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IMPLICATIONS OF THE FOURTH INDUSTRIAL REVOLUTION ON SUSTAINABLE DEVELOPMENT[2]

Abstract

We are at the cusp of the Fourth Industrial Revolution, and its implications on the society are far-reaching. The purpose of this paper is to give a comprehensive overview of the implications that Industry 4.0 has on the Sustainable Development Goals from the UN Agenda 2030, based on the review and the analysis of the available literature. The paper is structured to give an insight into the basic concepts of Industry 4.0 and Sustainable Development, then moves through the implications of new technologies on the Sustainable Development Goals, and finally, points out the areas that need to be addressed by policymakers. This paper just tapped into the potentials and issues that the Fourth Industrial Revolution brings while leaving the room for in-depth research of any of the analyzed areas.

Keywords: *Industry 4.0, The Fourth Industrial Revolution, Technological Innovations, Sustainability, Sustainable Development*

JEL classification: *O14, O33*

ИМПЛИКАЦИЈЕ ЧЕТВРТЕ ИНДУСТРИЈСКЕ РЕВОЛУЦИЈЕ НА ОДРЖИВИ РАЗВОЈ

Апстракт

Налазимо се на рубу Четврте индустријске револуције, а њене последице на људско друштво су далекосежни. Сврха овог рада је да, на основну прегледа и анализе доступне литературе, да свеобухватни преглед импликација које Индустрија 4.0 има на циљеве одрживог развоја представљене УН Агендом 2030. Рад је структуиран тако да прво даје увид у основне концепте Индустрије 4.0 и одрживог развоја, затим наставља кроз импликације нових технологија на циљеве одрживог развоја и на крају истиче области којима се креатори политике требају позабавити. Овај рад је назрео потенцијале и проблеме које доноси Четврта индустријска револуција, док притом оставља простор за детаљно истраживање било које анализиране области.

Кључне речи: *Индустрија 4.0, Четврта индустријска револуција, технолошке иновације, одрживост, одрживи развој*

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Introduction

Ever since the agricultural revolution ten thousand years ago, new technologies have changed the way of living at increasing speed. Scientific discussions about current technological changes incurred by the Industry 4.0 and the consequences of their use on the economy, social dynamics, and the environment are ongoing. "The "Industry 4.0" concept was first published in an article by the German government in November 2011, as a high-tech strategy for 2020" (Zhou et al. 2015, p.1). While there are opinions that so-called Industry 4.0 cannot be regarded as an industrial revolution, there is a rising number of technological experts and economists who point out that character of the changes and impact of the new technology imply that we are at the cusp of the Fourth Industrial Revolution (Schwab, 2016). Every technological revolution had widespread effects on all aspects of human existence. Economic, social, political changes are usually noticeable, but the changes in the environment and the impact on future generations are the most overlooked ones in the early phases of technological transformation.

The world's interest in the environmental changes caused by the continually increasing growth started to swell at the start of the 1970s and resulted in the first United Nations Conference on Sustainable Development in Stockholm (Jovanović et al. 2011 p.39–45). Since then, all significant stakeholders have paid much attention to the impact of economic growth and technological innovations to the social and ecological elements. Considering that the effects of the second industrial revolution on the environment were registered more than half a century after the revolution, the question of the implications of the Fourth Industrial Revolution on the environment, society, and future generations is completely legitimate.

Current work regarding the impact of Industry 4.0 on sustainable development is scarce. However, some papers tackle this broad subject at different points. Klaus Schwab (2016) gave a comprehensive overview of the Industry 4.0 impacts on economic growth, responsible resource use, and labor market, basing it on active or concluded projects under the umbrella of the World Economic Forum. Stock and Selinger (2016) analyzed opportunities for sustainable production at a macro and micro perspective. At the macro level, they indicated positive implications of new business models and closed-loop product life cycles on the reduction of negative impacts on the environment and society, while micro perspective gave an insight into the potential of Industry 4.0 for the labor market and customer well-being. Lopez de Sousa Jabbour (2018) gave an example of benefits that can be drawn from the Industry 4.0 concept implementation in sustainable manufacturing. The contributions of Carvalho and his colleagues (2018) contributions are the most notable in the field of entrepreneurship. Through the introduction of the Industry 4.0 concept in the field of sustainable entrepreneurship. Maresova (2018) gave an overview of the papers which address possible implications of Industry 4.0 on business and economics, which included papers addressing the topics significant for sustainable development. Beier (2017) surveyed companies in China and Germany on the sustainability aspects of a digitalized economy. The complexity of this topic allowed other researchers to tackle individual elements such as sustainable value creation within the whole value chain (Kiel, 2017), early assessment of the impact on corporate social sustainability (McWilliams et al. 2014) and the new approaches in the macroeconomic management and policy creation in the light of technological changes (Đuričin et al. 2018). Despite multiple approaches to addressing the topic, there is currently a unanimous view that long-term impacts of Industry 4.0 on sustainable development are still unclear.

