Strategos, 5(2), 2021, 225-232
UDK 32
UDK 355/359

STRATEGOS

Review

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EDA Technology Foresight Exercise 2021 – What future awaits us in twenty years?

Objective forecasting of technological trends is one of the preconditions for strategic planning processes in the European Defence Agency (EDA), Key Strategic Activities (KSA), Capability Development Plan (CDP), Strategic Research Agenda (SRA), and the Overreaching Strategic Research Agenda (OSRA). Futurological research in support of military research and technology strategies began in 2015 with several independent activities to monitor technologies and predict their development (Technology Watch & Foresight). Since 2020, these researches have been used in developing the Strategic Compass that will be completed during 2022. It will reduce the gap between the ambition and reality in EU defence and security policy. The three main objectives of this exercise are as follows:

- achieving a strategic, long-term vision (20 to 30 years into the future) of developing emerging and disruptive technologies of either dual or exclusively defence and security significance
- linking technology and CDP development forecasts to the application of EDA's strategic tools: KSA, OSRA, and Strategic Compass
- contributing to the EU's efforts to achieve strategic autonomy in scientific research and development and to equip and modernize defence and security by mobilizing all EU capabilities and capacities.

In 2021, EDA conducted several futurological activities. The most comprehensive was the exercise/workshop titled EDA Technology

Foresight Exercise 2021 for which the public call was issued. It was held from 17 to 25 May 2021 and attended by 160 experts (from defence, business, and academic domains) and independent stakeholders representing 20 EU countries, including the participants from the Republic of Croatia, and attendees from the Joint Research Centre of the European Commission (EC-JRC), NATO Science and Technology Organization (NATO-STO), NATO Allied Command Transformation (NATO ACT), as well as from Switzerland and Norway (EDA, 2021a). Given the epidemiological situation, the activity was carried out entirely via WebEx.

The exercise began with the backcasting activity, looking into the past to better foresee the future. Participants were instructed to refer to old films and literature and look for the indications of technologies that came into use in 2020. They were also supposed to refer to 22 EDA priorities in science and technology. The EC-JRC presented its study of 28 *weak signals* selected from a total of 75 examples from the EC-JRC's 2020 annual report (Eulaerts, 2021). The exercise also involved a group of multidisciplinary foresight experts, so-called "Future Tellers" who based their predictions on four likely outcomes of future events by 2040 (EDA, 2021b). The four futures proposed were: TechUtopia, Business As Usual?, Darwinian Games, and Humanity versus the Hungry Beast. The experts also played the role of the *red team* that challenged the participants in the exercise and constructively criticized their proposals and solutions.

The first narrative was called TechUtopia and foresaw the imminent application of efficient nuclear fusion technologies in energy production and quantum computing. The abundance of clean energy has made it possible to reverse global warming caused by the emission of fossil fuel gases. Quantum computers have provided the opportunity for the application of mathematical models of complex systems used in medicine and pharmacology, but also in social sciences. It enables societies to be governed by artificial intelligence algorithms as well as by human efforts to achieve Sustainable Development Goals (SDG). The dismissal of manual labour, now performed by robots, allows people to be creative and focus on culture, outdoor activities, and sports. As a result, the way of generating income is being redefined. New religions are also emerging, some of which rely on technologies and

intelligent algorithms intending to reach deep space. There are also forces of resistance to universal automation that require the abolition of algorithmic decision-making and a return to traditional ways of governing the societies. Our society's dependence on technology has changed military strategies and doctrines, putting the collective defence of critical infrastructure at the forefront. The development of directed radiation weapons, primarily laser ones, significantly increases the implementation of defensive actions by reducing the possibility of armed conflicts. Geopolitically, the influence of countries that used to be dependent on energy-exporting nations in the fossil fuel era is becoming stronger. On the other hand, former energy exporters are losing their influence. The EU provides efficient assistance to Africa in energy supply and technological development. The economic development of African countries is stopping immigration to the EU while limiting China's influence on African economies that used to be dependent on natural resource concessions. Globally, tensions are dwindling, and the threat of war is waning. Well-being is gradually improving and the technological superiority of law enforcement institutions can now significantly limit and suppress organized crime. The goals of sustainable development enable humankind's progress toward the "Type 2" civilization.

The second narrative is titled "Business as usual?" with the question mark in the title being very significant. According to this scenario, the COVID pandemic will be over soon and the EU economies will be revitalized. However, old tensions over illegal immigration into the EU and the dependence of EU economies on energy and raw material imports are growing into open anti-Europeanism, with Brexit being a prime example. In the United States, a charismatic leader who came to power has been focused on internal relations and problems. Politically, the United States, the EU, Russia, and China have conflicting interests, which are only exacerbated by poor political solutions. There is also global stagnation and the re-emerging of arms race resembling that of the Cold War. However, new weapons based on the use of artificial intelligence, the successful implementation of International Humanitarian Law (IHL), and the International Agreement on the Use of Deadly Autonomous Weapons Systems (ITLAWS) have resulted in a drastic reduction of property destruction and casualties, both fighters

and collateral victims. The preconditions for nuclear disarmament are being met and its implementation has begun. The cause for nuclear disarmament is the proliferation of nuclear weapons in an increasing number of developing countries. New sensors and high-volume data processing technologies made it impossible to launch covert nuclear programs. These positive trends have been driven by significant climate changes that have united the countries in tackling global warming as the biggest problem we face. The effects of climate change are most evident in underdeveloped nations around the equator, but the awareness of the extent of crises has not developed yet and has been manipulated by powerful technologies the media uses to deceive people and create fake news. The thoughts, feelings, decision-making, and actions of EU citizens are influenced by the manipulation of information by state and non-state actors. The EU is establishing a multinational brigade to counter information manipulation, but this has led to more powerful initiatives against EU defence and security institutions interfering in information systems and networks. Some of these initiatives have been supported by other states and criminal organizations.

