmission of information (often in real time), target detection, and more accurate directing of artillery fire. With UAVs, human lives are not put at risk, and their stealth and precision make them invaluable. Additionally, they also have practical civilian applications such as searching for missing persons, early detection of forest fires, and monitoring of land and sea borders. In comparison to traditional aircraft, UAVs offer significantly lower costs and can be operated by just a few or even one operator in a single area.

The analysis of small unmanned aerial vehicles (Class I(d)) suggests that the Orbiter 3B system is highly suitable for tactical reconnaissance and the support of short-to-medium-range artillery, such as that possessed by the CAF. Additionally, its relatively low cost makes Orbiter 3B the best choice.

The Croatian Armed Forces have recently procured exactly this UAV system. In the future, it will be necessary to continue with the further introduction of Orbiter 3B into the military organization, with the ultimate goal of complete integration of UAVs with components of the army and other branches. This could require the purchase of additional units; nevertheless, the knowledge gathered from the analysed modern-day conflicts shows that this is a justified procurement that delivers new capabilities, especially when used as part of artillery.

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Upotreba bespilotnih letjelica u potpori topničkim operacijama

Sažetak

Bespilotne letjelice (UAV) u posljednje vrijeme postaju sve važnije zbog njihove upotrebe u vojnim operacijama i borbi protiv terorizma. Vojne snage moraju pratiti i poticati razvoj modernih tehnologija kako bi unaprijedile svoje taktičke i strateške sposobnosti. Pokazalo se kako u vojnim operacijama 21. stoljeća u pravilu dominiraju one zemlje koje se više služe UAV-ovima. Razvoj bespilotnih letjelica ukazuje na velike promjene u konceptu ratovanja. Analizom njihove upotrebe utvrđeno je da se bespilotne letjelice nedovoljno upotrebljavaju u Oružanim snagama RH. U ovom se radu analizira primjena UAV-ova u svojstvu rubnih promatrača za topnička djelovanja, na temelju iskustava oružanih snaga diljem svijeta. Predlaže se uvođenje bespilotnih letjelica u sustav topničke vatrene potpore radi povećanja sposobnosti topničkog naoružanja, uključujući prijedlog za opremanje OSRH-a suvremenim UAV-ovima u svrhu usklađivanja sa sposobnostima oružanih snaga kojima se neke zemlje već uvelike služe.

Ključne riječi

bespilotna letjelica, Oružane snage Republike Hrvatske, topništvo, prednji promatrač za topnička djelovanja, klase, topničko naoružanje, struktura

Strategos, 7(1), 2023, 93-104
UDK 32
UDK 355/359
Professional paper

STRATEGOS

The Role of the "Rudolf Perešin" Training Center in the Military and Defense Segment

Melita Boltužić

Abstract

Military training is carried out within the military system with the aim of acquiring knowledge and achieving adequate skills of its members. Active military personnel must be highly trained in order to transfer their knowledge to their trainees who have a high volume of work on military assets. The complexity of the work is constantly changing and challenges can only be overcome through lifelong learning. The focus of the work is the presentation of military training with an emphasis on the implementation of training, specifically in the Training Center "Rudolf Perešin" as a unit within the Croatian Air Force. The key programs and trainings that active military personnel are trained as part of the Training Center were presented. The work of the teaching staff, their abilities and characteristics is presented. The goal of the work is to raise awareness of the importance of training active military personnel.

Keywords

military education, training, instruction, active military personnel, methodology, didactics

Introduction

Military training is a process based on the education, training and instruction of members of the military system in order to improve and perfect it in all areas of activity. The mission of military training is to develop the intellectual, mental, physical and professional abilities and skills of active military personnel. Military training, through the process of training and educating of members, enables solutions to the challenges they face. Its goal is to manage crisis situations in order to bring people's living conditions and safety to the highest possible level. Military education is fundamental for every member of the Armed Forces, while training is a form of education in a specific field. Instruction defines a member for the implementation of specific tasks, which will be discussed in the following text.

The first part of the paper discusses the history of military training and mentions the Homeland War, which accelerated the laying of the foundations for military training in Croatia. The second part of the paper explains the types of training of active military personnel. Later, concrete examples of training in the Croatian Air Force - a branch of the Armed Forces of Croatia - are presented. The continuation of the work brings the very core of the work, i.e. the work of the Training Center "Rudolf Perešin", the forms of teaching and its implementation, lecturers and their contribution to the entire military system.

History of military education

Military education reached its peak between the two world wars, while in Croatia it was experienced at the beginning of the Homeland War due to the challenges faced by members of the military system. The first foundations were laid in 1991 in Kumrovac, Varaždin, Zagreb and Samobor with the implementation of training courses. The initial form of military training was introduced with the establishment of the Military Officer Center in 1992. In the same year, the training of the first generation of the Officers' School began, and the year after the first generation of the Non-Commissioned Officers' School. Following this, the Naval Training Center in Split for

members of the Croatian Navy and the Aviation Training Center in Zadar for members of the Croatian Air Force and Air Defense are being established. Buklijaš (2005:p.102) states that "it is possible to better train officers for their functional duties in units with better organization, greater involvement of teachers and students, revision of existing and creation of new curriculum, linking theoretical teaching with practical-applied forms of training ."

Military education, training and instruction

The military system is an organization that functions on the principle of hierarchy. The character traits of every soldier, non-commissioned officer and officer are born, but it is the education system that shapes individuals ready to think critically with the skills to meet challenges in peace and war. According to Anić (2003), "competence represents a recognized expertise, that is, an ability that someone possesses". Competences are acquired through education and experience. Through military education, training and instruction, competences are acquired for the best possible execution of assigned tasks and challenges. These are basic and specialist military capabilities. Kozina states (2018:p.122) "how military education is carried out at the Croatian Defence Academy (CDA) "Dr. Franjo Tuđman" in Zagreb through military studies with the support of the University of Zagreb". Pursuant to the Law of Services in The Armed Forces of Croatia art 78 NN 75/15, military training is lifelong acquisition of knowledge and skills for all military personnel and is carried out in military schools. General military training, the so-called successively increasing is carried out through four levels of training for officers and non-commissioned officers. Specialist military training trains a military person to perform the duties of a certain military specialty. Military trainings are conducted within units that are specifically organized for the implementation of these activities.

According to Pastuović (2012:p.26), "education is a special form of education, narrowed down to specific, predetermined and directly applicable knowledge and motor skills of narrower transfer value". Through military training, an active military person acquires a number of competencies necessary for performing a certain military duty. Military training provides

narrower specialization for a precisely defined field of work. According to the Law of Service in The Armed Forces of Croatia NN 73/13, 75/15, 50/16, 30/18, 125/19, dated 21. 12. 2019. "military education is a time-limited planned process of acquiring theoretical knowledge and skills in schools and other educational institutions. Unlike military education, military training is a permanent process of acquiring knowledge, skills and abilities of military personnel through education and training. Military instruction is an organized form of activity by which active military personnel are trained to carry out specific tasks". In order for an active military person to be complete, it is necessary to go through all aspects of acquiring knowledge, skills and abilities. It is a process that requires high motivation and courage, all with the aim of acquiring competencies for quality work in the service.

According to Žižak (1997:p.3), there are three basic elements of an expert's professional competence:

- "Professional knowledge that includes all knowledge acquired during education that strengthens and supports professional forms of behavior
- Professional skills that include specific cognitive, interpersonal, social and motor abilities that operationalize professional identity
- Personal potentials, i.e. personality traits, appearance, life experiences, special talents that a person uses every day in fulfilling his professional role."

In order for active military personnel to be able to think critically and have the skills and abilities to perform assigned tasks, they must complete appropriate military education, military training and military instruction.

Military training in the Croatian Air Force

Three branches operate in the Ministry of Defense of Croatia: the Croatian Army, the Croatian Navy and the Croatian Air Force (CAF). The Croatian Air Force has the following units: 91st Wing, 93rd Wing, ZMIN Battalion, Command Company and Training Center (TC).

Figure 1. The organization of the CAF

In the field of military pedagogy and andragogy, the Training Center of the Croatian Air Force "Rudolf Perešin" certainly stands out. It is a key organizational unit for the instruction of all CAF members.

History of the training center

According to the portal of the Croatian technical heritage, The training center was founded on December 15, 1992 at the "Šepurine" military base in Zadar as the CAF Aviation Training Center. The current structure, CAF Training Center "Rudolf Perešin" has been operating since January 1, 2008 in the "Colonel Mirko Vukušić" barracks in Zemunik Donji. The location of the barracks is in an extremely favorable position, just 10 km east of the center of Zadar, near the access to the A1 Zagreb-Dubrovnik highway and not far from the Gaženica Passenger Port. In the immediate vicinity is Zadar Airport, with which it shares a runway.

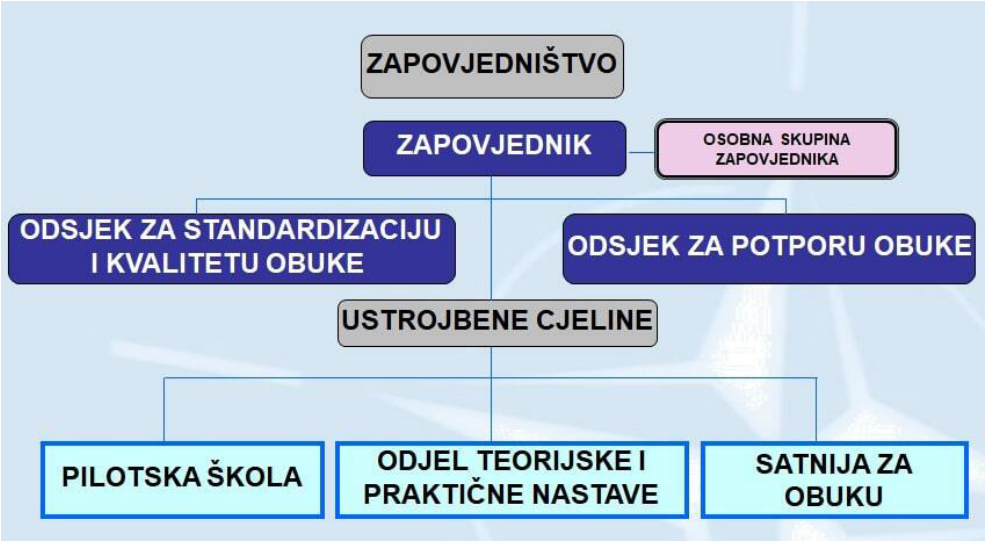

Figure 2. Organization of the TC

The mission of the Training Center is training and education of CAF members, i.e. cadet pilots, officers, non-commissioned officers and soldiers.

