The Economics of Sustainable Transformation

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Towards era 5.0

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1.1 Introduction

The problem of the relationship between economy, society, and environment has been, is, and will always be an important subject of interdisciplinary research at a time of constant transformation of the economy. These three pillars have become the basis for creating the concept of sustainable development. A contemporary challenge for humanity is to ensure decent living conditions for present and future generations, irrespective of where they live. Sustainable development is in turn response to dynamic changes in the global economy, with particular emphasis on the natural environment, thus requiring constant strengthening and simultaneous coordination of different measures in the social, economic, environmental, and spatial areas. Action taken at national and international levels, based on respect for the existing resources, is intended to raise the awareness of society and lead to an increase in social and individual well-being and harmony between social beings and nature.

A "sustainable development" is any development that moves society from a less sustainable to a more sustainable state. Without the economy's transformation, there is no sustainability. A large number of sustainability dimensions have been described in this chapter, starting with the transition from the economy based on the production of tangible goods to the economy based on knowledge production, along with new models for distribution and consumption of this knowledge. This chapter aims to introduce the readers to the subject area of economic transformation in the context of sustainable development as well as to provide a common general framework for the industrial revolution from 1.0 to 5.0 as a consequence of the economic transformation. The next aim of the chapter is to discuss the sustainable transformation of the economy in the face of the challenges era 5.0. It also focuses on a general framework of societal transformation from Society 1.0 to Society 5.0.

1.2 Travelling quickly from the stop "transform" to the station "transformation"

Transformation has been the subject of interdisciplinary research and scientific discussion for centuries. It is one of the most characteristic demographic,

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sociological, environmental, social, and economic processes in the modern world. Millions of publications have already been written on the transformation of the economy. At the end of 2020, there were 5 million scientific articles (records) on this issue in the Google Scholar database. It does not, however, mean that this issue has already been comprehensively discussed. It is still and will continue to be an extremely important and relevant topic for every country in the world, every company, and every person, both from a practical and theoretical point of view. This is due to the meaning, universality, and permanency of the aforementioned "transformation".

The term transformation, meaning the transformation of something or the alteration of something, is derived from Old French spoken in the 14th century (Old French "transformer" and from Latin "transformare" means "change in shape, metamorphose or alteration") (Brendecke and Friedrich, 2015, p. 6). McMahon presents a similar meaning defining the verb "to transform" as "to change shape or even to change the function of a particular being" (McMahon, 2004, p. 5). According to Ott, the word "transform" means to change the very nature of something (Ott, 2004, p. ix). Daszko defines the verb "to transform" as to change in form, appearance, or structure, or to create something new that has never existed before and perhaps could not have been anticipated (Daszko, 2018, p. 197). Harris states that being transformational means to be "intended to effect change in the nature and structure of persons, society and systems" (Harris, 1995, p. 8).

Transformation is a major and lasting change: in structure, appearance, character, or function (Myerhoff, 1990, p. 245). Transformation also means a comprehensive and radical change of general economic conditions for all entities and individuals (Wilczyński, 1995, p. 386). Baskin defines transformation as "bringing the organization and its people to higher levels of awareness by broadening and deepening their perspectives on all types of interconnectivity that neither a transitional change nor incremental change can bring" (Baskin, 2008, p. 34). Consequently, Daszko defines transformation as "leading an organization into the unknown. (…). Organizational transformation happens when leaders develop a vision of transformation and a system for continually questioning and challenging beliefs, assumptions, patterns, habits, and paradigms" (Daszko, 2018, p. 196).

Transformation involves extensive changes in the economic, political, and social system. The transformation process takes place in each area of our lives, e.g. economic, demographic, social, political, systemic, organisational, etc. Economic transformation, defined as a continuous process of moving labour and other resources from lower to higher-productivity sectors (structural change) and raising within-sector productivity growth, is necessary to enhance the quality of economic growth, create jobs, and reduce poverty long-term in a sustainable and inclusive way (McMillan, Page, Booth and Velde, 2017, p. 1). According to Sachs, systemic transformation means "the institutional, legal, political, and administrative change of the economic

system from state-ownership and central planning to private ownership and market allocation of resources" (Sachs, 1996, p. 128).

