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IMPROVING LIVING STANDARDS IN A GLOBALIZED WORLD: OPPORTUNITIES AND CHALLENGES

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Improving living standards in a globalized world: opportunities and challenges

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Edited by Tetyana Nestorenko

Tadeusz Pokusa

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Editorial Office:

The Academy of Management and Administration in Opole
45-085 Poland, Opole, 18 Niedziałkowskiego Str.
tel. 77 402-19-00/01
E-mail: info@poczta.wszia.opole.pl

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Humanity currently faces Industry 4.0 as a new reality. A massive predictable introduction of cyber-physical production systems to maintain the human needs as well as artificial intelligence is evolving. Different types of robots could replace many professions by year 2030. This might drastically change people's lives and societies and improve quality of life.

The report of the International Council on the Agenda for the Future of Software and Society, organized in the framework of the World Economic Forum, states that many disruptive technologies will reach a crucial point in their development by 2025 (Deep Shift, 2015). The society comes closer and faster near surprising technological innovations, as e.g., quantum computer, the universal introduction of the blockchain, virtual reality, and developments based on artificial intelligence. Every year experts and scientists discuss the issues related to the use of disruptive technologies, focusing on the positive sides for economic growth promotion.

Disruptive technologies and the issues of sustainable development. The main direction of Industry 4.0 is the formation of cyber-physical systems and the Internet of Things (IoT). The Internet of Things is a concept of an information-driven network of physical objects ("things") equipped with built-in technologies for interacting with each other or with the external environment. The formation of IoT is capable of rebuilding economic and social systems, contributing to personality development and the achieving sustainable development goals. IoT is closely related to sustainable development issues. First, it may significantly increase the efficiency of social systems, dematerialize industrial metabolism, and reduce the ecological impact on nature and improve quality of life. Second, it establishes conditions for the implementation of a circular economy. Third, disruptive technologies provide a solution to economic, environmental, and social problems. As a rule, disruptive technologies are not realized as separate innovations, but within a broad front (cluster) with other disruptive technologies. In one case, they serve as an auxiliary,

providing the implementation of other disruptive technologies. In another example, they are the leading (essential) application of which other disruptive technologies work. That drives the innovative transformation of a systemic nature (Koblianska et al., 2019).

The duality between social and technological innovation is important because of the potential adverse effects of Industry 4.0, such as job losses, human substitution by technological innovations, end of privacy, and possible loss of human control. However, the social perspective demonstrates that technical innovations are likely to affect the diffusion of social innovation and vice versa positively. Digitization technologies in the public sector have a positive impact on citizen welfare and improve quality of life (Katz, 2017).

Despite the positive effects of Industry 4.0, Kovacs (2018) highlights the dark corners of Industry 4.0: security-related uncertainty, consequences of automation, distorting effects of measurement, unintended consequences of neglecting contextual interactions. Wright et al. (2018) involving stakeholder theory and social contract theory highlight the issue of ethical challenges as an Automation and AI wave demands for the new moral frame.

Economic and social implications of the transformative impact of disruptive technologies related to improving quality of life.

AI impacts. AI is transforming different sectors: *Transportation*. Uber and Lyft increased the use of self-driving technology. *Criminal Justice*. Advancements in face recognition facilitate control by authorities. Courts started to use AI to sentence criminals (Delgado, 2018). As well, too much innovation could be a terrible thing for society and lead to a dystopian future if society is not careful. The risk of significant disruptions to democracy is evident. *Advertising*. AI is targeted to personalized advertising. Advertisers are already able to select advertising that would have a positive impact on purchasing behavior (Delgado, 2018). Table 1 shows the forecast of the most important developments in the internet of things for 2025.

