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ENVIRONMENT AND THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE. IS AI HELPING OR HURTING THE PLANET MORE?

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Purpose: The purpose of this article is to provide an overview of the benefits and problems arising from the rapid development of artificial intelligence and its application in environmental protection. The considerations carried out lead to the conclusion that actions using AI, surpassing human capabilities, can be helpful in the realization of the idea of sustainable development and, consequently, in the protection of our planet. However, the environmental costs of developing AI and enjoying its benefits may be higher than the positive results achieved.
Design/methodology/approach: The study is theoretical in nature and is based on a critical analysis of the literature on the subject. The literature has been limited to the part of the literature on the artificial use of artificial intelligence in environmental protection and related environmental costs associated with its development.
Findings: Studies show that the pace of development of modern technology is far ahead of human competence in environmental activities and is a good tool. However, there is insufficient reflection on the environmental costs associated with the development and use of AI.
Originality/value: The technological reality calls for a broader discussion of the environmental costs associated with the development of artificial intelligence and its application, which requires the development of appropriate procedures. The article can serve as a starting point for detailed work on this issue.
Keywords: environment, artificial intelligence, environmental costs.
Category of the paper: Conceptual paper.

1. Introduction

Artificial intelligence in the 21st century has become an indispensable part of human life. It is present in medicine, communications, banking, logistics, science, education, automotive, military, management and marketing, journalism and many other fields. A variety of solutions using AI are also shaping the modern system of culture and technology and are constantly being updated (Zawojski, 2019; Marszałek-Kotzur, 2024). Therefore, the future of humans is

inextricably linked to the development of artificial intelligence (Kuzior et al., 2019; Tomaszewska, 2023). Artificial intelligence has entered the world of man, and in fact man is now living in a world of artificial intelligence. Along with this awareness comes an increasing number of concerns and questions about man's future, his role in the world and his security. The impact of technology on human development, including tremendous advances in artificial intelligence and cognitive technologies, is inspiring representatives from various fields and disciplines. This problem also calls for urgent humanistic analyses, including philosophical ones. After all, the development of artificial intelligence is not without influence on the formulation of predictions about the future of humanity itself. The choice of the topic of this article is dictated by the ambivalence associated with the perception of artificial intelligence. On the one hand, we appreciate its revolutionary role in the modern world. On the other hand, we perceive various dangers arising from its functioning (Marszałek-Kotzur, 2024). Of course, it is difficult to underestimate its analytical and creative potential, but it seems that the dangers threatening from it are too often ignored. This is not just a matter of replacing humans in many activities and the loss of jobs for millions of people around the world (Kuzior, Marszałek-Kotzur, 2022). Nor is it about concerns about AI taking total control over humans, although the above issues are also very important. This article is about environmental issues and climate change problems related to the systematic degradation of our planet. Artificial intelligence, on the one hand, is an invaluable and effective tool used for various activities that exceed the capabilities of humans in the area of implementation of the idea of sustainable development, including environmental protection. On the other hand, however, it negatively affects the environment and exacerbates the climate crisis. In the latter case, there seems to be a lack of sufficiently broad discussion. The fascination with artificial intelligence effectively covers up its dark side, which undoubtedly exists and poses a serious danger to humans. So are the questions resounding enough today: Where does artificial intelligence come from in the physical sense, what "fuel" does it run on, and what are the environmental costs of its widespread use and systematic development? What price will mankind pay for the development of modern technology in terms of protection, or degradation of our planet? In the final analysis, will artificial intelligence help save our planet, or does it contribute more to its destruction?

2. Methodology of research

This study is theoretical in nature and is based on a critical analysis of the literature on the subject. The literature was limited to selected items in the field of the benefits of artificial intelligence as well as the negative effects of its application in terms of environmental impact. The literature study conducted, i.e. the analysis and critique of the literature of the selected publications, made it possible to determine what has been analyzed and how it has been

analyzed in the topic of interest in this paper. It also made it possible to outline the direction of further research. The focus was on issues of explicating examples of positive IS activities in environmental protection. Some selected examples of the benefits of these technologies were cited, and some of their negative effects on humans in selected situations were described. Some probable reasons why artificial intelligence can be destructive to the environment are also described. This article presents only some of the many. Attempts to justify concerns about the future of our planet in the context of further development of artificial intelligence are considered. The research shows that the pace of development of modern technology serves to protect the environment and can help counteract in the face of climate change. At the same time, there is insufficient reflection on the dangers of degradation of natural resources in the area of AI development. The considerations presented here, of course, do not exhaust the whole issue, they are only intended to encourage the reader to do in-depth research in this area.