Daszko also indicates that "our world needs transformation and optimization because it faces multiple challenges: wars, declines, attacks, riots, famine, corruption, fraud, arrogance and greed, elitism, obsession with money and consumerism, corporate ethics, measure mania, fear-driving reactive behaviours, ruthless and controlling power, judgments and blame, trade wars, climate change, and Wall Street's quarterly and short-term thinking" (Daszko, 2018, p. 5). According to Szczepański, transformation is a series of changes in various areas that leads to changes significant for the entire social system (Szczepański, 1999, p. 14).

Transformation is an internal fundamental change. Each transformation is a change but not every change is a transformation. Change can be small and incremental, or it can be large and complex. What is more, change is fundamental to human existence. Kubik said that a change is a transformation if it has at least two features: a relatively rapid pace (experienced as faster than the "normal" flow of life) and comprehensiveness (affecting all or most areas of life) (Kubik, 2019, p. 84). Change, from Kubik's point of view, means the proactive rearrangement of the meaning structure and provision of novel descriptions (diagnoses) of the world, goals (values), and scripts of action (norms) (Kubik, 2019, p. 90). According to Lipiński, change is any noticeable modification of any element of reality. Transformation, in turn, should be understood as a non-trivial and intentional process of changing one part of the environment at a given time, with the aim to create a new and, above all, permanent state of the environment (Lipiński, 2017, p. 14).

The above definitions imply that the term transformation is mostly used as a synonym of the term change. It is often used as a synonym of the term development and sometimes as a synonym of the term progress. Transformation occurs under the influence of internal forces, which change social, economic, and political systems. Political, social, and economic transformation is a complex historical phenomenon. In this context, transformation is understood as a process of transition from a centrally planned economy and its accompanying authoritarian system to a market economy and a democratic system, with gradual changes in many areas of social and economic life (Kołodko, 2000, p. 21). As emphasised by Kołodko, transformation consists in replacing the previous system with a new institutional order (Kołodko, 2010, p. 188). Moreover, transformation must be viewed as a tool of a long-term development policy, but not as an end in itself (Kołodko, 2000, p. 25).

People and their needs are the driving forces behind the transformation. The desire to satisfy human needs has led to a change in the relationship between people and the environment. Whereas people were entirely dependent on environmental factors in the past, they have become selfishly determined to make choices at their own risk over time, interfering with nature more and more, occupying ever-larger areas, and making our planet the

scene of a human, animal, and plant drama. The environmental changes that have taken place over the centuries have affected and will continue to affect the state of equilibrium and exacerbate the need to establish a new balance between the environment and society with more than half living in cities. Hence, sustainable development plays a key role in this respect. Transformations for sustainable development must be based on the reform of the relationship between the environment, the economy, and the society (United Nations, 2016, p. 2). It should be emphasised that transformation cannot be fully controlled and completely foreseen.

1.3 Sustainability transformations: From black transformation to green transformation

The idea of sustainable development has developed over the centuries. Ever since the dawn of time, people have had an impact on the natural environment and in order to satisfy their own needs, have strived to improve their own well-being by placing their self-interests over the common good. By the same token, they paid no attention to the effects of their interference in the surrounding environment, which manifested itself in systematic deforestation, deforestation by burning, land reclamation, river regulation, substorage of water in rivers and lakes, extraction of natural resources on a massive scale, and growing industrialisation.

Thus, it can be stated that in fact, civilisation has been moving through successive phases of "sustainable" transformation for centuries, heading often unknowingly towards sustainable development. The first phase included prehistory, the Stone Age, the Palaeolithic, and the Mesolithic. It can be stated with certainty that this was the period of the least harmful human interference with nature in the history of civilisation. The second phase is marked by the transition from a nomadic to a sedentary lifestyle, i.e. the Neolithic Revolution (c. 9 000 BC). This transition to a settled way of life was an extremely important moment in the history of humanity and we still feel its consequences. The invention of the animal-drawn plough, the wheel, writing systems, numbers, and then the application of copper, bronze, and iron to human activity initiated the development of agriculture, livestock breeding, crafts, and trade. This, in turn, became an immanent feature of agricultural intensification and the development of cities. Human interference with the natural environment then became increasingly intense. Research carried out by a team of 255 archaeologists from around the world as part of the ArchaeoGLOBE Project (Stephens et al., 2019, p. 897) demonstrates that environmental changes due to the introduction of intensive farming methods and urbanisation were initiated as early as 6,000 years ago and spread to more than half of the oecumene (i.e. areas of the globe continuously inhabited and economically used by humans) over the next 4,000 years. The third phase is marked by the Renaissance and the Middle Ages.