The third narrative, titled "Darwinian Games" involves genetic modification technologies that are becoming widely available. In addition to the benefits in fighting against new forms of infections, there are many side effects associated with the attempts to improve the human body, make it stronger, more resistant, and able to live longer through DNA and stem cell manipulation. Biotechnologies are changing the food industry by enabling the production of artificial foods. The decline in the number of animals and plants needed to feed humanity has brought positive effects on the climate, which is slowly beginning to recover. However, the emergence of the so-called XNA molecules can cause significant disturbances in environmental balance. There is also resistance coming from *genopuritans* who are physically attacking genetically modified people and other living creatures. This movement is becoming global. Wealthier individuals use this to achieve longevity, health, and beauty. The boundaries in achieving sporting success are being pushed, while the regulation of genetic modification levels is failing due to the economic effects of high-level sports. On the other hand, some people are turning into *genophiles* who independently use biotechnological knowledge

and discoveries to lead humanity towards transhumanism. However, mankind is not united. Old disputes and disagreements are still there, and warfare is gradually moving into the domain of genetic modifications, most often spread by silent biological vectors obtained by secret biotechnological researches. Under the auspices of the UN, many states signed a treaty to ban genetic warfare, which is difficult to impose or control. It could only be achieved by coming up with a detailed DNA sequence of every person's genome, which would completely violate the human right to privacy.

The fourth narrative was called "Humanity versus the Hungry Beast" and was based on the computer revolution in the second half of the 1920's. Supercomputers are becoming widely available and are equipped with sophisticated sensors and artificial intelligence algorithms. Mass production of computers also set new requirements for the raw materials and energy necessary to maintain this stage of production, which led to additional pressure on the environment. The largest computer centres are being built in areas with cold climates to keep their operating costs as low as possible. Crypto currencies are gradually replacing traditional money. Movements are emerging all over the world criticizing the companies behind the largest cryptocurrencies for the rising cost of the energy necessary for crypto mining. The EU hasn't reacted quickly enough and has poorly implement environmental policies. This led to stagnation and caused substantial damage to the agricultural sector, which was already threatened by climate change. That is why the EU is resorting to GMO technologies and imposing taxes on fossil fuels and fertilizers. Nevertheless, food prices in the EU are rising uncontrollably, as is inflation. Due to the decline in the value of traditional money, more and more people use cryptocurrencies. That is why the cash inflow from taxation is getting smaller which results in low public spending and reduced quality of life. The EU is responding to these trends by introducing agricultural zones for the cultivation of basic food and industrial crops with the aim of significantly reducing imports. However, climate change is hampering these efforts, and large areas of the Earth are becoming uninhabitable due to rising sea levels, high temperatures and droughts, and the emergence of invasive insects and uncontrollable tropical diseases. The Arctic has become navigable throughout the year, and countries such as

India and China compete for its resources. Ensuring the smooth navigation and exploitation of submarine resources requires the development of new weapon systems and doctrines applicable to Arctic conditions.

During the eight days, participants could hear seven motivational lectures. During three iterations of the divergent and convergent approaches, 97 ideas were collected with 632 comments and 434 *likes* (EDA, 2021c).

After the third iteration, the following ideas sparked the greatest interest in terms of the number of comments and *likes*:

- space as a new operational domain
- application of lethal autonomous weapon systems in urban conditions
- commercialization of warfare
- Kessler syndrome
- dominant automation of combat systems
- the next generation of weapons of mass destruction
- camouflage and deception adaptive and smart measures
- dilemma: quantity or quality of weapon systems
- posthumanism and transhumanism
- The Arctic as a new operational environment.

Ideas that got most *likes*:

- tensions due to water and other scarce resources
- singularity of artificial intelligence
- mind-reading techniques
- sensors that will enable water transparency
- disinformation and creation of false information
- possibilities of deterministic future prediction.

Ideas assessed as the most relevant for the future of the EU:

- • resilience of all EU infrastructures relevant for defence and security
- • cybersecurity shocks

- aging of the population in Western countries
- Codespace and Storyweapons (see Gleeson, 2020)
- security and protection of soldiers
- exploiting the vulnerabilities of the Internet of Things
- Deepfakes as an anti-democratic weapon
- new variants of COVID-19 and the emergence of new viruses
- cyberspace as a new fully operational domain
- machine learning and cognitive warfare.

Ideas assessed as most certain:

- cybersecurity shocks
- new variants of COVID-19 and the emergence of new viruses
- combat operations in cyberspace
- machine cognitive warfare
- the aging of the population of Western countries
- attacks on infrastructure important for defence and security
- Deepfakes as an anti-democratic weapon
- the risk of losing the moral dignity of the armed forces
- management and fusion of information as a key skill
- general application of artificial intelligence techniques.

On the other hand, the ideas that were marked as the least likely were:

- new economic revolution
- Codespace and Storyweapons
- independence of the Mars colony
- biodiversity in seas and rivers
- mind-reading techniques
- new sources of electricity
- EDA – European Defence Academy
- change in the polarity of the Earth's magnetic field
- climate engineering.

In addition to its Technology Foresight Exercise involving the foreseeing of technological trends, EDA also organized three similar activities in 2020 and 2021: a hypersonic weapons debate, an expert discussion on energy sources for future weapon systems, and an online workshop on propulsion for air and space. All activities were open and involved a large number of participants. The great diversity and an opportunity to join discussions and workshops involving topics from different domains and areas contributed the most to identifying the technologies that will have the biggest impact in the future.

Literature

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