The ambition of this paper is to give a comprehensive insight into the potential impacts of the Fourth Industrial Revolution on the UN Agenda 2030 Sustainable Development Goals (UN, 2015). On the foundation of the Industry 4.0 technological drivers, we will build an overview of potential connections with sustainability goals and expected results of their implementation. Due to the volatility and everchanging nature of new technologies, this paper does not presume to give a definitive overview of impacts but only provides a starting point to new and more pervasive research.

1. Fundamental Concepts

Understanding of fundamental concepts that define complex subjects of the Fourth Industrial Revolution and sustainable development is essential in the analysis of the interaction of the tremendous technological advancement and the new goals of sustainable development established by the UN Agenda 2030.

1.1. Industry 4.0

The dominant understanding is that Industry 4.0 represents a new and powerful industrial wave with an orientation toward digital and virtual technologies and customer service (Lopez de Sousa Jabbour et al., 2018). The actual concept of Industry 4.0 originated in Germany, and that is not surprising if we take into consideration that Germany has one of the most competitive manufacturing industries in the world (Rojko, 2017). However, the impact of Industry 4.0 will far exceed the German and international industrial development and become the driving force which will change traditional industrial production and steer future manufacturing (Zhou et al. 2015).

Table 1: Technological Drivers of Industry 4.0 and Potential Areas of Application

Technology driver	*Fields*	*Potential Areas of Application*
Physical	Autonomous Vehicles	Logistics, Agriculture
	3D Printing	Automotive, Aerospace, Medical
	Advanced Robotics	Industry in General, Services
	New Materials	Industry in General
Digital	Internet of Things (IoT)	Industry in General (Smart Factory), Services, Security
	Artificial Intelligence (AI) and Machine Learning	Finance, Security, Services
	Big Data and Cloud Computing	Business in General
	Digital Platforms	Sales, Sharing Economy, Gig Economy
Biological	Genetic Engineering	Agriculture, Medicine
	Neurotechnology	Medicine, Marketing, Military

Source: Schwab, K. (2016). The Fourth Industrial Revolution. Switzerland. World Economic Forum, and Li, G. Hou, Y. Wu, A. (2017). Fourth Industrial Revolution: technological drivers, impacts, and coping methods. Chinese Geographical Science, 27(4): 626–637.

According to Anderl (2018), the backbone of the Fourth Industrial Revolution is Cyber-Physical Systems (CPS), which are the main generator of significant innovation push. Acatech in 2013 gave one of the definitions for Industry 4.0. In their publication, they perceive it as "the technical integration of CPS into manufacturing and logistics and the use of the Internet of Things and Services in industrial processes. This will have implications for value creation, business models, downstream services, and work organization" (Kagermann et al. 2013, p.14). Cyber-Physical Systems do not represent a closed circle of the technologies which define the fourth revolution. Many organizations have tried to list all the technologies that will drive the changes. Based on the available literature, we can differentiate physical, digital, and biological technology drivers (Schwab, 2016; Li et al. 2017).

Physical technology drivers might be the most comprehensible for the broader audience because of their tangible manifestation.