Table 1. Forecast of the most important developments in the internet of things for 2025

Event	Important consequences	
	Positive	Negative
	Double effect option	
The beginning of mobile phone implementation	Improving the effectiveness of treatment, personalizing data, monitoring the location of children	Privacy violation; reduced data security, addiction
	Changes in relationships between people	
About 10% of people's clothing is connected to the Internet	Personalization of clothing; health monitoring; self-managed treatment	Privacy violation; reduced data security
	Real-time identification	
One trillion sensors connected to the internet	Improving resource efficiency; productivity growth; improving the quality of life; environmental monitoring; improving safety; cheaper services	Breach of confidentiality; job loss for unskilled workers; increased risk of hacking and reduced security; increased complexity and danger of losing control
	Changes in business models; the emergence of new and decline of old businesses; increased use of production and personal assets; automation of information operations; change of institutions	
Over 50% of home internet traffic is expected to come directly from devices (neither entertainment or communication)	Improving the efficiency of the use of resources and energy; comfort increase; increased security	Vulnerability to crime and cyber-attacks, reduced privacy
	Increase of distance works; change in the number of jobs	
The emergence of the first government, replacing a significant part of the channels for obtaining information (for example, census) with big data sets	An increase in the number of decisions made in real-time. Improving and speeding up decision making. An open information data set for potential investors. Resource-saving and saving time. Simplification of procedures for citizens. The emergence of new jobs	Concern over privacy. Loss of traditional jobs. Risks of abuse of information (algorithm) owners. Risks of declining confidence in the government
	Changes in government and business. Changes in information use	
10% of self-driving electric vehicles on the roads of leading countries are expected	Reduced stress and road rage. Improved security. The increasing mobility of old people and people with disabilities. Improving electric vehicles and reducing emissions	Loss of jobs (taxi and truck drivers). Income loss from traffic tickets. Increased risk of hacking and cyber-attacks
	Change in insurance and emergency assistance	

Source: Compiled from Christensen (2016), Schwab (2017), Schwab et al. (2018), Sotnyk et al. (2015)

Research on the Internet of Things proves several challenges: unauthorized surveillance, uncontrolled data generation, and use, inadequate authentication, and information security risks (Caron et al., 2016).

The disruptive technologies can bring significant challenges to policymakers, business leaders, and workers. There are several solution spaces to consider.

The World Economic Forum predicts that by 2025, 75 million jobs will have disappeared to be replaced by 133 million new ones as automation spreads in the workplace (Gilchrist, 2019).

Socio-economic effects of disruptive technology (Figure 1) are challenging because the set of critical functions of society is not constant over time, and plausible new functions that may develop in the years are unknown. Disruptive technologies may lead to the collapse of existing economic models (Magruk, 2016). All the processes ongoing in Industry 4.0 are complex and subject to a high degree of uncertainty. The current uncertainty makes it difficult predicting the possible effects of disruptive technologies.