3. Results of research and discussion

What is artificial intelligence?

AI has the ability to learn, create and memorize huge data sets and communicate between databases. It also has the ability to use the principle of cause and effect (Cymanow-Sosin et al., 2024, p. 59). In the context of discussions on the operation of artificial intelligence, there is talk of so-called machine learning and its subgroup, called deep learning (Kondas, 2022). Deep Learning is the foundation of cognitive computing (Kwilinski, Kuzior, 2020). In this process, a computer learns to perform tasks that are natural to the human brain, such as speech recognition, image identification, natural language processing or a recommendation system. Computers are thus able to learn without directly programming new skills, using neural networks to do so (Gillespie, 2014; Marszałek-Kotzur, 2024). In the process, the algorithms analyze the data provided to them and draw conclusions based on it. They then learn to use the knowledge thus gained in making decisions and solving specific problems. As they process more and more data, they self-improve without reprogramming (Kucinski, 2021). There are many definitions of algorithms. One, describes them as a combination of logical and control processes (Kowalski, 1979), another as procedures for transforming input data into the results we expect by means of mathematical calculations performed by a computer (Neyland, 2018). Algorithms can also be understood as a defining technology, because as such they shape the way we think and perceive the world (Bolter, 1990). They process thousands of complex data in real time, exceeding the capabilities of not just a single person, but entire groups of experts (Kosiński, 2021). Hence they are often used, among other things, to standardize many decision-making processes (Caplan, Boyd, 2018). Therefore, artificial

intelligence appears to be a promising tool in many fields. Including in the fight to protect our planet. Using its capabilities, AI can contribute to the solution of many problems related to ecology and climate change. Its ability to analyze vast amounts of data, identify patterns, and predict outcomes has great potential in understanding and solving problems of environmental degradation.

Use of artificial intelligence for environmental protection

One of the most important problems we face in the modern world is climate change and pollution. Scientists are pinning great hopes in this regard on the use of artificial intelligence. Its virtually unlimited learning capabilities could be key to, among other things, monitoring carbon emissions, predicting climate change, optimizing various processes related to environmental disaster prevention and other activities (Neyland, Möllers, 2017). AI can assist scientists, policymakers or various organizations in making sustainable, ecological decisions. One of the most important applications of AI in the environmental field is the aforementioned monitoring and prediction of climate change. Artificial intelligence can analyze huge amounts of data on temperatures, precipitation, wind and many other atmospheric factors. This allows for a more accurate understanding and more precise prediction of climate change. As a result, it is possible to more effectively plan and adjust measures to protect against the effects of climate change, such as hurricanes, floods, droughts and sea level rise. A serious threat to our environment is the increase in greenhouse gases such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). They trap heat in the atmosphere, causing a gradual increase in the Earth's temperature, thus contributing to global warming. The consequences of this process include the melting of glaciers, rising sea levels and the occurrence of other extreme atmospheric phenomena. Artificial intelligence can play an important role in monitoring and optimizing manufacturing processes, which are a major source of greenhouse gas emissions. By analyzing vast amounts of data, AI has the ability to identify areas where there is any potential to reduce emissions. Through forecasting, trend analysis and mathematical modeling, it can make decisions aimed at more efficient and environmentally friendly production. Using data on energy consumption and other environmental factors, companies will be able to optimize production processes, which will translate into reduced greenhouse gas emissions (Pałasz, 2023). For the realization of sustainable development, the protection of natural resources such as water, soil and energy is a key issue. Artificial intelligence enables more efficient management of these resources. AI systems analyze data from sensors in water supply networks, detecting leaks or predicting failures. This helps reduce water losses and water supply costs. In agriculture, AI-based systems help with precise irrigation, adjusting the amount of water according to the needs of specific crops and local weather conditions. With the development of mankind, the need for natural resources is increasing, leading to their overexploitation and depletion. This phenomenon not only has a negative impact on our environment, but also on the stability of ecosystems and people's quality of life (Nature, 2016).