Operation of the training center

TC covers two specialty areas: aviation technical service and aviation surveillance and guidance. Training and education in the technical service are:

- theoretical parts of instruction for aircraft ZLIN 242L, PILATUS PC9, BELL 206B-III, OH-58D Kiowa Warrior, Mi-8/Mi-171Sh, AT-802, CL-415
- technical classrooms for ZLIN 242L, PILATUS PC9, BELL 206B-III, OH-58D Kiowa Warrior, Mi-8/Mi-171Sh, AT-802, CL-415
- support of CMA"Dr Franjo Tuđman" in the implementation of the specialist part of the training
- instruction for technicians in the first level of aircraft maintenance
- instruction for engineers in the first level of aircraft maintenance

- instruction of trainers
- functional instructions.

All the mentioned trainings are divided by specialties into Aircraft and engine, Instruments, radio-radar and electrical equipment of the aircraft and Aircraft armament.

Trainings and educations in the field of Aviation monitoring and guidance are:

- basic course for maintaining the FPS-117 radar
- advanced course for maintaining the FPS-117 radar
- FPS-117 radar operator course
- IDO and TPO courses in peace
- IDO and TPO courses in crises and conflicts
- communication subsystem course
- support of CDA "Dr Franjo Tuđman" in the implementation of the specialist part of the training
- functional instructions for duty.

Also, it is important to note that the TC participates in international activities through the NATO smart defense initiative - the Braad project. The courses conducted by the TC are:

- radar technique
- console masses
- process functions.

Partner countries are Bosnia and Herzegovina, North Macedonia and Montenegro.

The area in which the Center operates is wide, including instructions that are conducted on a large number of aircraft, assets, radars, consoles. It is necessary to carry out detailed and high-quality instructions, because even a minor mistake is enough to make the entire system fail.

TC actively cooperates with the University of Zagreb and Zadar. In this way, space is created for connecting academic with military knowledge, skills and abilities. Civil-military cooperation certainly contributes to strengthening the

system. According to Corum (2012:p.19), "the sixth key principle of quality military education is close cooperation between the military and civilian institutions". Kozina (2018:p.125) states that "military education becomes a synergy of academic knowledge and military skills and abilities".

Implementation of training and instruction

Education and training are conducted according to a predetermined plan and program in order to increase its quality. The main goal of learning is to improve and professionally train participants for further work on the means. Active military personnel who are highly trained for their work, train candidates to work on modern technologies and aircraft whose volume and complexity of work is constantly changing and strives for lifelong learning of new skills, knowledge, entrepreneurship, critical thinking. They are divided into officers and non-commissioned officers, that is, lecturers and instructors. Lecturers conduct training, and training instructors. Thus, the lecturers transfer their knowledge to the participants in the form of theoretical learning, while the instructors carry out practice in squadrons and at radar stations. Lecturers and instructors need to know the techniques and methods of teaching that will motivate the participants and raise the training to a higher level. Through motivation, we greatly influence the acquisition of competencies and their development. A motivated participant remembers more easily and quickly, and more successfully acquires new knowledge better and builds on existing knowledge. Lecturers and instructors play a major role in motivating students. Through their work, they can make classes interesting and thus encourage students to think critically, be active and motivated.

Through lifelong learning, lecturers and instructors gain experience and knowledge for successfully conducting education and training. Continuous professional development is very important for them, because by developing their competencies, they raise the entire military system to a high level. Instructors are the ones who take responsibility for the quality of the educational process. Kozina (2014:p.38-39) states "how by developing their competencies, officers encourage the quality of work, the development of

their organization and unit, and thus experience success, achievements and advancement in the service or promotion to a higher rank". Therefore, it is of great importance to work on the training of instructors so that they can properly train their trainees and the entire military system with their competencies. Only a professionally and methodically trained lecturer can guarantee the fulfillment of the goal of training and instruction. Also, an educated active military person achieves faster progress in the service and a positive contribution to his unit.

It must be emphasized that the quality of the instructions of active military personnel is also affected by the place where training is carried out. These are special cabinets equipped with teaching aids such as a blackboard, computer, projector, but also engine parts, aircraft, simulators, weapons and the like. This way of learning helps the participants to master the teaching material easier and faster because there is no dry learning that is tiring and weakens concentration and motivation. The classroom atmosphere is more pleasant, and the achievements of the participants are higher because the didactic aids and work on concrete resources give the possibility of a clearer presentation of the teaching material.

Impact of the pandemic covid-19

It is impossible not to refer to the pandemic caused by the COVID-19 virus, which caused changes in all activities. The aforementioned pandemic also had a negative impact on the education system. Every crisis brings a psychological strain on the individual, a decrease in concentration in the performance of tasks. However, in every negative situation, it is necessary to find an adequate solution as quickly as possible. By overcoming difficulties, new ways to grow and develop are found. The TC readily accepted the challenge, and classes were conducted in accordance with epidemiological measures. Interruption of training and education should not be an option because it leaves unfavorable consequences for the entire system. The most important response to the pandemic was the continued instructing of CAF members. It is a process that must be continuous and flexible so that unpredictable situations do not undermine the goal of the system. In that critical period,

teaching took place smoothly through various models such as remote work or shift work. The lecturers and instructors, as well as the participants, gave maximum engagement. The highest level of the entire military system was achieved through the complete coordination of training in military units. It is a process that requires constant upgrading and developing competencies for making adequate decisions in unpredictable situations.

Conclusion

The Homeland War stimulated the accelerated growth and development of military education and training in the Armed Forces. The military pedagogical process within the military system effectively prepares employees for top-notch work and making adequate decisions in different situations. Military training is divided into military education, training and instruction of active military personnel. In the paper, emphasis is placed on instructions and their implementation in the TC "Rudolf Perešin" - CAF unit. Due to the wide range of challenges in which aviation operates, it is necessary to carry out high-quality instructions for the employees of the Armed Forces. Instruction providers develop their competences in working with participants. They also necessarily follow the professional literature and thus upgrade their work. They also attend professional training to achieve teaching competencies such as initiative, didactics, digital competence, knowledge of foreign languages, and other knowledge and skills in teaching. In this way, the goal of the instructions is achieved - the training of the participants for quality mastering of challenges and adequate completion of tasks. Only in this way can the military system function as it should.

The aim of the work is to point out the importance of continuous growth and development of the military organization through the processes of education, training and instruction. The knowledge and abilities of members are key factors that guarantee overcoming challenges, achieving goals and further developing the system. Through the interaction of academic and military knowledge, optimal results are achieved in the training of active military personnel. The training center is a representative example because it shows how investing in active military personnel encourages the growth

and development of the individual, the success of the military organization and the maintenance of national security as a whole. From this comes the necessity of showing the way and scope of work of the Training Center, as a key link in the Croatian Air Force.

Abbreviations

CDA – CROATIAN DEFENCE ACADEMY

CAF – CROATIAN AIR FORCE

TC – TRAINING CENTER

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Uloga Središta za obuku „Rudolf Perešin" u vojnome i obrambenom segmentu

Sažetak

Vojnoj obuci koja se provodi u vojnome sustavu cilj je omogućiti pripadnicima oružanih snaga stjecanje potrebnih znanja i razvoj odgovarajućih vještina. Djelatne vojne osobe moraju biti vrhunski obučene kako bi svoje znanje prenijele polaznicima obuke koji se u velikoj mjeri služe vojnim sredstvima. Složenost posla neprekidno se mijenja, a izazovi se mogu prevladati samo cjeloživotnim učenjem. U ovom je radu prikazana vojna obuka s naglaskom na provedbi obuke u Središtu za obuku „Rudolf Perešin" kao postrojbi u sastavu Hrvatskoga ratnog zrakoplovstva. Predstavljeni su najvažniji programi i obuke kojima se djelatne vojne osobe osposobljavaju u sklopu toga središta. Prikazan je rad nastavnog osoblja, njihove sposobnosti i osobine. Svrha je ovoga rada podizanje razine osviještenosti o važnosti obuke djelatnih vojnih osoba.

Ključne riječi

vojna izobrazba, obuka, nastava, djelatne vojne osobe, metodologija, didaktika

Strategos, 7(1), 2023, 105-112
UDK 32
UDK 355/359
Review scientific paper

STRATEGOS

Availability of geomagnetic information

Mario Brkić

Abstract

The issue of public availability of the Earth's magnetic field data is not adequately regulated. The paper presents a proposal to declare geomagnetic information publicly available only when its reliability drops to the reliability of the currently best publicly available global geomagnetic model. With such a criterion, the monitoring and prediction of the unreliability of the current geomagnetic information model GI2022 suggests a reliability period of the original geomagnetic information of at least three years from the epoch of reduction of the last geomagnetic network measurements. The same should be the period of geomagnetic information public unavailability in Croatia. During this period it is necessary to pay adequate attention to the data safety.

Keywords

geomagnetic models, geomagnetic information, data dissemination, data safety

Introduction

After the end of 2nd renewal cycle of geomagnetic information in the Republic of Croatia – (Brkić & Pavasović, 2022) carried out for the State Geodetic Administration and the Ministry of Defense of the Republic of Croatia, arose the question of public availability and use of data on the Earth's magnetic field, especially the so-called geomagnetic information (declination and its annual variation). Although the use of geomagnetic information – GI is limited in defense matters nowadays (Rasson & Delipetrov, 2006; Brkić et al., 2020), it is still subject of cycles of measurements of the national territory with the aim of creating GI models and maps, since it reduces risks related to navigation and orientation (Brkić et al., 2017), and maintains this capability after after a possible (nuclear) electromagnetic pulse (Critical National Infrastructures, 2008). Required standard accuracy (6') of national GI models cannot yet be achieved by free and publicly available global models of the Earth's magnetic field such as Enhanced Magnetic Model EMM2017, International Geomagnetic Reference Field IGRF-13, or World Magnetic Model WMM2020 (Chulliat et al., 2020). On the other hand, producing national model is an independent way of securing the GI – a must for a sovereign state.

Since there is a legitimate right of the academic or scientific community and the public in general to use geomagnetic data, the sovereign is required to resolve the issue of data availability without aiding the hidden threat. The Rulebook on basic geodetic works (Official Gazette, 2017), as well as the Rulebook on confidentiality of defense data (Official Gazette, 2018), does not have a suitable answer to that issue. Regardless of legislation, geomagnetic data in the world are *de facto* unavailable only for a limited time, spanning from a few years in Western countries to a decades in Eastern ones. In some countries, geomagnetic data is not publicly available at all (seek for examples in British Geological Survey). The purpose of the paper is thus to motivate and offer a principle for solving a potential security issue in context of state of Croatia.