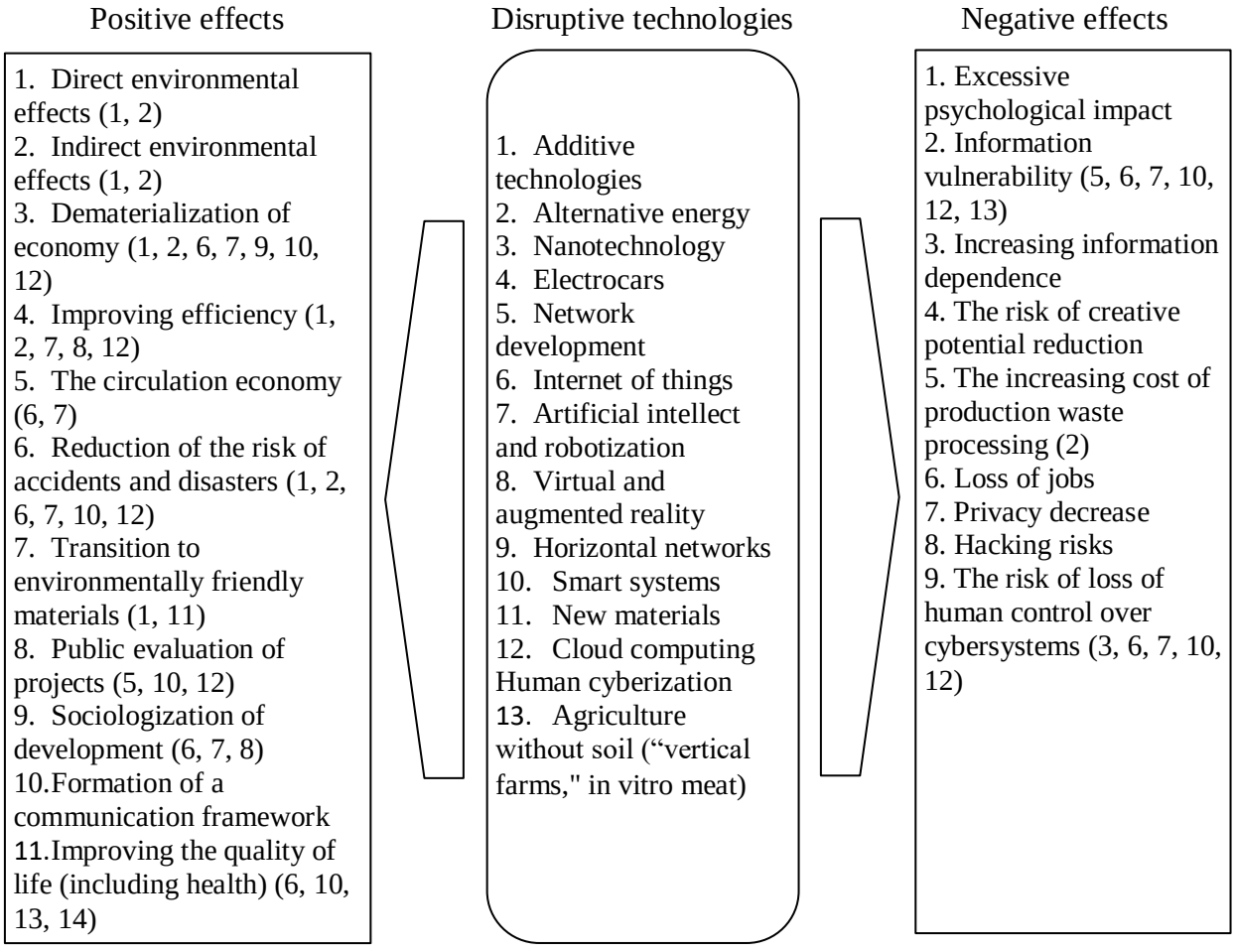

Fig. 1. Positive and negative impact of disruptive technology (DT) on sustainable development (in brackets – the predominant DT effect)

The socio-economic effects of disruptive technology can be explained by analyzing the peculiarities of Industry 4.0. A disruptive technology is a technology

that changes the bases of competition by improving the performance metrics along which firms compete. Therefore, the primary effect of a disruptive technology occurs in competition.

1. Direct environmental effects are the result of the decrease of environmental impact from energy production, the manufacture, and consumption of products (Sineviciene, et al, 2018). Advanced alternative energy technology made renewable energy highly competitive comparing to traditional sources. Significant pollution of water and soils originates from the toxic materials in the caught ash. Renewable energy sources (sun, wind, rain, geothermal) in the United States overtook coal-fired power plants for the first time. The share of the former was 21.56%, while the latter was 21.55%. Successes of the EU countries are even more impressive (Kabanov, 2019). The significant environmental effect will result in the widespread use of electric vehicles. It allows building electricity generating systems in more remote locations. Currently, road transport contributes up to 40% of air pollution. The development of alternative energy will increase this effect immensely.

2. Indirect environmental effects. Alternative energy can prevent significant environmental impacts of the processes of extraction, transportation, and storage of fuel resources (drainage and soil pollution, oil spills, pipeline accidents, blocking animal migration routes, etc.).

3. Dematerialization of the economy. Disruptive technology (primarily additive methods based on 3D printers) can significantly reduce material intensity and energy consumption (energy intensity and input of material per unit of product) (Sotnyk, 2012). The share of waste in traditional production equals 90-95% of natural resources extracted from nature. Additive technologies may significantly reduce the amount of waste.

If we compare traditional and alternative energy, the latter allows abandoning material and energy-intensive processes of extraction and transportation of fuel. This means there is no need to extract the materials and energy necessary for the production.

4. Improving resource efficiency. Resource efficiency is a key factor in a greening the economy (Sotnyk et al, 2015). The use of new materials, computerization (digitization) of design and manufacturing products based on artificial intelligence may significantly increase the efficiency of economic processes. Fiber-optic communication (quartz, glass, or polymer fiber) allowed increasing the speed of information transfer by more than five times. A single light guide can easily replace an entire cable containing several hundred metal wires.