- Autonomous Vehicles (AV), in addition to cars, include trucks, aircraft, boats, and drones. Sensors and Artificial Intelligence speed up the progress of the implementation of this technology. "AVs have the potential to fundamentally alter transportation systems by averting deadly crashes, providing critical mobility to the elderly and disabled, increasing road capacity, saving fuel, and lowering emissions" (Fagnant et al. 2015, p.1). However, production costs at this point are limiting commercial use.
- 3D Printing is the technology which uses layer-based printing to transform loose-based charge to three-dimensional object from the digital template "Applications of 3D printing are emerging almost daily, and, as this technology continues to penetrate more widely and deeply across industrial, maker, and consumer sectors, this is only set to increase" (3D Printing Industry, 2019).
- Advanced Robotics is the field that combines multiple technologies from the Industry 4.0 complex. Robots were becoming more adaptive and flexible, connected to the cloud, and augmented with Artificial Intelligence. This will make human-robot interaction possible in many different areas, including house chores (Schwab, 2016).
- New materials are changing multiple aspects of human life. New materials are lighter, stronger, recyclable, and adaptive. Materials such as graphene and polyhexahydrotriazines (PHTs) will completely change multiple industries as soon as they become cost-efficient.

All new technological advancements are made possible or enhanced through the use of digital technology. Digital technology is the foundation of the Fourth Industrial Revolution, and connective tissue for Physical and Biological drivers.

- The Internet of Things is the technology that makes objects in our environment recognizable and, at the same makes it available for them to obtain intelligence, communicate information about themselves and access the information stored in the "cloud" (Bhuvaneswari, 2014). The Internet of Things European Research Cluster (IERC) definition states that IoT is "a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual

personalities and use intelligent interfaces, and are seamlessly integrated into the information network" (Vermesan et al. 2012, p.10).

- "Artificial intelligence (AI) is concerned with the use of computers in tasks that are normally considered to require knowledge, perception, reasoning, learning, understanding, and similar cognitive abilities" (Saloky et al. 2019, p.135). AI is supposed to simulate the process of thinking and behaving, which are the inherent characteristics of human beings. Machine learning is a niche within the AI field, which has made an active contribution to the development of self-learning, self-improving systems. Through an algorithm, machine learning enables iterative learning to the computer, which can make a more reliable and repeatable decision when exposed to the new data (Li et al. 2017).
- The third aspect of digital technology is Big Data and Cloud Computing. Information age brought a vast amount of available data, and with further implementation of sensors, improvement in storage technology, and development of machine learning, that amount is only increasing. Processing power and storage capacity were limiting factors for further development and efficient use of available data, but with Cloud Computing, these two problems are overcome. Cloud Computing is making available other capabilities such as leasing of infrastructure, platform, or software, through the subscription-oriented services in a pay-as-you-go model (Buyya et al. 2011).
- Digital Platforms are a technological adaptation of an old concept. De Reuver and his colleagues (2017) categorized platforms into three main groups: internal platforms, supply chain platforms, and industry platforms. The key feature of all platforms is that they mediate between at least two groups of users. Digital platforms are online businesses that facilitate commercial interactions between them (ITIF, 2018). They have enabled sharing and gig economy and, through them, more efficient use of resources.

Advances in biotechnology make up some of the most significant advances that drive the Fourth Industrial Revolution. The cornerstone of biotechnological research is genetics and neurotechnology.

- The importance of the genetic study was recognized ever since its foundation, and since then, it became a vital part of biological research (Li et al. 2017). With advancements in the processing power of computers, costs of genome sequencing have dropped from approximately 100 million USD in 2001 to 1000 USD in 2019 (Wetterstrand, 2019). At the same time, ease and efficiency of genome sequencing, activation, and editing have been recorded. Possibilities in computer-determined therapy in medicine and sequencing in agriculture are just some of the possibilities of Genetic Engineering.
- Neurotechnology is a both fascinating and ethically challenging field because one of its primary goals is connecting the human brain to the machine. "Neurotechnology is defined as the assembly of methods and instruments that enable a direct connection of technical components with the nervous system" (Müller et al. 2017. p.1). Monitoring of the changes that happen in the brain as the reaction to the outside world is the crucial advantage that can be used

in many different areas of human society. However, there is an ethical factor that should lead the use and further research.

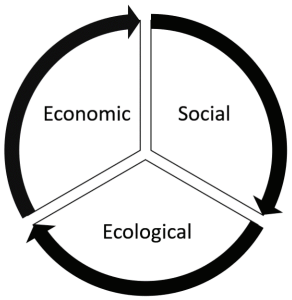
All previously discussed technologies are changing the whole pallet of instruments that we can use in different fields. However, when they are used together, these technologies are setting up the foundation for currently unimaginable future technologies and advancements.