Reliability period of geomagnetic information

By geomagnetic data let us consider all processed and analyzed data of geomagnetic survey of the Croatian Geomagnetic Repeat Stations Network (Brkić et al., 2013), assuming the conditions of the Geomagnetic Survey Protocol were met: the disturbance index of the Earth's magnetic field K or Kp < 3, the absence of civilization noises, ground anomalies, etc. (Chulliat et al., 2020). Such a data reduced to a certain reference epoch, the middle or beginning of the year, determine the declination, while the annual change of declination is derived from the reduced declinations of successive epochs and modelled into normal annual variation model (Brkić & Pavasović, 2022). Such a geomagnetic information could be found on geomagnetic models or topographic maps. Since the annual variation of the Earth's magnetic field is by its very nature unpredictable, therefore models and maps need to be periodically updated (see e.g. Brkić et al., 2013, and the references therein).

The reliability of the original geomagnetic information for the epoch of publication of a GI model or the reliability of the GI model, determines |errD| or the absolute difference of the declination predicted by the GI from the actual or measured declination. Due to the unpredictable change in declination, GI reliability decreases over time, so renewed GI models are valid or reliable (within a given standard accuracy of 6') for about three years. The increase of unreliability in time is monthly monitored (Brkić, 2019) by comparison of the GI model declinations to quiet days (Matzka et al., 2021) measurements at the observatory.

By monitoring the actual GI2022 model (based on latest network surveys in 2018 and 2021) in relation to LONjsko Polje observatory, the monthly maximal absolute unreliabilities max|errD| were determined and ploted in Figure 1. In April 2023, max|errD| for the GI2022 model was around 1.9', and it can be expected that its reliability will reach the standard error (6') in the next year at the earliest (see Figure 1). Thus the suggested period of unavailability of the actual geomagnetic information in that case would be about 2.8 years from the last reduced survey (epoch 2021.5).

The behaviour of unreliability is rather nonlinear (Brkić et al., 2013) so one can expect predictions in between faster exponential and slower linear trends; how these functions fit the data will only become clear after the end of monitoring. According to the latest (May 2023) predictions, the reliability of the GI2022 model will become 9′ and equal the reliability of the best available Enhanced Magnetic Model EMM2017 for the territory of the Republic of Croatia around August 2024. Therefore, the period of GI reliability or GI unavailability period should be defined as the period of time required for the reliability of the GI (model) to drop to the reliability of the best model at the repeat stations or obsevatory. This is currently 9′ for the EMM2017, so the suggested period of unavailability of geomagnetic information would be about 3.2 years from epoch 2021.5.

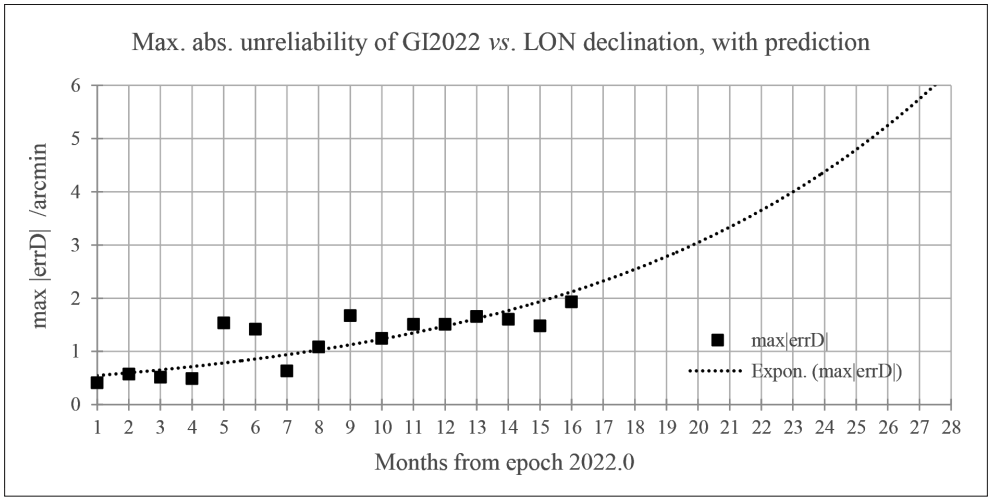

Figure 1. Max. abs. unreliability of GI2022 *vs*. LON declination, with prediction.

The principle can be applied to the other two global publicly available models, IGRF-13 or WMM2020, which are of comparable reliability of about 15′ at the territory of Croatia. Current GI reliability will deteriorate to that limit around 2025.0. If only those models were available, the period of unavailability will amount to approximately 3.7 years from epoch 2021.5. Note that the each inclusion of new monthly data slightly changes the coefficients in exponential

fitting function, affecting more the far away predictions; this means that a lower limits (6′ or 9′) are expected to be reached in about 3 years from epoch 2021.5. However, the GI renewal should be based not only on predictions but firstly on regular monitoring of model unreliability (Brkić, 2019).

These considerations refer to the INTERMAGNET's LON observatory, and it is assumed that the same essentially applies to the entire geomagnetic repeat stations network of Croatia. For a more trustworthy assessment, it is desirable to establish more (at least temporary) observatories or variometer stations near the borders of the national territory. Other reasons for the establishment of the second Croatian geomagnetic observatory can be found in the aforementioned papers.

Cnclusion

The unavailability of geomagnetic information is justified if it can provide an advantage in situations of (potential) threat. However, after some period of time the geomagnetic information should be available to the public. Geomagnetic information may become publicly available only when its reliability drops to that of the currently best publicly available global model. In practice, the reliability limits can be set, for example, to 6′, 9′ or 15′, corresponding to GI (model) reliability periods, i.e. GI unavailability periods of about 2.8, 3.2 or 3.7 years. These periods are more or less realistic predictions; reliability should be monitored monthly up to the limit set. Anyway specified reliability limits provide periods comparable to the Western geomagnetic data availability periods. At a times when war is in the neighborhood and can spill over into the Croatian national territory, it is justified to set a reliability limit at least to 9′. Only in peace, or in the absence of the probability of war, it is reasonable to relax the limit to 6′. Accordingly, it is proposed to adjust (rise) the degree of secrecy of the geomagnetic information, and to remove the degree completely after the expiry of the reliability period, whenever the monitoring will impose it. Note that the issue of public availability loses its meaning if the preservation and access to geomagnetic information, as well as appropriate legislation and supervision, are not properly resolved as well.

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Dostupnost geomagnetske informacije

Sažetak

Pitanje javne dostupnosti podataka o Zemljinom magnetskom polju u Hrvatskoj nije odgovarajuće riješeno. Rad predstavlja prijedlog kojim se geomagnetska informacija proglašava javno raspoloživom tek kada njena pouzdanost padne na onu od trenutno najboljih javno dostupnih globalnih geomagnetskih modela. Uz takav kriterij, praćenje i predikcija nepouzdanosti aktualnog modela geomagnetske informacije GI2022 sugerira razdoblje pouzdanosti izvorne geomagnetske informacije od najmanje tri godine od epohe redukcije posljednje izmjere nacionalne geomagnetske mreže. Jednako bi tako trebalo biti razdoblje nedostupnosti geomagnetske informacije u hrvatskoj javnosti. Naravno, tijekom tog razdoblja nužno je posvetiti prikladnu pozornost sigurnosti samih podataka.

Ključne riječi

geomagnetski modeli, geomagnetska informacija, diseminacija podataka, sigurnost podataka

Strategos, 7(1), 2023, 113-140
UDK 32
UDK 355/359
Pregledni znanstveni rad

STRATEGOS

Umjetna inteligencija – cilj, način ili sredstvo strateškog natjecanja?

Dražen Smiljanić

Sažetak

Dostignuti i očekivani tehnološki pomaci u umjetnoj inteligenciji (UI) postali su izvor napretka, ali i geopolitičkog natjecanja te straha od njezine potencijalno neetične uporabe. Osim toga, uloga umjetne inteligencije postala je sve istaknutija i u međunarodnoj politici, što se može uočiti po značajnim ulaganjima u istraživanje i razvoj te tehnologije i ulozi koju ciljevi povezani s njom imaju ili mogu imati u strategijama država. Nameće se stoga pitanje je li razvoj i implementacija umjetne inteligencije cilj, način ili sredstvo strateškog natjecanja. U članku se daje pregled motivacijskih čimbenika i ambicija te mjera koje SAD, Rusija i Kina poduzimaju u razvoju umjetne inteligencije, u kontekstu zauzimanja liderskih pozicija. Također se raspravlja o prilikama i rizicima povezanim s proliferacijom UI tehnologije u međunarodnoj politici. Procjenjuje se uloga koju ova tehnologija može imati u autoritarnim sustavima i liberalnoj demokraciji. Također, procjenjuje se utjecaj ove tehnologije na globalnu ravnotežu snaga i sposobnosti ratovanja. U zaključku, konstatira se da globalno natjecanje u razvoju i implementaciji umjetne inteligencije daje ovoj tehnologiji istodobno ulogu i cilja i načina i sredstva.

Ključne riječi

umjetna inteligencija, strateško natjecanje

Uvod

Prošle industrijske revolucije stvorile su značajne promjene u ravnoteži snaga velikih sila (Horowitz et al., 2018). Takav potencijal mnogi prepoznaju i u razvoju i implementaciji umjetne inteligencije (UI). Henry Kissinger (The Economist, 2023a) tvrdi da su SAD i Kina u situaciji sličnoj onoj neposredno prije Prvog svjetskog rata, koja bi mogla dovesti do sukoba, ali da umjetna inteligencija čini da se te tenzije ne odvijaju pod „uobičajenim okolnostima". Razlika je sada u tome što, smatra Kissinger, veliki rivali imaju na raspolaganju ne samo nuklearno naoružanje već bi s umjetnom inteligencijom mogli biti na korak od stvaranja drugog alata koji bi mogao „izbrisati" čovječanstvo.