5. A circular economy. Cyber-physical systems in Industry 4.0 and the Internet of Things are a step towards building a circular economy. The digitalization of production processes and the development of cloud technologies also contribute to this. Ideally, each product will have its label, which will carry information about the source of resources, production technology, the type of energy used, and other data. This information is the basis for creating closed material use cycles.

6. Reducing the risk of accidents and disasters. The new economy may significantly reduce the risk of emergencies that cause significant environmental damage. At least two circumstances contribute to this. The first is the dematerialization of the production and consumption processes. The dangerous links of production, transport, and storage of resources are eliminated. We can compare, on the one hand, traditional capacities requiring a significant amount of hazardous materials and energy carriers, on the other hand, additive manufacturing and alternative energy. The increased control of cyber-physical systems over the production and consumption process minimizes the negative impact of the human factor and the inevitable mistakes in production management.

7. Transition to environmentally friendly materials. The modern technological revolution and the creation of new materials allow them to be included in the metabolism of ecosystems. In particular, silicon and cellulose “ink” were invented for 3D printers. These substances are in the material metabolism of the planet. Packaging materials from agricultural waste became widespread.

8. Public evaluation of projects. The platforms for the broad involvement of people in public governance allow environmental impact evaluation by the public at a

minimal cost. There are prerequisites for taking into account the views of citizens in the formation of their environment. One of the basic principles of sustainable development can be implemented in practice: “think globally, act locally”.

9. Sociology of development. The formation of the Internet of things and the widespread use of robots may significantly reduce the physical labor. The increase of human well-being in different countries allows satisfying basic biological needs. Modern methods of agricultural production (“vertical” farms, test-tube meat) are essential. This forms prerequisites for the implementation of the basic approach and creates the conditions for the development of a personal basis. It is ultimately the main goal of sustainable development.

10. Improving the quality of life. The implementation of individual monitoring of human health, the development of medicine based on the reproduction of renewable organs, and a new generation of pharmaceuticals, contribute to a significant increase in the quality of human life. It ultimately brings society closer to sustainable development.

The negative consequences of disruptive technologies are less noticeable and much more difficult to predict. However, many researchers (Schwab et al., 2018; Skinner, 2018) highlight the threats of the possible negative effects.

1. Excessive psychological impact. Information control over systems based on disruptive technologies demands constant concentration and is stressful. The situation is complicated because someone will have to solve information problems, the skills for solving which are not inherent to the biological nature of man. They must be newly acquired anew, and it is unclear to what extent a person will be able to withstand this psychological pressure.

2. Information vulnerability. The widespread use of cyber-physical systems in production and consumption may reduce the risk of human errors. At the same time, the weakness of these systems significantly increases in the case of information failures. We often encounter such phenomena today (the computer freezes, the Internet turns off, computer viruses). In the future, such situations may turn out to be much more dramatic. The situation may be worsened by the fact that there is no

alternative to the mentioned systems. Their complexity is continuously increasing. Completed tasks are incredibly complex. Cyberphysical systems are unique, and there is no alternative to them.

3. Increasing information dependence of a person. Constant concentration on the perception of information may cause specific relationships, similar to drug addiction. It can cause mental disorders, poor social behavior. Besides, this can cause negative processes in the body and abandoning regular physical activity. Ultimately, all these consequences worsen human health and stimulate the emergence of diseases.

4. The risk of creative potential reduction. Few people can switch to creative activities when they do not fulfill numerous production functions. Many people do not have sufficient creative potential. Part of society not capable of creative development may feel gradual personal degradation.

5. The increasing cost of producing waste in a green economy. The green economy can significantly reduce the environmental impact of production systems. However, the material basis of a green economy can have an environmental impact. First, the manufacturing green means of production is eco-destructive. Second, generated waste after the useful life period of assets should be disposed of or buried. For example, an enormous amount of waste from solar panels and batteries is expected soon. Today, people should think about the unification and industrialization of these processes.

6. Loss of jobs. The loss of traditional jobs as a result of the introduction of disruptive technologies is possible. New technologies will contribute to establishing new jobs, probably, no less than the ones that will disappear. However, this does not entirely solve the emerging social problems for two main reasons. First, not all people are ready to learn new professions due to their more complex information content. Second, even those who, in principle, are prepared to learn new functions are at rise of experiencing additional psychological overloads. Rapid technology changes necessitate acquiring new skills (and possibly their place of residence) several times during their lives.