1.2. Sustainable Development

The concept of Sustainable Development is the second important point that needs to be addressed before moving forward. There are different levels of sustainability analysis, moving from the standpoint of microeconomic subjects (Drakulevski et al. 2015) to the macroeconomic dynamics related to sustainability. The modern concept of Sustainable Development has three key dimensions: economic, ecological, and social.

IUCN[3], UNEP[4], and WWF[5] representatives agree that the term Sustainable Development should mean the improvement of the quality of life while taking into consideration the ecosystem's regenerating capacity which is the maximal continuous load on the environment and the carrying capacity which is the highest number of population that can survive while the ecological balance is undisturbed (Ciegis et al. 2009).

Figure 1: Dimensions of Sustainable Development



Source: Jovanović, S. Radukić, S. Petrović-Ranđelović, M. (2011). Teorijski i institucionalni okvir održivog razvoja. Niš, Srbija, Ekonomski fakultet Univerziteta u Nišu

The first discussions about objective the limitations of growth can be found in the work of Thomas Malthus, where he challenged the ability of the earth resources to sustain the growth of population at the same rate over a long period. After him, the number of authors engaged in the analysis of the different aspects of sustainable resource utilization. However, the conceptualization of the contemporary model of development is strongly associated with the book Limits to Growth (1972) published by the Club of Rome. The point of the book was that exponential growth could not continue indefinitely

[3] International Union for Conservation of Nature

[4] United Nation Environment Programme

[5] World Wildlife Fund

(Mitcham, 1995). The same year the book was published, the first UN Conference on Human Environment (Stockholm Conference) was held, and for the first time, the problems of Sustainable Development were addressed on the international and strategic level. However, the first time the trifecta of Sustainable Development Goals appeared five years later in the *Our Common Future* report by the World Commission on Environment and Development (Brundtland Commission).

Following these first steps, the number of conferences was held, and agreements and declarations signed, leading to the formulation of Sustainable Development goals as we know them today.

The first group of eight Sustainable Development Goals was published following the Millennium Summit of the United Nations (2000) and is known as the Millennium Development Goals by 2015. These goals were the foundation for the Development Agenda 2030, which was adopted on 25th September 2015, under the name *Transforming our world: the 2030 Agenda for Sustainable Development.* This new agenda contains 17 goals (SDGs) and 169 targets with 1 to 3 indicators, which are used to measure progress toward each target. These goals we will use for further analysis, and they are:

Goal 1. No Poverty

- Under Goal 1, the new agenda implies the eradication of poverty in all its forms all over the world.

Goal 2. Zero Hunger

- Goal 2 has broad implications, which include ending hunger, enabling food security, improving nutrition, and promoting sustainable agriculture.

Goal 3. Good Health and Well-Being

- Ensuring healthy living and promoting overall well-being without regard to the age or place is what is meant by the formulation of Goal 3.

Goal 4. Quality Education

- The promotion of lifelong learning and providing opportunities for it, together with ensuring inclusive and equitable education for all, are the critical elements of Goal 4.

Goal 5. Gender Equality

- Due to the existing gender gap, stepping toward gender equality and the empowerment of all women and girls is the main direction of Goal 5.

Goal 6. Clean Water and Sanitation

- Making sure that water and sanitation are available to all and ensuring sustainable management of it is the core of Goal 6.

Goal 7. Affordable and Clean Energy

- In the light of climate change, resource scarcity Goal 7 places priority on providing access to modern energy, which is affordable, reliable and comes from sustainable sources.

Goal 8. Decent Work and Economic Growth

- Sustainable economic growth, employment at full capacity, and high productivity and insurance of decent working conditions for all are the key elements for Goal 8.

Goal 9. Industry, Innovation, and Infrastructure

- Establishment of resilient and supportive infrastructure, promotion of sustainable and inclusive industrialization and support system for fostering innovation is the cornerstone of the Goal 9.

Goal 10. Reduced Inequalities

- Inequality is, and it will be a big problem for the world, both on the international and national levels. Reducing inequality is one of the most important goals among the SDG.

Goal 11. Sustainable Cities and Communities

- Adapting and creating more inclusive and safer cities and settlements and improving their resilience and sustainability is the foundation of Goal 11.