Općenito, natjecanje u razvoju i implementaciji UI tehnologija ima potencijal preoblikovanja međunarodne politike jer se natječu i države, a ne samo tvrtke. Implikacije utrke u području umjetne inteligencije nadilaze razvoj tehnologije i imaju značajne geopolitičke, ekonomske i upravljačke implikacije:

- Geopolitičke implikacije: Države se nastoje nametnuti kao lideri u umjetnoj inteligenciji i natječu se za utjecaj u globalnom ekosustavu umjetne inteligencije. Državni akteri koriste i strateška partnerstva i saveze kako bi unaprijedili svoje sposobnosti uz potporu umjetne inteligencije.
- Ekonomska konkurentnost: UI se smatra jednim od ključnih pokretača ekonomske konkurentnosti zbog razvoja novih UI tehnologija i industrija. Natjecanje u privlačenju talenata, ulaganja i tvrtki za razvoj UI tehnologija i aplikacija postaje sve više predmet ekonomskih politika koje donose države.
- Globalno upravljanje: Razvoj umjetne inteligencije nameće pitanja o globalnom upravljanju jer države i tvrtke razvijaju tehnologije koje imaju značajne društvene, ekonomske i političke implikacije. To dovodi do potrebe za međunarodnom suradnjom i upravljanjem u rješavanju pitanja kao što su privatnost podataka, kibersigurnost i problemi povezani s etičnom upotrebom umjetne inteligencije.

Ova nova vrsta konkurentnosti u području UI tehnologija može se smatrati strateškim natjecanjem između država jer UI ima potencijal transformirati i industrije i vojne sposobnosti. Neke države (a prednjače SAD i Kina) ulažu

velika sredstva u istraživanje i razvoj umjetne inteligencije kako bi stekle stratešku prednost pred svojim suparnicima.

Sadašnji razvoj UI-ja dotiče se svih dimenzija strateškog „tronošca" cilj-način-sredstva (Lykke, 1989), dok je realno pretpostaviti da bi u „zreloj" fazi razvoja ta tehnologija trebala biti prije svega „sredstvo" (engl. *means*) i eventualno djelomično „način" (engl. *ways*). U radu se između ostalog nastoji identificirati mjera u kojoj UI utječe na elemente „strateškog tronošca".

U članku se prvo sagledava UI kao „varijabla" strateškog natjecanja. Analiziraju se percepcije, politike i načini postizanja ciljeva u području razvoja UI-ja u SAD-u, Rusiji i Kini te ispituju čimbenici koji motiviraju razvoj umjetne inteligencije. Nakon toga se raspravlja o prilikama i rizicima povezanima s proliferacijom UI tehnologije u međunarodnoj politici. Radi ilustracije, procjenjuje se i uloga koju ova tehnologija može imati u autoritarnim sustavima i liberalnoj demokraciji te područja za koja bi moguća strategija za praćenje UI-ja u Republici Hrvatskoj mogla dati okvir i smjernice za djelovanje. Na kraju se daje zaključak o utjecaju UI-ja na globalnu ravnotežu snaga te na glavne komponente strategije (ciljevi-načini-sredstva), u kontekstu strateškog natjecanja u razvoju UI-ja.

Umjetna inteligencija i strateško natjecanje

Umjetna inteligencija (UI) doživljava se kao remetilačka (engl. *disruptive*) tehnologija. U optimističnoj predodžbi, očekuje se da će se njezin učinak koristiti prvenstveno za boljitak i dobrobit čovječanstva te donositi ekonomsku i drugu korist (na primjer, u obrazovanju, zdravstvu i slično). No, smatra se da UI ima i potencijal koji može svojim vlasnicima donijeti i odlučujuću nadmoć u postizanju strateških ciljeva. S obzirom na ozbiljnost napora koje poduzimaju SAD, Kina i, barem deklarativno, Rusija, može se zaključiti da su očekivanja velika. Kina, a i Rusija, smatraju umjetnu inteligenciju perspektivnim alatom koji bi mogao pridonijeti postizanju njihovih ciljeva preoblikovanja globalnog poretka (vidi više u: Wright, 2018).

SAD i Kina trenutačno predvode po visini financijskih ulaganja u umjetnu inteligenciju i dominiraju narativom vezanim uz tu tehnologiju. Podatci pokazuju da su ukupna globalna ulaganja u umjetnu inteligenciju u 2021.

godini iznosila 92,95 milijardi dolara, a očekuje se da će porasti na 301,43 milijarde dolara u 2026. Ukupna godišnja stopa rasta bila je oko 26,5 % (IDC, 2022).

Natjecanje za globalno vodstvo između Kine i SAD-a u UI-ju i strojnom učenju uvelike je u tijeku. No, za sada SAD ima globalno vodstvo u razvoju UI-ja. U usporedbi s ambicioznom Kinom, SAD prednjači u području hardvera, istraživanja i razvoja te dinamičnosti komercijalnog UI sektora. Unatoč poduzetim naporima, Kina još ne može dostići SAD u razvoju poluvodiča i raspoloživosti stručnjaka. Štoviše, ove dvije zemlje koriste vrlo različite pristupe razvoju umjetne inteligencije. U SAD-u se ulaže u UI uglavnom kroz sveučilišni obrazovni sustav, u koji je ugrađen razvoj i istraživanje, koje je i omogućilo današnji UI. Kina, s druge strane, ima sveobuhvatan pristup poticanju razvoja umjetne inteligencije, kombinacijom financiranja, političkih inicijativa i strateških partnerstava čiji je cilj učiniti zemlju globalnim liderom u umjetnoj inteligenciji.

Druga skupina država, uključujući Kanadu, Japan, Njemačku i Ujedinjeno Kraljevstvo (MSC, 2019) slijedi iza SAD-a i Kine, sa značajnim zaostatkom. Prema *McKinsey's Start-up and Investment Landscape Analysis* (SILA), ukupna ulaganja u umjetnu inteligenciju u 2018. godini iznosila su 43 milijarde dolara u SAD-u, 7 milijardi dolara u Kini i 8 milijardi dolara u ostatku svijeta (MSC, 2019).

Natjecanje u razvoju umjetne inteligencije već bi se moglo okarakterizirati kao „objava rata". Iako je još teško zamisliti UI kao digitalno oružje, njegova upotreba u autonomnim sustavima već je uvelike razvijena. Svjetske velesile bore se za dominaciju, ali i za definiranje generacija tehnologije koje tek dolaze. Međutim, za razliku od primjerice svemirske utrke, „UI natjecanje" nema jasnu ciljnu liniju. Konkurencija u razvoju umjetne inteligencije također dovodi u pitanje tradicionalni pojam „kontrole naoružanja", zbog inherentnih karakteristika umjetne inteligencije, koja se prvenstveno oslanja na softver (i podatke), a ne na hardver, pa je inherentno dvostruke namjene. Ovi su izazovi prvenstveno etičke prirode i uglavnom su povezani s korištenjem smrtonosnog autonomnog oružja (engl. *Lethal Autonomous Weapons* – LAWS). Ukupno su se 82 zemlje članice Konvencije Ujedinjenih

naroda o konvencionalnom oružju (*the United Nations Convention on Conventional Weapons* – UN CCW) sastale u travnju 2018. kako bi razmotrile zabranu smrtonosnog autonomnog oružja. Protivno očekivanjima, dok Kina pripada skupini zemalja koje izričito podupiru poziv na zabranu smrtonosnog autonomnog oružja, neke su zemlje izričito odbile pregovore o novom međunarodnom zakonu o potpuno autonomnom oružju. Među njima su Francuska, Izrael, Rusija, Velika Britanija i Sjedinjene Američke Države (Campaign to stop killer robots, 2018).

Ovaj metaforički nastavak svemirske utrke događa se uglavnom u komercijalnoj sferi i predstavlja nastavak trenda tranzicije istraživačkih i razvojnih napora te investiranja u napredne tehnologije iz vojnih u komercijalne okvire. Kako bi se procijenila uloga umjetne inteligencije u natjecanju velikih sila, koja ima i svoju geopolitičku dimenziju, ključno je predvidjeti karakter suparništva i potencijalnog oružanog sukoba koji bi se mogao voditi. Trenutno je glavna orijentacija zapadnih vojski, a na to je značajno utjecao i rat u Ukrajini, prema razvoju sposobnosti za združeno ratovanje (konvencionalne vojne sposobnosti, uključujući kibernetičke i svemirske operativne domene), potpomognute naprednim tehnologijama. No, razumno je očekivati da će sukobi budućnosti imati i visoku razinu neregularnosti (vidi, na primjer, Jones, 2018; McFate, 2019). Paradoksalno, ta je neregularnost posljedica upravo pokušaja da se izbjegne izravan sraz sa zapadnom vojnom i ekonomskom nadmoći. Dakle, sve dok zapadne konvencionalne (i nuklearne) snage predstavljaju vjerodostojno odvraćanje – suparnici (protivnici) koristit će svaku drugu priliku i doktrinu za postizanje svojih dugoročnih ciljeva.

UI bi doista mogao igrati ključnu ulogu u tom (visokotehnološkom) natjecanju, premda se istodobno može vidjeti snažne američke konvencionalne snage (brodove američke ratne mornarice) raspoređene u Južnom kineskom moru i velika ulaganja i Kine i SAD-a u nove generacije (konvencionalnog) oružja. Obje se države nadaju da će im nove remetilačke tehnologije, uključujući nova oružja, dati vojnu prednost u nadolazećim godinama. Sustavi u koje ulažu, trebali bi iskoristiti nedavni napredak u robotici, umjetnoj inteligenciji i kvantnom računalstvu. Kao rezultat toga, istraživanja u domeni umjetne inteligencije dolaze u fokus interesa koji je obično rezerviran za obrambenu

industriju koja proizvodi oružje. Prije toga, tijekom više desetljeća, UI tehnologija razvijana je u okruženju međunarodne suradnje i slobodnog protoka ideja.

Za bolje razumijevanje potencijalnog utjecaja (čak i neizravnog) umjetne inteligencije na međunarodne odnose, korisno je analizirati trenutna postignuća i razinu ambicija u razvoju umjetne inteligencije u SAD-u, Rusiji i Kini.

Sjedinjene Američke Države

UI se u SAD-u brzo razvija, a pored komercijalne primjene, potencijalno je značajan i za nacionalnu sigurnost. Međutim, za razliku od nekih drugih zemalja, američka vlada još nema razvijenu koordiniranu nacionalnu strategiju za povećanje ulaganja u umjetnu inteligenciju ni adekvatne odgovore na društvene izazove koje proizvodi njezina uporaba. Kao rezultat javljaju se pokušaji zaustavljanja razvoja ove tehnologije na neko vrijeme, do donošenja pravne regulative i dogovora (konvencije) oko upravljanja ovom tehnologijom. Obamina administracija postavila je temelje za američku strategiju u tri odvojena izvješća, od kojih je jedno bio Nacionalni strateški plan za istraživanje i razvoj umjetne inteligencije (POTUS, 2016). Taj je dokument zacrtao strateški plan za javno financirano istraživanje i razvoj umjetne inteligencije. Administracija predsjednika Trumpa zauzela je drukčiji pristup umjetnoj inteligenciji, orijentiran na slobodno tržište. Pristup umjetnoj inteligenciji Trumpove administracije artikuliran je u četiri vladina cilja: (1) zadržati američko vodstvo u umjetnoj inteligenciji, (2) podržati američke radnike, (3) promicati javno istraživanje i razvoj i (4) ukloniti prepreke inovacijama (POTUS, 2018).