AI can play a significant role in the conservation of natural resources by monitoring and analyzing environmental data, such as detecting abuses associated with the extraction of coal or other non-renewable energy resources, or tracking illegal fishing activities. In addition, AI can help protect natural habitats by continuously monitoring their condition and identifying potential threats, such as degradation or misuse. With AI-assisted satellite technology, it is possible to monitor oil spills, chemical spills into waterways or illegal logging. AI algorithms analyze images from satellites, detecting anomalies that may indicate pollution or illegal activities (Dydel, 2024). Another important area where artificial intelligence can play an important role is in optimizing energy consumption. The use of algorithms can analyze energy consumption data and predict how it can be optimized. Algorithms can, for example, manage lighting, heating and air conditioning systems in buildings, thereby minimizing energy consumption in cities. Collecting information on work schedules, temperature, traffic volume and many other factors, artificial intelligence can control heating, ventilation and air conditioning systems in buildings, minimizing energy waste and reducing carbon emissions (AI o AI, 2023). Another area where artificial intelligence can help protect the environment is in transportation automation and optimization. Using its autonomous vehicles, it can optimize routes, leading to reduced fuel consumption and harmful emissions. Intelligent systems can also be used to manage traffic, minimizing congestion and regulating the flow of vehicles, thereby reducing road congestion and air pollution. Using sensory technologies, systems equipped with artificial intelligence can analyze the quality of air, water and soil, identifying harmful substances and emitters. When abnormalities are detected, such as exceeding permissible standards, these systems can generate automatic alerts and inform relevant services of the danger. In this way, we effectively control the level of pollution and take appropriate measures to reduce it. Artificial intelligence can also help develop sustainable agriculture. By analyzing data on soil, weather, fertilization and various factors affecting crop yields, algorithmic systems can provide farmers with information and recommendations on optimal farming methods. This makes it possible to reduce chemical abuse, as well as reduce yield losses (ByleEko, 2021). However, the potential of AI in agriculture does not end with plants. There are also opportunities to use it in animal husbandry. With AI's analysis, farmers can make more informed decisions and improve the health of their herd (Palasz, 2023). Artificial intelligence also supports the work of foresters. Combined with remote sensing, it is being used to create digital models of forests. This allows foresters to monitor the condition of trees, assess the biodiversity of forest ecosystems and observe their changes. Experts are also working on methods to accurately measure biometric characteristics of trees and recognize species. The results of the measurements can be useful in many environmental tasks - planting planning, managing alien species, shaping biodiversity. The network of listening posts allows scientists to precisely monitor large areas of forest simultaneously - in the case of traditional methods, this would require the involvement of one and a half hundred qualified experts (Sikorska, 2024; Sozosfera, 2023). There has also even been a conceptual design for an autonomous landscape

infrastructure system, a proposal to integrate artificial intelligence systems into the environmental management process (Cantrell, Martin, Ellis, 2017; Knosala, 2023; Kwiliński, Kuzior, 2020) Another application of artificial intelligence could be in the area of recycling and waste management. Utilizing advanced algorithms and image recognition technology, AI systems can effectively sort waste, allowing for more efficient processing and maximizing recycling. This represents an important step toward the realization of zero waste. One of the key areas where artificial intelligence can help protect the environment is education and environmental awareness building. The use of AI in e-learning systems and educational platforms, allows for the transfer of information and education on sustainability, environmental protection and climate change. Raising public awareness of ecology, can result in the public making more informed choices and taking action to protect the environment (Jaskuła, 2023).