Goal 12. Responsible Consumption and Production

- Enabling and establishing the system for improving sustainability in production and consumption is the basis for Goal 12.

Goal 13. Climate Action

- The urgency to deal with climate change and its impacts are rising daily. Therefore, this is the primary concern for Goal 13.

Goal 14. Life Below Water

- Oceans, seas, and marine resources were highly disregarded in terms of their preservation. Through Goal 14 UN is aiming to improve its sustainability.

Goal 15. Life on Land

- Stopping the negative impact of human actions on the terrestrial ecosystems, reversing the process of deforestation, and halting biodiversity loss are the primary elements of the Goal 15 actions.

Goal 16. Peace, Justice and Strong Institutions

- Establishment and insurance of the competent, accountable, and inclusive institutions at all levels, promotion of peace and inclusive societies, and extending the access to justice for all are the main concerns for Goal 16.

Goal 17. Partnership for the Goals

- Improving the process and means for implementation of the Sustainability Agenda and revitalization of the global partnership, and higher participation in the realization of the SDG are essential segments for Goal 17. (UN, 2015).

2. Industry 4.0 and Agenda 2030 Sustainable Development Goals

Natural resources were the key determinant of industrial development, and they still are. However, the Fourth Industrial Revolution is threatening to change the whole approach to development. Technological breakthroughs happen at an ever-increasing speed, with an impact that is hard to anticipate or comprehend (Đuričin et al. 2018).

Within this chapter, we will discuss the impact of Industry 4.0 on the Agenda 2030 Goals starting from the research regarding several aspects of the Agenda and building upon it to give broader perspective and possible impacts on the broader spectrum of Goals. However, since the impact and the outcomes of the Fourth Industrial Revolution are yet to be perceived and fully understood, we will not discuss all of them, but we will try to give an insight into the possible interaction of Industry 4.0 technologies and Sustainable Development.

Two of the most analyzed impacts in the available literature are the impact on the work environment and ecological consequences of the implementation of the Industry 4.0 concept. However, different technologies in Industry 4.0 portfolio have the potential to disrupt many of SDGs through their targets.

Poverty (SDG 1) and world hunger (SDG 2) are the main problems that modern society has to tackle. The Fourth Industrial Revolution has different impacts on these two goals. While there are no foreseeable solutions for poverty in the spectrum of Industry 4.0 technologies, world hunger can be tackled in different ways. Unmanned Aerial Vehicles (UAV) are currently used in some parts of the world for technology-assisted farming (Tripicchio et al. 2015). The further development of AI and AV will enable farmers to use resources more efficiently and to increase future outputs (Schwab, 2016; Li, 2017). Genetic Engineering is another aspect of Industry 4.0 technologies that can be used to reduce world hunger. Genetically modified crops, plants, and animals used in agriculture can increase the resilience, yield, and even include healing properties in their genome (yourgenome, 2017).

Ensuring a healthy life and well-being (SDG 3) can be significantly pushed forwards through the means of new technologies. Steadily increasing computational power and advances in Genetic Engineering and AI can lead to genetically personalized medical treatments and their increased efficiency (Schwab, 2016). Further advancements in AV technology and infrastructure can reduce traffic accidents, which, as a part of SDG 3 (Bertoncello et al. 2015). Reduced pollution from production, as another aspect of this SDG, can be reduced through smart manufacturing and closed-loop product cycle. These two new business models are enabled through the Internet of Things, new recyclable materials, Big Data, and Cloud Technology (Gabriel et al. 2016; Kiel et al. 2017; Bonilla et al. 2018).

Quality education for all (SDG 4), with a particular focus on reducing the number of illiterates and making primary education available to all, is the foundation of future Sustainable Development. In this context, the contribution of Industry 4.0 is unknown and even though better connectivity and Digital Platforms can enable better quality and availability of education in already developed regions and schools, the contribution to the regions without infrastructure for Industry 4.0, where the main hotspots for SDG 4 are, is limited at best and nonexistent at worst. However, the technologies of the Fourth Industrial Revolution will progressively impact the future of education by raising the minimum standards of education and transforming curriculum in schools, to adapt to the new labor market demands.