National Artificial Intelligence Initiative (NAIIO, 2021) kao svoju misiju definira: osigurati kontinuirano vodstvo SAD-a u istraživanju i razvoju umjetne inteligencije, voditi svijet u razvoju i korištenju pouzdane umjetne inteligencije u javnom i privatnom sektoru te pripremiti sadašnju i buduću radnu snagu SAD-a za integraciju UI sustava u svim sektorima gospodarstva i društva.

U obrani i nacionalnoj sigurnosti, istraživanje umjetne inteligencije trenutno je u tijeku u područjima obavještajnih podataka (prikupljanje i analiza podataka), logistike, operacija u kibernetičkom prostoru, zapovijedanja i nadzora (C2) te niza autonomnih vojnih vozila (Hoadley & Lucas, 2018). Neki stručnjaci tvrde da čelnici SAD-a, unatoč značajnim ulaganjima u razvoj umjetne inteligencije, uglavnom nisu svjesni kako SAD gubi „tehnološki rat" s Kinom. Štoviše, tvrde da SAD nema strategije za „sprječavanje povijesnog gubitka" (Andriole, 2018).

U Nacionalnom strateškom planu za istraživanje i razvoj umjetne inteligencije SAD-a navodi se da je 2015. savezna vlada uložila približno 1,1 milijardu dolara u neklasificirano istraživanje i razvoj umjetne inteligencije (POTUS, 2016). Od 2015. godine ulaganje savezne vlade SAD-a u neklasificirano[1] istraživanje i razvoj umjetne inteligencije i srodnih tehnologija poraslo je za više od 40 %, uz značajna ulaganja u obrambenim i obavještajnim zajednicama u području klasificiranih istraživanja (The White House, 2018). Prema Goviniju, neovisnoj istraživačkoj skupini, Pentagon je potrošio otprilike 7,4 milijarde dolara na nove tehnologije u fiskalnoj 2017. godini (Govini, 2017). Umjetna inteligencija činila je otprilike 33 % ukupnog iznosa, ali navedene veličine također uključuju kvantno računalstvo i analizu velike količine podataka (engl. *Big Data*) te druge informacijske tehnologije.

U SAD-u se općenito pretpostavlja da njihova sposobnost inoviranja predstavlja način održavanja i ponovnog stjecanja tradicionalne tehnološke nadmoći, čime se osigurava kontinuirana vojna nadmoć. Međutim, današnji tehnološki trendovi nisu pogodni za očuvanje takve odlučne, nesporne prednosti. Razlog je tome činjenica što se vrhunska istraživanja i razvoj sve više odvijaju unutar privatnog sektora jer se brzina tehnološke difuzije (engl. *spin-off*) iz vojnog u komercijalni sektor značajno povećala. Također, većina novih tehnologija inherentno je dvostruke namjene. Kako bi osigurao bržu implementaciju komercijalnih tehnologija u nastajanju u sposobnosti američke vojske, Pentagon je 2015. godine pokrenuo takozvanu Postrojbu za obrambene inovacije (engl. *Defense Innovation Unit* – DIU) koja mu pomaže u ostvarivanju suradnje s novoosnovanim tvrtkama. Kako bi osigurao bližu

1 Odnosi se na stupanj tajnosti, a time i dostupnosti široj javnosti.

suradnju sa Silicijskom dolinom, Pentagon je smjestio Postrojbu za obrambene inovacije u Mountain View u Kaliforniji. Međutim, pokazalo se da američka vlada od privatnih tvrtki ne može tražiti istu lojalnost kakvu uživa Peking. Godine 2018. Google je objavio da neće nastaviti projekt umjetne inteligencije s Pentagonom nakon što su tisuće Googleovih zaposlenika potpisale pismo izvršnom direktoru, prosvjedujući zbog njihova doprinosa programu čiji je cilj bio poboljšati sposobnosti ciljanja bespilotnih letjelica (Harwell, 2018).

Rusija

Govoreći ruskim studentima u rujnu 2017., predsjednik Vladimir Putin rekao je da će onaj tko postigne napredak u razvoju umjetne inteligencije zavladati svijetom. „*Umjetna inteligencija je budućnost, ne samo za Rusiju, već za cijelo čovječanstvo. Dolazi s kolosalnim prilikama, ali i prijetnjama koje je teško predvidjeti. Tko god postane lider u ovoj sferi, postat će svjetski vladar*" (Gigova, 2017). Ova je tvrdnja često bila citirana, ali bez konteksta, kao dokaz ruske ambicije da sudjeluje u tehnološkoj utrci naoružanja za UI. Kao rezultat toga, ruske sposobnosti i ambicije u području umjetne inteligencije uvelike su precijenjene, što je postalo očito tijekom njihove agresije na Ukrajinu u veljači 2022. U istoj izjavi Putin je primijetio kako Rusija ne želi vidjeti da bilo koja zemlja „monopolizira" to polje i dodao: „*Ako postanemo lideri u ovom području, podijelit ćemo to znanje i iskustvo s cijelim svijetom, na isti način na koji danas dijelimo svoje nuklearne tehnologije*" (Gigova, 2017). Ova proklamacija spremnosti na dijeljenje znanja čini se krajnje nerealnom iz zapadne perspektive nakon razlaza s Rusijom 2022.

Čak i prije invazije na Ukrajinu, Rusija je bila daleko od vodstva u UI tehnologiji, a ekonomske sankcije dodatno su je prisilile na zaostajanje i u razvoju i korištenju drugih naprednih tehnologija. Rusija je uložila znatno manje u istraživanje i razvoj umjetne inteligencije i drugih tehnologija u nastajanju od Sjedinjenih Američkih Država i Kine. To je očekivano s obzirom na to da rusko gospodarstvo čini manje od 2 % svjetskog BDP-a, u usporedbi sa SAD-om s 24 % i Kinom s 15 %. Na primjer, pet godina prije rata u Ukrajini Rusija je držala jedanaesto mjesto, u rangu sa zemljama poput Kanade ili Republike Koreje (The World Bank, 2017). Prema procjeni, rusko godišnje

domaće ulaganje u umjetnu inteligenciju iznosilo je oko 700 milijuna rubalja ili približno 10,5 milijuna dolara (Bendett, 2018).

Ključni izazov s kojim se Rusija suočava u razvoju i uporabi umjetne inteligencije u različitim sektorima raspoloživost je eksperata i talenata. U Rusiji se, objektivno, premalo ljudi bavi proučavanjem umjetne inteligencije, istraživanjem novih metoda ili implementacijom UI algoritama u različitim kontekstima. Nasljeđe sovjetskog obrazovnog sustava, koji je bio naveliko hvaljen za matematičko i prirodoslovno obrazovanje, polučilo je nešto uspjeha u razvoju umjetne inteligencije na nekoliko elitnih ruskih sveučilišta, ali se generalno taj razvoj nalazi znatno ispod drugih razvijenih zemalja u istraživanju visokih tehnologija (vidi, na primjer, OECD, 2019).

Kada je riječ o službenim strategijama, Rusija do sada nije razvila ni jednu službenu strategiju koja bi se fokusirala na UI. Ruski predsjednik Vladimir Putin dao je nalog svojoj vladi 30. siječnja 2019. da razvije pristupe nacionalnoj strategiji o UI tehnologiji (Kremlin, 2019). Moskva je nedvojbeno bila svjesna nepovoljnog položaja Rusije u globalnoj konkurenciji umjetne inteligencije. Rusko strateško ponašanje od 2014. godine, uključujući rat u Ukrajini, nije bilo podržano tehnološkim napretkom za koji se pretpostavljalo da je Rusija razvila (npr. hipersonične rakete i sposobnosti za sprječavanje pristupa / uskraćivanje područja). Imajući na umu jaz između ambicije i kapaciteta, Kremlj je očito uložio svoje resurse u ona područja u kojima bi Rusija potencijalno mogla imati komparativnu prednost pred zapadom (tenkovi, samohodno topništvo itd.), a to prije svega znači konvencionalne vojne i obrambene tehnologije.

Ipak, ruska spremnost da iskoristi i nove remetilačke tehnologije, ima cilj potkopati zapadnu meku moć i koheziju. U tom smislu, korištenje umjetne inteligencije može pružiti priliku za lakše manipuliranje ljudskim emocijama i odlukama te izvlačenje osjetljivih informacija s društvenih mreža. Tehnologija umjetne inteligencije također može pružiti prilike za distribuciju „dubokih krivotvorina" i emocionalno manipulativnog sadržaja te biti u mogućnosti doprijeti do ciljane publike s visokim stupnjem točnosti.

Nekonvencionalni alati, poput kibernetičkih napada, kampanja dezinformiranja, političkog utjecaja i nezakonitog financiranja, koji se često

opisuju kao dio hibridnog ratovanja, postali su središnje načelo ruske strategije prema zapadu. Rusija je koristila te alate za projiciranje svoje moći i utjecaja izvan svojeg neposrednog susjedstva („bliskog inozemstva"). Međutim, cjelokupna perspektiva umjetne inteligencije za ovu vrstu asimetričnog ratovanja ostala je, čini se, još neistražena. Ipak, umjetna inteligencija ima potencijal umnožiti rusko korištenje dezinformacija, namjerno širenje lažnih i pogrešnih informacija kako bi se utjecalo na unutarnju i vanjsku politiku i društvo u nekoj državi. Za razliku od konvencionalnih vojnih kapaciteta, SAD i Europa nisu adekvatno pripremljeni za odgovor na hibridni rat vođen umjetnom inteligencijom u domeni informacija (Polyakova, 2018).

Kina

Razvoj umjetne inteligencije u Kini mora se promatrati u okviru kineske „velike strategije". Kineska vlada postavila je ambiciozan program, „Made in China 2025", s ciljem da Kina postane vodeća industrijska sila. Kina želi postati simbol za inovativnost i proizvode visoke kvalitete te prestati biti arhetipom za imitaciju i jeftinu robu masovne proizvodnje. Ovaj je program dio šireg cilja Kine da postane „inovativna nacija". Kineski 13. petogodišnji plan 2016. – 2020. (CCoCP of China, 2016) primjer je kako je ovom cilju dan prioritet na najvišim razinama Komunističke partije Kine. Pet godina poslije, 14. petogodišnji plan (CCoCP of China, 2021) ne pridaje eksplicitnu pozornost umjetnoj inteligenciji. Plan je, međutim, visoko prioritizirao digitalizaciju i inovacije.