Ecological costs of developing artificial intreligence

Artificial intelligence is one of the most important technologies of the 21st century, driving innovation in almost every field. Generative AI models are transforming the way we work and communicate, offering increasingly sophisticated analysis and content creation capabilities. But behind the technological advances, there are also growing pressures on the environment. Increased demand for computing power, intensive energy consumption, as well as impacts on water resources and the production of electronic equipment are aspects that are often overlooked in the public debate on AI (Kanungo, 2023). It is worth noting their significant impact on the environment and climate. For example, processing texts with these advanced models requires large computational resources and is associated with high energy consumption. It should be noted that both the training of AI language models and the operation of the data centers required to run them require huge amounts of electricity and water resources (Leffer, 2024). Factors such as algorithm complexity, continuous activity, integration with large systems and the need to store large amounts of data can all contribute to increased energy resource consumption. AI chatbots, as well as other AI-based applications, can consume a significant amount of energy, especially if they operate on a large scale or use advanced language models. Some of the chatbots that can consume large amounts of energy are those that handle large user movements or are integrated with systems that require continuous processing, such as chatbots that operate service areas, instant messaging or social media platforms. In addition, chatbots that use advanced technologies such as deep machine learning may also require more computing resources, resulting in higher energy consumption (Halecki, 2024). One of the most serious problems with AI, therefore, is its intense energy requirements. Language and visual models require enormous computing resources (Marszałek-Kotzur, 2022). Training one large AI model can consume as much energy as the average household for decades. Based on studies and reports, including from the Massachusetts Institute of Technology and the UN Environment Program, it is estimated that training the GPT-3 model generated more than 500 tons of carbon dioxide. This used more than 1200 megawatt hours of

energy, enough to power about 120 American households for a year. Also problematic is the fact that many server rooms are powered by fossil fuel energy. Although some technology companies are declaring a shift to renewable energy sources, still much of the global AI infrastructure runs on coal and natural gas. Data centers are likely to account for an increasing percentage of carbon emissions in the coming years. Artificial intelligence also has a huge impact on water consumption. Cooling servers in data centers requires millions of liters of water per year, which in some regions of the world poses a significant threat to local ecosystems. According to a UNEP report, in the near future the equipment used to develop artificial intelligence could use six times more water than the whole of Denmark. Additionally, according to a study conducted at the University of Texas, training large AI models can consume up to several million liters of water per run. The problem becomes even more significant in drought-stricken areas, where any additional use of water resources can lead to serious environmental and social consequences (Azurro, 2024; Ren, Wierman, 2024). Artificial intelligence relies on advanced processors, such as GPUs, which are needed to perform complex calculations. Their production requires the use of rare earth metals. The process of extracting them is extremely energy-intensive and often involves environmental degradation, deforestation and groundwater pollution. In addition, the rapid development of AI is contributing to the growing amount of electronic waste. Processors used in data centers have a limited lifespan and are often replaced every few years, leading to huge amounts of electronic waste. Currently, recycling such components is extremely expensive and complicated, and much of it ends up in landfills or countries with weak environmental regulations (Azurro, 2024). Building the necessary electronic infrastructure requires the consumption of a wide range of critical minerals and rare metals. The very process of extracting them is often carried out in a predatory manner, with no regard for the environment. The result is sometimes soil erosion and the ingress of heavy metals into ecosystems. For example, it takes as much as eight hundred kilograms of raw materials for two kilograms of electronics. In addition, servers and accompanying instrumentation, like all computer equipment in the world, go out of use after a while, creating mountains of electronic garbage. Very often they contain hazardous substances such as lead, cadmium and mercury, which are serious contaminants of water and soil, endangering humans and nature. Unfortunately, the level of e-waste recycling is so far very low. And according to the Global Economic Forum, by 2050 the amount of them on Earth will exceed 120 million tons. Skeptics also point out that it is virtually impossible to estimate all the potential environmental damage associated with artificial intelligence. Examples of AI's controversial impact include the possibility of generating and spreading false information about climate change, which could demotivate some of the public to make green choices. Another threat is the wider use of AI-controlled cars and drones, which could have a negative impact on the animal world (Pavlinec, 2025).