Achieving gender equality (SDG 5) might get a setback through the Fourth Industrial Revolution. Technology does not discriminate, and experts suggest that the "destruction effect" on the jobs will hit both male and female workers. However, while the male workers will be displaced in the first phase due to automation in manufacturing,

construction, installation, and other labor-intensive jobs, female workers will be substituted further down the line by AI in the jobs which are dominantly female, such as jobs at call centers, retail, and administration. Therefore, the rising demand for computer-science, mathematical, and engineering, which are still dominant male fields, might exacerbate the gender inequalities (WEF, 2018).

Contribution of Industry 4.0 toward better water management and availability of clean water and sanitation (SDG 6) is highlighted by the additive manufacturing (3D printing) since this process does not use water for cooling or lubrication. Therefore, there is less water used in production, and consequently, less wastewater is produced. Additionally, the decentralized organization enables the implementation of resource-efficient and flexible digitalized smart solutions in water management (Stock et al. 2018).

Internet of Things and Smart Grids can significantly contribute to energy savings (SDG 7) in the production process. Real-time monitoring of the production and energy use enables matching energy consumption with production and information-based decision-making about the cost-efficient use of renewable energy sources. In combination with Big Data analytics, the previous two technologies enable implementation of life cycle assessment, which in turn can significantly increase the use of renewable energy sources (Bonilla et al. 2018).

There is a scientific debate about the impact of the Fourth Industrial Revolution on Economic Growth (SDG 8). On the one side, some authors point out that it can have profound effects on the Global Economy (Li et al. 2017), while others indicate that there the Global Economy is slowing down. Currently, the latter has more empirical evidence since the Global Economy before the crisis of 2008 was growing by 5% a year, while today, the growth is around 3%. Defenders of the slow-down hypothesis are emphasizing the deflationary impact, which Industry 4.0 will have due to structural unemployment, caused by the destruction effect on the current jobs (Schwab, 2016).

Cohesive force of the Internet of Things and Big Data analytics has an intensive impact on Sustainable industrialization (SDG 9). Smart factories as a product of these two technologies are the foundation for reducing the CO_2 emission. At the same time, the invention of the New Materials in combination with 3D printing and new business models is leading toward the full use of the power of recycling and renewables and their integration in the circular economy.

In the available research, it is noted that Industry 4.0 hurts the reduction of inequalities in the world, between and within countries (SDG 10). While the technologies of Industry 4.0 have the potential for wide-spread positive effects, there are some significant concerns and facts that limit the optimism of the Industry 4.0 proponents. Firstly, Industry 4.0 means transformation from labor-intensive toward capital intensive production. While capital-rich countries and individuals will profit from the implementation of new technologies, unadjusted countries and individuals will be left behind, and the gap will increase. Secondly, smart factories as the primary representative of Industry 4.0 will be located within smart cities, increasing their gravitational pull, leaving rural areas empty and increasing the gap between regions. Thirdly, according to Statista, there were approximately 3.89 billion users of the internet, whereas only 1.08 billion users have a fixed broadband connection. Internet connection is a prerequisite for the implementation and dissemination of the Industry 4.0 technologies. More than 6 billion people will not be able to use all the advantages it gives.

All previously discussed technologies will enable rational use of resources, smart waste and energy management, smart resource usage, and circular economy. All these segments are a step toward Smart and Sustainable Cities (SDG 11).

Responsible Consumption and Production (SDG 12) is probably the goal that Industry 4.0 puts closest to completion. Big Data, Cloud Computing, and Digital Platforms are enabling customers to have a completely customized product. Customers will have unlimited options, and at the same time, producers will have a continually growing data pool, real-time interaction, and automatized production, which will increase the efficiency of resource consumption, reduce waste, and increase customer satisfaction.

Climate action (SDG 13), preservation of the life below water (SDG 14) and life on land (SDG 15) will all have benefits from better water and waste management, reduced amount of CO_2, increased efficiency of resource usage, and implementation of circular economy principles, which are enabled through the use of all previously discussed Industry 4.0 technologies.

Sustainable Development Goals 16 and 17 have little to no reaction to the Fourth Industrial Revolution. The only segment of these two goals that can have significant benefits from Industry 4.0 is institutions. Stronger, independent, and transparent institutions can be enabled through the efficient use of Blockchain technology, which was not mentioned as an independent segment in this paper.