U srpnju 2017. Državno vijeće Narodne Republike Kine (NRK) objavilo je Plan razvoja umjetne inteligencije sljedeće generacije (PRC State Council, 2017), pod nazivom „Umjetna inteligencija 2.0" (AI 2.0). Plan je imao cilj voditi svijet u teorijama, tehnologijama i primjenama umjetne inteligencije. Najbolje ga je shvatiti kao plan u tri koraka, uključujući držanje koraka sa zapadom do 2020., njegovo prestizanje do 2025. i postajanje globalnim liderom do 2030. (uključujući to da budu glavni svjetski centar inovacija umjetne inteligencije, inteligentno gospodarstvo i inteligentno društvo). U dokumentu se navodi nekoliko ambicioznih ciljeva, ali ostaje nejasno koje su strategije razvijene za njihovo postizanje. Kineska vlada očekuje da će do

2030. kultivirati domaću industriju umjetne inteligencije vrijednu 1 trilijun RMB (približno 150 milijardi dolara), s povezanim industrijama u vrijednosti od 10 bilijuna RMB.

Prema Institutu Wuzhen u Hangzhouu, Kina je bila drugi najveći ulagač u umjetnu inteligenciju u svijetu 2016. U razdoblju 2012. – 2016. kineske tvrtke za umjetnu inteligenciju primile su 2,6 milijardi dolara financiranja, što je bitno manje od 17,9 milijardi dolara ubrizganih u američki sektor umjetne inteligencije (The Economist, 2017). Međutim, Kina ubrzano popunjava prazninu. Dok je Kina činila samo 10 % globalnih UI poslova u 2017., kineske UI razvojne tvrtke te su godine uzele 48 % svih dolarskih financiranja UI-ja, nadmašivši po prvi put SAD u financiranju UI-ja (CB Insights, 2019). U 2020. ulaganja u kinesku industriju umjetne inteligencije iznosila su 174,8 milijardi RMB (oko 22,7 milijardi dolara). Ovo je ulaganje bilo usmjereno na područja kao što su strojno učenje, računalni vid, obrada prirodnog jezika i robotika. Tvrtka koja je privukla najviše ulaganja bila je medicinska tvrtka Medbot osiguravši vrijednost financiranja od 3 milijarde RMB (Statista, 2022). IDC (2022) predviđa da će kinesko ulaganje u umjetnu inteligenciju dosegnuti 26,69 milijardi američkih dolara u 2026., što čini oko 8,9 % globalnih ulaganja i drugo mjesto u svijetu. Posljednjih se godina sve više tvrtki uključilo u eru digitalne inteligencije (the Digintelligence Era) i započelo implementaciju digitalne transformacije (DX) i inteligentne nadogradnje, što je dovelo do veće potražnje za umjetnom inteligencijom. Potaknut politikama, tehnologijama i tržištima, UI koji osnažuje industrije postaje glavni razvojni trend.

Kineska vlada provela je nekoliko politika i inicijativa za poticanje razvoja umjetne inteligencije u zemlji:

- Financiranje i ulaganja: Kineska vlada osigurava značajna sredstva za istraživanje i razvoj umjetne inteligencije. Vlada je osnovala nekoliko fondova za potporu novoosnovanim UI tvrtkama, a također daje porezne olakšice i subvencije za tvrtke koje rade na UI tehnologijama.
- Središta za inovacije umjetne inteligencije: Kineska vlada uspostavila je nekoliko čvorišta za inovacije umjetne inteligencije, koja okupljaju sveučilišta, istraživačke institucije i tehnološke tvrtke radi suradnje na istraživanju i razvoju umjetne inteligencije.

- Razvoj talenata za umjetnu inteligenciju: Kineska vlada ulaže u razvoj talenata za umjetnu inteligenciju, što je vidljivo iz činjenice da je osnovala nekoliko sveučilišta i istraživačkih instituta usmjerenih na UI, a također osigurava programe obuke i stipendije kako bi pomogla u razvoju kvalificirane radne snage za UI industriju.
- Strateška partnerstva: Kineska vlada uspostavila je strateška partnerstva s tehnološkim tvrtkama i istraživačkim institucijama za promicanje razvoja umjetne inteligencije. Na primjer, vlada angažira tvrtke poput Alibabe, Baidua i Tencenta, koje su uspostavile vlastite laboratorije za istraživanje umjetne inteligencije i rade na razvoju proizvoda i usluga koje pokreće UI.

Još jedna vitalna svrha dokumenta „AI 2.0" bila je inspirirati kineske poslovne vođe da postignu nadmoć u umjetnoj inteligenciji u sljedećem desetljeću. To se u dobroj mjeri i događa, a istraživanje Boston Consulting Group pokazuje da je nevjerojatnih 85 % kineskih tvrtki aktivni igrač na području umjetne inteligencije (Duranton, Erlebach & Pauly, 2018).

Projekt „AI 2.0" predstavlja svojevrsni program kojim kineska vlada ne samo da planira iskoristiti svoj utjecaj na razvoj UI kako bi poboljšala nacionalnu konkurentnost i ubrzala industrijski razvoj, već i ojačala svoj kapacitet za razvoj sposobnosti za potrebe nacionalne sigurnosti i obrane. Očekivanja su velika i u pogledu modernizacije Narodnooslobodilačke vojske (PLA). Predsjednik Xi Jinping, obraćajući se nacionalnim zakonodavcima iz PLA-a, u ožujku 2017. godine, pozvao je na produbljivanje vojno-civilne integracije i naglasio da su znanost i inovacije ključ kineske vojne nadogradnje (Xinhua, 2017).

Kineski vojni stratezi predviđaju prijelaz s „informatiziranog" ratovanja, gdje vojska djeluje s pomoću informacijske tehnologije (IT), na ono što se naziva „inteligentiziranim" ratovanjem, pri čemu UI igra ključnu ulogu (kao što se često teoretizira u kineskom časopisu Vojna znanost). Međutim, nema vjerodostojnih dokaza da su eksperimenti PLA-a s umjetnom inteligencijom daleko stigli. Unatoč živopisnoj retorici o potencijalnom utjecaju umjetne inteligencije na oružje i doktrinu kao potencijalnoj promjeni paradigmi vojne moći, čini se da vodstvo PLA-a još nije postiglo ni konsenzus o ovom pitanju.

Budući da Peking namjerava transformirati PLA u modernu, informatičku združenu snagu, također se nastoji nadmašiti SAD u hipersoničnim projektilima, oružju usmjerene energije, elektromagnetskim tračničkim topovima, protusvemirskom oružju te oružju bez posade i UI-ju. Kineska vlada smatra ove potencijalno remetilačke obrambene tehnologije sposobnostima kojima može iskoristiti slabosti SAD-a. Naime, američka vojska ovisi o informacijskim sustavima i svemirskim sredstvima za precizne udare, navigaciju i sustave zajedničkog obavještavanja, nadzora i izviđanja (The US-China ESRC, 2018).

Kinesko vodstvo želi osigurati da se razvoj umjetne inteligencije iskoristi i za nacionalnu obranu. Osmislili su plan „vojno-civilne fuzije" kroz koji bi se resursi i napredak dijelili i prenosili između civilnih i vojnih dionika. Plan uključuje uspostavu i normalizaciju mehanizama za komunikaciju i koordinaciju između vojne industrije i znanstveno-istraživačkih instituta, sveučilišta i poduzeća. Ovaj pristup, međutim, izaziva zabrinutost u SAD-u jer bliska suradnja između kineskog privatnog sektora i PLA-a daje prednost Pekingu u ovoj nadolazećoj „svemirskoj utrci" (Hille & Waters, 2018).

Ipak, očekuje se da će UI u Kini vjerojatno imati više primjena u domeni „društvenog upravljanja". To uključuje zaštitu javne sigurnosti i društvene stabilnosti ili same vlade. Neke od ovih UI aplikacija već su u funkciji, uključujući korištenje prepoznavanja lica za pronalaženje disidenata i kriminalaca. Jedno je izvjesno, kineski ambiciozni razvoj umjetne inteligencije u godinama koje dolaze, neće biti ograničen rastućim etičkim, privatnim i antimonopolskim problemima koji zabrinjavaju zapad. Moglo bi se čak govoriti i o pojavi svojevrsnog „digitalnog autoritarizma" u Kini, koja se suprotstavlja zapadnoj ideji liberalne demokracije. Na taj način razvoj umjetne inteligencije stvara novo ideološko bojno polje između SAD-a i Kine (Goujon, 2018).

Kina tek treba postići značajne originalne rezultate u UI-ju, a zaostaje u kritičnim hardverskim komponentama, kao što su čipovi visokih performansi za strojno učenje. Unatoč retorici, Kina još nije razvila sustavan dizajn visoke razine za istraživanje i razvoj UI-ja. Kineske istraživačke institucije i poduzeća tek trebaju uspostaviti utjecaj na međunarodnoj razini

i popuniti prazninu između postojećeg bazena talenata u Kini i njezine potražnje. Također je simptomatično da je kineski predsjednik pozvao na međunarodnu suradnju samo godinu dana nakon što je najavio agresivni plan za dominaciju umjetnom inteligencijom. Xi je naglasio da je Kina voljna promicati razvoj, održavati sigurnost i dijeliti rezultate s drugim zemljama u umjetnoj inteligenciji. Također je pozvao na bližu suradnju među državama na temama umjetne inteligencije, kao što su zakonske regulative, etika, upravljanje i sigurnost (Wei, 2018).

Zaključno, može se pretpostaviti da bi vodstvo SAD-a u UI-ju i povezanom razvoju moglo biti dovedeno u pitanje kineskim centraliziranim političkim planiranjem usmjerenim na preuzimanje vodeće pozicije u razvoju tehnologija povezanih s UI-jem. Kineska vlada UI-ju pristupa kao području od strateškog značaja. Ovu ambiciju podupiru politike s ambicioznim ciljevima na visokoj razini, međuministarska koordinacija, „civilno-vojna fuzija", državno financiranje istraživanja i razvoja, podrška razvoju radne snage i prijedlozi za međunarodnu suradnju i širenje. Međutim, s obzirom na to da je relativno kasno ušla u globalnu utrku za umjetnu inteligenciju, Kina se suočava s brojnim izazovima u provedbi svojih ambicija, uključujući kratkoročni nedostatak vještina i dugoročna institucionalna ograničenja.