Proposals for regulation of sustainable development of AI

The development of artificial intelligence is not without its impact on drawing down energy resources and generating a carbon footprint. It poses numerous environmental challenges, but there are practical steps that can reduce its negative effects (Marszałek-Kotzur, 2023). The Massachusetts Institute of Technology points to several key strategies that can help reduce the negative impact of artificial intelligence development on the environment. First, technology companies can focus on creating more energy-efficient algorithms. New models can be trained using smaller data sets or in a way that is more optimized for energy consumption. Already, techniques that allow previously trained models to be reused rather than built from scratch are becoming more common. Second, investing in renewable energy sources is a good option. Data centers in the future could be fully carbon-neutral. For such commitments to have a real impact, it is necessary to globally implement green standards in the IT industry. Responsible management of raw materials should be kept in mind in this context. The Unit ed Nations Environment Program (UNEP, 2024) recommends developing technologies to recycle and extend the life cycle of IT equipment. It is also crucial to reduce the production of unnecessary AI models, which do not add significant value but generate huge environmental costs. Key in this regard is the use of renewable energy to maintain the company's IT infrastructure. This significantly reduces its carbon footprint. Companies developing artificial intelligence commercially or for their own needs should therefore choose vendors that provide not only adequate infrastructure, specific computing power but also adequate cooling and scalability. It is also extremely important to have metrics that guarantee certain energy and water efficiency and the use of renewable energy to reduce the carbon footprint. Especially since the development of projects based on this technology is expected to be very dynamic (Infor, 2024). Artificial intelligence has many environmental benefits. It is already being used, for example, to map problematic sand mining or analyze emissions of methane, one of the most adverse greenhouse gases. AI is also helping many companies transform to better use resources. The key, then, is to enable its further development in such a way that the costs to the Earth and its inhabitants are not greater than the benefits. Therefore, national standards for monitoring the ecological impact of AI are proposed. Companies are required to disclose information on the environmental costs of products and services created based on AI. AI algorithms and server cooling technology need to be improved to reduce energy and water consumption. E-waste management also needs to be improved and recycling rates increased. It is also important to promote the use of renewable energy to power data centers and raise public awareness of the energy and water losses associated with the use of GPT Chat. There is also a need for greater transparency about the potential impacts of further development and widespread use of AI. The carbon and water footprints of AI need to be known to users, and the goal of the technology should be to reduce them as much as possible. As long as the majority of global energy comes from fossil fuels, AI will be a major ballast for climate change.

Some regions may feel the pressure of water abstraction and mineral and metal extraction more than others. The result of such activities could be local droughts and increasing pollution. This is an example of ecological and climatic injustice, which is yet another challenge for promoters and builders of new technologies. UNESCO openly calls for abandoning the use of artificial intelligence if it leads to disproportionate environmental damage (Azurro, 2024).

4. Summary

Currently, opinions are sharply divided on the degree of existential threat to humanity that may arise from the global development of artificial intelligence. There are extremely optimistic and extremely pessimistic opinions. There seems to be a general consensus that there are risks associated with artificial intelligence, as with most technological advances, but different people perceive these risks in different ways. The specific situations cited in the above reflections, as well as visions for the future of artificial intelligence development in the service of sustainability, open up new horizons for research and the search for answers to the questions raised in the introduction. Perhaps fears about the development of artificial intelligence are exaggerated, but the questions we are concerned about cannot be left unanswered… Contemporary processes of artificial intelligence development should not only be subject to the analysis of current problems, but more broadly should try to identify threats that may escalate in the future (Chomsky, 2023). The purpose of this article is to encourage the reader to reflect on the problem raised and perhaps raise new questions on the issue. Artificial intelligence has become the foundation of modern technologies, and its application is invaluable, also in terms of solving various problems related to the exploitation of our planet, consequently leading to pollution and climate change. The benefits of utilizing its capabilities, among others in the field of environmental protection and pursuing the idea of sustainable development, are obvious. However, it seems that the negative aspects of its development and application are not discussed as widely as the benefits. Therefore, this article more clearly explains the environmental costs. A definitive statement on whether AI brings more benefits or more harm to the environment would require detailed and in-depth research. High energy consumption, exploitation of water resources and increasing electronic waste are just some of the challenges that the AI industry is facing. While some companies are taking steps toward greener AI, real change requires global regulation and informed decisions by both consumers and businesses. The future of AI should not only be smarter, but also more sustainable - so that the technology can serve humanity without destructive consequences for the planet.

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