It is important to note that these effects are present in the current literature and research results. Since the Fourth Industrial Revolution is only at its inception, many of them may differ from the current situation, or completely change direction down the line. Therefore, it is essential to monitor them and take actions that will propel the benefits while mitigating the harm from new technologies.

3. Policy and Legislation Implications

Industrial revolutions have changed the state of the affairs and balance of power for centuries. With every discovery, adaptations need to be made in order to gain or maintain the advantage at the regional or global level. The Fourth Industrial Revolution is not much different in this aspect. However, the speed of change and the variety of results are staggering. Governments, traditionally slow in adaptation to change, will have to pick up the pace in both developing supportive policies and creating legislative frameworks which will contain negative consequences and allow undisturbed generation of innovations.

Governments of most developed countries around the world already have or are in the process of developing their strategy for the Industry 4.0 concept implementation. Half of EU countries have already created their strategic documents that are supposed to guide the transformation. At the same time, the USA, Japan, South Korea, and China are not lagging behind Germany, where this concept originated. Other countries will have to find their place in the new reality of the hyperconnected world, or they will become losers of the Fourth Industrial Revolution.

Policies and legislation will have to address many different segments affected by the transformation of economic, social, and ecological aspects of development.

Industrial development, labor market, monetary and fiscal system, security and privacy, education, and social welfare are just some elements where changes and adaptation will be necessary.

Industrial development will be changed from the core. Many countries will have to change their approach toward industrialization due to "reshoring effect"[6] caused by the Industry 4.0. Countries that traditionally based their competitive advantages on the cheap and skilled workforce will have to reevaluate their approach and reposition themselves in the global economy completely.

Monetary policy will have to include and assess the effects of new technologies such as Blockchain, which "gave birth" to the cryptocurrencies, which caused turmoil in the international currency markets. At the same time, Fiscal policy will have to tackle the challenges caused by Digital platforms and new business models.

A globally significant topic of security and privacy will have to be addressed due to the increasing interconnection of the world. Data collection, processing, and reselling of personal data rules are not widely accepted, which in term leaves the world vulnerable to cybercrime, identity deft, and breach of human rights such as the right to privacy. Additionally, data available in the cloud, if properly unguarded, can cause a significant risk to real-world security due to terrorism threats.

Complete change toward education will be necessary due to changes in the labor market. Destruction of existing jobs, and the creation of new ones, in combination with entirely new skillsets required for the positions, will radically change the requirements and the approach toward this critical topic.

Structural unemployment caused by the Fourth Industrial Revolution and the demographic tendency of the aging population will force policymakers to reevaluate their approach toward social security and retirement, which are unsustainable under current conditions in the long run.

Here we have given a little insight into the potential implications on the policies and decision-making process within Government institutions. There is a lot more consideration to be made in the context of Industry 4.0, and its impact on public institutions and interest.

Conclusion

The Fourth Industrial Revolution is leading toward new technologies and innovations, which are changing the approach toward all aspects of human existence. These technologies are changing the way of doing business, through smart, informed, and sustainable solutions, which are increasing productivity, reducing costs while at the same time reducing waste and pollution. Impacts are spreading to human well-being as well. Better, personalized medical solutions will be available to every patient, increasing health and life expectancy, and reducing the mortality at the same time. Currently, the impact on the environment is the most discussed positive impact of the Fourth Industrial Revolution. Smart and data-driven solutions, real-time monitoring, and recyclable

[6] Reshoring effect refers to the returning of labor-intensive industries to their origin countries, due to capitalization effect and substitution of cheap labor with sophisticated machines

materials are all leading toward a circular economy, which is the step forward to a better and healthier environment.

However, just like every revolution, the Fourth Industrial Revolution has its challenges. The destruction and capitalization effects are increasing the pressure on the labor market and policymakers to transform the regulation and organization of multiple segments, including education, social security, and retirement. In addition to previously mentioned, probably the most concerning problem that needs special attention in the light of the Industry 4.0. is the rising inequality.

Available literature offers segmented insights into different aspects of the Fourth Industrial Revolution. Since it is in the early phases, there is a lot more research to be done moving from the impacts on the labor market and environment to the broader spectrum of problems. The overview we gave in this paper is not based on empirical research and only gives an overview of available theoretical and empirical evidence in this field. Possible areas of future research include the impact on agriculture, regional development, inequality, education, development policies, and many others.

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