Diskusija

Strateško natjecanje u UI-ju – prilike i rizici

Natjecanje u UI-ju obuhvaća potragu za podatcima, računalnom snagom i rijetkim ljudskim talentima koji će omogućiti pomake u razvoju ove tehnologije. Činjenica da umjetna inteligencija povezuje toliko mnogo bliskih tehnologija i da se koristi u mnogim područjima, objašnjava njezinu moć, a time čini natjecanje u razvoju UI-ja dijelom šireg globalnog tehnološkog natjecanja.

Konkurencija će, očekuje se, ubrzati inovacije, što ima svoju pozitivnu stranu kada je natjecanje u UI-ju usmjereno na postignuća koja su od koristi za čovječanstvo, poput otkrivanja cjepiva. Vrijedno je napomenuti kako su suradnja i partnerstvo također važni aspekti razvoja umjetne inteligencije, iako je konkurencija pokretačka snaga (NSC AI, 2021). Mnoge države i

organizacije prepoznaju potrebu za međunarodnom suradnjom u rješavanju zajedničkih izazova, razmjeni znanja i uspostavljanju etičkih okvira kako bi se osigurao odgovoran razvoj i implementacija umjetne inteligencije. Strateško natjecanje za posljedicu može imati i proliferaciju tehnologije, koja sa sobom nosi prilike i rizike. Oni su, između ostalog:

Prilike

- Povećana učinkovitost i produktivnost: UI može pomoći vladama i organizacijama pojednostaviti procese, poboljšati kvalitetu (točnost informacija) i ubrzati donošenje odluka.
- Poboljšane javne usluge: UI se može koristiti za poboljšanje javnih usluga kao što su zdravstvo, obrazovanje i prijevoz. Na primjer, UI može pomoći u dijagnosticiranju bolesti, personalizirati obrazovanje i optimizirati protok prometa.
- Poboljšana nacionalna sigurnost: UI se može koristiti za poboljšanje nacionalne sigurnosti poboljšanjem nadzora, otkrivanjem kiberprijetnji i poboljšanjem (jačanjem) obrambenih sposobnosti (na primjer: preciznost, brzina detekcije i reakcije itd.).
- Gospodarski rast: Razvoj UI tehnologija i industrija može doprinijeti gospodarskom rastu stvaranjem novih radnih mjesta, povećanjem produktivnosti i privlačenjem ulaganja. Ovdje treba napomenuti i obrnut slučaj, npr. u svibnju 2023. objavljeno je da IBM obustavlja zapošljavanje na 7800 radnih mjesta (oko 30 % zaposlenika u ljudskim resursima i u poslovima koji ne uključuju odnose s kupcima) koja se mogu zamijeniti UI-jem (Tangalakis-Lippert, 2023).
- Globalna suradnja: Razvoj umjetne inteligencije predstavlja priliku za globalnu suradnju jer države i organizacije mogu raditi zajedno na rješavanju zajedničkih izazova kao što su klimatske promjene i javno zdravlje.

Rizici

- Zamjena poslova: Proliferacija tehnologije umjetne inteligencije mogla bi dovesti do sve veće zamjene ljudi UI-jem na određenim poslovima, u određenim industrijama. Hipotetski, sve veća uporaba umjetne inteligencije može rezultirati stvaranjem „beskorisne" klase ljudi koji društvu ne mogu ponuditi nikakvu vrijednost. To je mogućnost

na koju Yuval Noah Harari upozorava u svojoj knjizi Homo Deus (Harari, 2018). Harari objašnjava da su inicijative iz prošlosti prije zahtijevale golem broj pojedinaca, poput industrijalizacije i vođenja ratova, kako bi ispravno funkcionirale i kako bi civilizacija postigla napredak. Nasuprot tome, tehnologije 21. stoljeća mogle bi umanjiti i eliminirati potrebu za pojedincem (ljudima). Primjeri tehnologija s omogućenom umjetnom inteligencijom koje bi mogle u potpunosti zamijeniti potrebu za ljudima uključuju autonomne automobile i dronove, prepoznavanje lica i analizu rendgenskih slika.

- Pristranost i diskriminacija: Sustavi umjetne inteligencije mogu funkcionirati pristrano i diskriminirajuće ako su uvježbani na pristranim podatcima ili su dizajnirani bez uvažavanja društvenih i etičkih normi.
- Prijetnje kibernetičkoj sigurnosti: Sustavi umjetne inteligencije mogu biti ranjivi na kibernetičke prijetnje kao što su hakiranje, povrede podataka i manipulacija.
- Utrka u naoružanju: Proliferacija umjetne inteligencije u vojnoj primjeni mogla bi dovesti do utrke u naoružanju (koje se temelji na UI-ju) kako zemlje razvijaju sve sofisticiranije sustave oružja.
- Nedostatak transparentnosti i odgovornosti: Korištenje umjetne inteligencije u donošenju odluka moglo bi biti problematično ako postoji nedostatak transparentnosti i odgovornosti jer se odluke donose složenim algoritmima.

Može se reći da širenje UI tehnologije predstavlja i prilike i rizike u međunarodnoj politici. Ta je činjenica važna i za vlade i za organizacije i pojedince, koji bi morali uvažiti rizike i djelovati na njihovu smanjenju te istodobno maksimalno iskoristiti prilike koje pruža UI tehnologija.

Nadalje, UI ima potencijal igrati važnu ulogu i u autoritarizmu i u liberalnoj demokraciji, premda, logično, svrha i ishodi razvoja i korištenja mogu biti značajno različiti:

Autoritarni sustavi

- Nadzor i kontrola: UI se može koristiti za poboljšanje nadzora (kontinuiranog praćenja) i kontrole (postupka koji se provodi

neposrednim uvidom) građana. Sustavi umjetne inteligencije mogu nadzirati društvene medije, pratiti pojedince i identificirati potencijalne prijetnje režimu.

- Cenzura i propaganda: UI se može koristiti za automatizaciju cenzure i propagande. Sustavi umjetne inteligencije mogu prepoznati i ukloniti sadržaj koji se smatra kritičnim ili prijetećim za režim te generirati sadržaj koji promiče narativ režima.
- Sustav društvenih kredita: UI se može koristiti za razvoj sustava društvenih kredita koji dodjeljuju bodove pojedincima na temelju njihova ponašanja (npr. Kina). To se može koristiti za poticanje poslušnosti i kažnjavanje neslaganja u autoritarnim režimima.

Liberalno-demokratski sustavi

- Donošenje odluka i upravljanje: UI se može koristiti za podršku donošenju (strateških) odluka i upravljanju u liberalnim demokracijama. Sustavi umjetne inteligencije mogu analizirati podatke i pružiti uvide za podršku kreiranju politika i javnih usluga.
- Personalizacija i praktičnost: UI se može koristiti za pružanje personaliziranih usluga i pogodnosti pojedincima u liberalnim demokracijama. Na primjer, UI sustavi mogu personalizirati zdravstvo, obrazovanje i zabavu.
- Društveno dobro: UI se može koristiti za rješavanje društvenih i ekoloških izazova u liberalnim demokracijama. Na primjer, UI se može koristiti za poboljšanje javnog zdravlja, borbu protiv klimatskih promjena i smanjenje nejednakosti.

Implikacije razvoja i korištenja UI-ja

Specifičnost je umjetne inteligencije u etičkim, društvenim i političkim implikacijama. Razvoj i korištenje sustava umjetne inteligencije trebali bi se stoga voditi načelima transparentnosti, odgovornosti i pravednosti kako bi se osiguralo da služe javnom interesu i promiču demokratske vrijednosti.

Sve veće uvođenje umjetne inteligencije u vojne sposobnosti transformira način na koji će se provoditi vojne operacije pa će se vlade i društva morati prilagoditi tim promjenama. Za ilustraciju može poslužiti primjer

učinkovitosti vojnih snaga međunarodne koalicije na čelu sa SAD-om u 1. zaljevskom ratu, vođenom 1990. – 1991. (npr. uloga naoružanja s preciznim navođenjem i Global Positioning System tehnologije). Potencijalne prednosti umjetne inteligencije u ratovanju uključuju povećanu učinkovitost, brzinu i točnost u donošenju odluka i mogućnost smanjenja broja ljudskih žrtava uvođenjem bespilotnih sustava. No, time se otvara i mnoštvo etičkih i pravnih implikacija vezanih uz uporabu umjetne inteligencije u ratovanju i mogućnosti da umjetna inteligencija utječe na eskalaciju sukoba. Zato će biti potrebno kreirati međunarodne norme i propise kako bi se spriječilo naoružavanje umjetne inteligencije i osiguralo da je njezina uporaba u ratovanju u skladu s međunarodnim pravom (vidi Cummings et al., 2018). Umjetna inteligencija ima i potencijalni utjecaj na radnu snagu, uključujući zamjenu ljudske radne snage tehnološkim rješenjima u vojnoj i obrambenoj industriji. To će zahtijevati anticipiranje društvenih i ekonomskih posljedica uporabe umjetne inteligencije u području obrane.

Henry Kissinger smatra da je ljudski nadzor umjetne inteligencije vrlo poželjan cilj, ali brzina kojom umjetna inteligencija djeluje, učinit će ga problematičnim u kriznim situacijama (Koppel, 2023). Kissinger drži da je utrka u razvoju umjetne inteligencije problematična i zato što se u prijašnjim utrkama u naoružanju moglo razviti uvjerljive teorije o tome kako bi se moglo pobijediti, dok je kod uporabe umjetne inteligencije to intelektualno potpuno nov problem.

Strateško natjecanje u razvoju i korištenju UI-ja stoga je specifično i u svojem strategijskom aspektu. Strategija je, generalno, proces međusobnog povezivanja i uravnoteženja ciljeva i sredstava. Kada se primijeni na dani skup ciljeva i sredstava, rezultat je specifičan način korištenja određenih sredstava za postizanje različitih ciljeva (Vego, 2011). Međutim, strategija se ne smije ograničiti samo na učinkovitu organizaciju sredstava kako bi se postigli ciljevi. Strategija je i sposobnost definiranja ciljeva oko svrhe postojanja onoga za što se razvija strategija, iz čega se zatim derivira održivost i ispunjenje onoga što jest i što se teži postati.

Ciljevi strateškog natjecanja u području UI-ja, kao što su tehnološko vodstvo i gospodarske koristi, nose sa sobom i potencijal nadmoći (prestiža) u području nacionalne sigurnosti, geopolitičkog utjecaja te utjecaja na društvo

(npr. etička dimenzija, transparentnost, pravičnost, „odgovornost" UI sustava te klimatske promjene). Ova nedorečenost strategijskih ciljeva, između ostalog, čini strateško natjecanje u području UI-ja rizičnim i uzrok je nepovjerenja i bojazni prema načinima ostvarenja ovog natjecanja (vidi, na primjer, promišljanja Yuval Noah Harari: The Economist, 2023b).