7. Privacy. Individual privacy faces numerous threats from new technologies. On the one hand, new technologies help to reduce the corruption and criminal component in human activities. It will be increasingly tricky for subjects of such actions to keep the negative aspects of their efforts secret for the public. On the other hand, each person becomes more vulnerable to criminal manipulations and blackmailing by criminals.

8. Hacking risks. Hacker attacks and actions can withdraw many advantages of new technologies that are grounded based on information programs and communications – the targets for hackers. The fight against hacking and strengthening the security of systems should be accompanied by social measures aimed at improving the ethical component.

9. The risk of losing human control over cyber systems. Complex cybersystems regularly increase the ability of their self-design and self-organization. This is the basis for the development of the Internet of things and nanotechnology. Moreover, the implementation of nanotechnology without the self-organization of cybersystems is generally not completely possible. The self-organization of cybersystems can lead to a complete loss of human control. This danger increases as the Cloud develops. Currently, it acts as a global memory system. Very quickly, it evolves towards the formation of an independent universal mind, working at the meta-level. It may both control human behavior and establish other competing entities (including material ones) with the personal ones.

Currently the European Union and its institutions initiate a variety of initiatives to engage in social dialogue on digitisation in every Member State. These EU-level initiatives, developed within European Platform of National Initiatives “needs to take into account the social aspects of digitisation, coordinating and stimulating discussion in all Member States through the relevant National Initiatives”.

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Part 6. Interdisciplinary approach to solving the problem of improving the life quality

6.1. *Aleksander Kuzienkow* – PhD of Physical and Mathematical Sciences, Associate Professor
Nikita Głazow – Master Student
Oles Honchar Dnipro National University, Dnipro, Ukraine
Jana Głazowa – PhD in Economics, Associate Professor
Berdyansk State Pedagogical University, Berdyansk, Ukraine.

6.2. *Nataliya Martynenko* – PhD in History, Associate Professor
Kharkiv National Medical University, Kharkiv, Ukraine.

6.3. *Leonid Melnyk* – Doctor in Economics, Professor
Iryna Dehtyarova – PhD in Economics, Associate Professor
Mykola Kharchenko – PhD in Economics, Associate Professor
Sumy State University, Sumy, Ukraine.

6.4. *Viacheslav Osadchyi* – Doctor of Pedagogical Sciences, Professor
Vladyslav Kruglyk – Doctor of Pedagogical Sciences, Professor
Hanna Varina – Master in Psychology, Senior Lecturer
Bogdan Khmelnitsky Melitopol State Pedagogical University, Melitopol, Ukraine.

6.5. *Viacheslav Osadchyi* – Doctor of Pedagogical Sciences, Professor
Kateryna Osadcha – Doctor of Pedagogical Sciences, Professor
Hanna Varina – Master in Psychology, Senior Lecturer
Bogdan Khmelnitsky Melitopol State Pedagogical University, Melitopol, Ukraine.

6.6. *Wladyslaw Wornalkiewicz* – PhD, Professor WSZiA
The Academy of Management and Administration in Opole, Opole, Poland.

6.7. *Svitlana Avdieieva* – Senior Lecturer
Irina Minakova – Senior Lecturer
Zaporizhzhia Regional Institute of Postgraduate Pedagogical Education, Zaporizhzhia, Ukraine.

6.8. *Mykola Balukh* – Lecturer
Khmelnytskyi Humanitarian-Pedagogical Academy, Khmelnytskyi, Ukraine.

6.9. *Galyna Buchkivska* – Doctor of Pedagogical Sciences, Professor, Honored Artist of Ukraine
Valentyna Baranovska – PhD of Pedagogical Sciences, Associate Professor
Khmelnytskyi Humanitarian-Pedagogical Academy, Khmelnytskyi, Ukraine.

6.10. *Eleonora Vlasenko* – Senior Lecturer
Iryna Stotyka – PhD of Pedagogical Sciences, Associate Professor
Oleksandr Stotyka – PhD of Pedagogical Sciences, Associate Professor
Bogdan Khmelnitsky Melitopol State Pedagogical University, Melitopol, Ukraine.