Prijedlog okvira za strategiju i politike razvoja UI-ja u Republici Hrvatskoj

Republika Hrvatska ne pripada skupini država koje predvode u razvoju i primjeni UI-ja. Međutim, kao članica NATO-a i EU-a, ako već ne zbog vlastitih potreba, Hrvatska ima obvezu razvijanja politika i strategija vezanih uz UI. Ta bi se potreba trebala realizirati, prvenstveno u kontekstu EU-a, koji želi postati svjetski predvodnik u razvoju i primjeni napredne, etične i sigurne umjetne inteligencije i pritom globalno promicati antropocentričan pristup (EU EC, 2018).

Prema podatcima koje objavljuje OECD Policy Observatory, vidljivo je da još nema pomaka u razvoju i donošenju strategije i politike razvoja umjetne inteligencije u Republici Hrvatskoj, na kojoj se službeno počelo raditi u 2020. godini (OECD.AI, 2023).

Moguća strategija za praćenje UI-ja u Republici Hrvatskoj mogla bi dati okvir i smjernice za djelovanje po sljedećim područjima:

- Obrazovanje i razvoj vještina – obuhvaća poticanje osnaživanja obrazovnog ekosustava umjetne inteligencije, ulaganjem u istraživačke programe povezane s umjetnom inteligencijom, uvođenjem tema vezanih uz umjetnu inteligenciju u nastavne programe sveučilišta te uspostavljanjem partnerstva između sveučilišne zajednice i industrije. Nadalje, razvoj talenta za umjetnu inteligenciju mogao bi se potaknuti kroz programe visokog obrazovanja (magistarski i doktorski studiji), osposobljavanja, radionice i stipendije.
- Suradnja istraživačkog, industrijskog i javnog sektora – obuhvaća poticanje suradnje između istraživača u području umjetne inteligencije, tehnoloških tvrtki i industrija te javnog sektora u Hrvatskoj. Poticanje partnerstava, posebice javno-privatnog, moglo

bi ubrzati usvajanje UI tehnologija i rješenja u raznim sektorima, kao što su zdravstvo (poboljšanje dijagnostike i liječenja), poljoprivreda, transport, energetika, industrijska proizvodnja te kibersigurnost.

- Inovacije – obuhvaća podržavanje otvaranja i rasta razvojnih tvrtki koje se bave UI-jem, pružanjem mogućnosti financiranja, (poduzetničkih) inkubatora i akceleratora. Nadalje, važno bi bilo stvoriti poticajno okruženje koje potiče inovacije i poduzetništvo u sektoru umjetne inteligencije, koje bi razvojnim tvrtkama omogućilo razvoj i komercijalizaciju tehnologija umjetne inteligencije.
- Etična i odgovorna umjetna inteligencija – obuhvaća stavljanje snažnog naglaska na etička razmatranja i odgovorne prakse umjetne inteligencije. Isto tako, riječ je o razvoju sustava umjetne inteligencije koji su transparentni, nepristrani i koji poštuju privatnost. To bi se moglo postići definiranjem smjernica i regulatornih okvira za rješavanje potencijalnih rizika povezanih s uvođenjem umjetne inteligencije.
- Podatkovna infrastruktura i pristup – obuhvaća ulaganje u izgradnju snažne podatkovne infrastrukture koja omogućuje sigurno i učinkovito prikupljanje, pohranu i dijeljenje podataka za razvoj umjetne inteligencije te poticanje inicijative za dijeljenje podataka uz osiguranje privatnosti i sigurnosti podataka.
- Funkcioniranje javnog sektora – obuhvaća istraživanje primjene UI-ja u poboljšanju javnih usluga, kao što su zdravstvena skrb, prijevoz, javna sigurnost i administracija. Implementiranje rješenja uz potporu UI-ja ima potencijal poboljšanja učinkovitosti i brzine u pružanju javnih usluga. U ovo područje ulazi i razvoj i korištenje UI-ja u Oružanim snagama Republike Hrvatske, koje bi se u početnoj fazi moglo usmjeriti na primjenu na taktičkoj razini, na primjer, na razvoj sustava za prepoznavanje uzoraka (borbena vozila i slično, u terenskim uvjetima).
- Međunarodna suradnja – obuhvaća poticanje partnerstva i suradnje s drugim državama, međunarodnim organizacijama i istraživačkim institucijama. Sudjelovanje u inicijativama za razmjenu znanja, zajedničkim istraživačkim projektima i međunarodnim UI konferencijama omogućilo bi ostajanje tijeku s globalnim napretkom u UI-ju.

Zaključak

U međunarodnim odnosima umjetna inteligencija ima potencijal postati novo ideološko bojno polje i objekt svojevrsnog nastavka „svemirske utrke", posebice u rastućem nadmetanju velikih sila između SAD-a i Kine. Razvoj UI-ja trenutno je mjesto strateškog nadmetanja, utrke za tehnološku i ekonomsku, ali i vojnu moć. Ostaje vidjeti koliko će UI i vodstvo u njegovu razvoju biti učinkoviti kao pokretač i alat (sredstvo) u preoblikovanju globalnog poretka. Što se tiče pitanja nacionalne obrane, umjetna inteligencija već je implementirana u mnoge platforme za dvostruku namjenu i obranu i sigurno će se sve više koristiti u vojnim sposobnostima u budućnosti. Međutim, dominantan pokretački čimbenik u istraživanju i razvoju ove tehnologije komercijalni je sektor, a ne obrambena industrija. Nedemokratske zemlje bit će bitno manje ograničene ovom podjelom jer njihove vlade mogu „zapovjediti" bližu suradnju između tvrtki i obrambenog sektora (npr. kineska „civilno-vojna fuzija").

Utrka za umjetnom inteligencijom ima značajan utjecaj na globalnu ravnotežu snaga jer uključuje natjecanje između zemalja u razvoju i implementaciji tehnologija umjetne inteligencije. Nekoliko je načina na koje UI utrka utječe na globalnu ravnotežu snaga:

- Ekonomska konkurentnost: Razvoj UI tehnologije i vezanih industrija smatra se ključnim pokretačem gospodarske konkurentnosti. Države koje vode u istraživanju i razvoju umjetne inteligencije, vjerojatno će imati konkurentsku prednost u industrijama kao što su zdravstvo, financije i proizvodnja.
- Vojne (obrambene) sposobnosti: Umjetna inteligencija ima potencijal transformirati vojne sposobnosti, a države koje su vodeće u istraživanju i razvoju umjetne inteligencije, vjerojatno će imati i vojnu prednost (naprednije sposobnosti). UI se može koristiti za poboljšanje nadzora, otkrivanje prijetnji (trendova) i razvoj autonomnih sustava oružja. Međutim, umjetna inteligencija sama po sebi vjerojatno neće u skoro vrijeme biti odlučujući čimbenik u dobivanju rata (pobjede u oružanom sukobu), ali nedostatak primjene umjetne inteligencije u obrambenim sposobnostima dovest će u konačnici do njihove inferiornosti.

- Tehnološko vodstvo: Razvoj UI tehnologija smatra se danas izvorom tehnološkog vodstva. Države koje predvode u istraživanju i razvoju umjetne inteligencije, vjerojatno će biti tehnološki lideri i u drugim područjima.
- Inovacije i poduzetništvo: Razvoj tehnologija umjetne inteligencije također će vjerojatno dovesti do novih oblika inovacija i poduzetništva. Države koje su vodeće u istraživanju i razvoju umjetne inteligencije, vjerojatno će imati uspješan ekosustav razvojnih tvrtki i privući strana ulaganja.

UI na neki način predstavlja i cilj i način i sredstvo (engl. *ends-ways-means*) strateškog natjecanja. Cilj, jer se nastoji postići prednost i globalno vodstvo u razvoju i implementaciji UI-ja. Način, jer je sâm razvoj tehnologije put do postizanja cilja. Na kraju, sredstvo, jer je UI sve više u funkciji donošenja odluka na strateškoj razini te tehnologija koja ubrzava, a u mnogim poslovima i nadmašuje čovjeka.

Može se reći da utrka u razvoju i implementaciji tehnologija umjetne inteligencije (kao strateški cilj) ima potencijal preoblikovati globalnu ravnotežu snaga (ravnotežu moći između država), ako one s naprednijim sposobnostima umjetne inteligencije steknu stratešku prednost. Implikacije te utrke protežu se izvan tehnološkog razvoja i imaju značajne ekonomske, vojne i geopolitičke implikacije. Države koje su vodeće u istraživanju i razvoju umjetne inteligencije, zahvaljujući čitavom tom skupu prednosti, vjerojatno će imati značajnu prednost u oblikovanju globalnog poretka u nadolazećim godinama.

Trenutno UI ima potencijal, prije svega, ubrzati postojeće trendove, pa i one u međunarodnoj politici, ali ne i proizvesti drastične, nepredviđene promjene. No, umjetna inteligencija jest tehnologija koja ima potencijal[2] promjene pravila igre (engl. *game changer*) i može u budućnosti imati značajne implikacije na međunarodne odnose i ratovanje. Vlade, kreatori politika i društva morat će se stoga uključiti u otvorene i transparentne rasprave o etičkim i pravnim implikacijama umjetne inteligencije u ratovanju i raditi

2 Posebno imajući na umu dostizanje tehnološke razine, tzv. Artificial General Intelligence (AGI).

zajedno kako bi osigurali da je njezino korištenje odgovorno i u skladu s međunarodnim pravom.

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Artificial intelligence – the ends, ways or means of strategic competition?

Abstract

The achieved and expected technological advances in artificial intelligence (AI) have become a source of progress, but also of geopolitical competition and fear of its potentially unethical use. In addition, artificial intelligence has become more prominent in international politics, which can be seen by the significant investments in research and development of this technology and the role that the goals related to it have or can have in the strategies of states. Therefore, the question arises whether artificial intelligence development and implementation represents ends, ways or means of strategic competition. The article provides an overview of the motivational factors and ambitions and measures taken by the USA, Russia and China in the development of artificial intelligence, in the context of taking leadership positions. Opportunities and risks associated with UI technology proliferation in international politics are also discussed. The role this technology can play in authoritarian systems and liberal democracy is evaluated. Also, the impact of this technology on the global balance of power and warfare capabilities is assessed. In conclusion, it is stated that global competition in the development and implementation of artificial intelligence gives this technology the role of ends, ways and means at the same time.

Keywords

artificial intelligence, strategic competition

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