The third phase of the process preceding sustainable transformation is the period from the Middle Ages to the 18th century, i.e. until the Industrial Revolution. The Middle Ages lasted ten centuries – from the 5th to the 15th century. During the Enlightenment, the idea of revitalising the previous heritage emerged. Europe was a primeval forest stretching from the Pyrenees to the Urals. It is also worth mentioning the medieval climatic anomaly, a period of warming occurring mainly in the North Atlantic region (Europe, North America), which took place around 800–1300 AD. (Stine, 1998, pp. 45–46). It followed the cool period of the so-called Medieval Migration of Peoples in Europe, or the Early Medieval Cooling. The most important inventions of that era include the first steam engine constructed by J. Watt and the mechanical weaving loom that came into use at that time. According to L. White, around the year 1000, an economic revolution swept over Europe (White, 1964, p. 78). The invention of the printing press, development of a linear (geometric) perspective, patent law, and applications of completely new solutions in architecture, among others, are all credited to the medieval era. New technologies entered into mining and metallurgy (especially at the invention of the blast furnace, which made it possible to produce iron in large quantities). The development of the crank and connecting rod mechanism, which allowed the conversion of rotary motion into a reciprocating piston motion, is definitely one of the greatest breakthroughs in Renaissance technology. Mining also became one of the economic drivers in the 15th century – the search was mainly for precious metals, but ores of other metals were also mined.

In the second half of the Middle Ages, much was done to develop and disseminate technology. In Roman times, water wheels were used exclusively to grind grain. In medieval Europe, on the other hand, such solutions were used to power sawmills, bellows, and hammers in smithies (the metalworking industry of the time), equipment in tanneries and cloth mills, grinders, and, in time, special mills in paper mills. For many centuries, water power became the primary means of propulsion in industry. The use of wind energy for work was an achievement of the Middle Ages. The Persians were the first to do so about a thousand years ago (Samuels, 2011, p. 14). Their windmills had a vertical axis of rotation (vertical axle windmills). Two hundred years later, European windmills appeared in France and were more efficient than Persian windmills (Rao, 2011, p. 13). Initially, European windmills consisted of a small box rotated on a pole so that the wind passed over the entire surface of the wings. By the end of the Middle Ages, the improved Dutch windmills consisted of brick buildings on which only a turret with suspended wings rotated. Windmills were used in the Middle Ages almost exclusively for grinding grain. Only the Dutch, who were draining the land flooded by the sea, used them to operate bucket wheels and pumps (Hill, 1996, p. 174).

It can be said that all these three stages of the development of civilisation that accompanied the transformation of the economy had a linear

sequence. It was not until the period of the Great Industrial Revolution (which will be discussed in Section 1.4) that the pace of the transformation of the entire world began to accelerate, showing a destructive impact on the environment. On the other hand, without the efforts and endeavours of our ancestors, it would be impossible to speak of technological progress and civilisation development. Every change brings both benefits and costs. The negative impacts of activities undertaken by people, making both rational and irrational choices, could not always have been foreseen.

For centuries, economic sciences have searched for an answer to the question of how to ensure economic and social growth in pursuit of prosperity. Neoclassical economics and the 17th century concept of homo oeconomicus, being rational in his or her choices, have been particularly important in this context. According to Smith, selfishness is the natural force that motivates individuals to act and is the main driving force of society and economics (Smith, 1986, p. 119). This means that people having unlimited needs always pursue their own interests and social well-being is shaped according to individual preferences. For J.S. Mill, a human is a being who invariably acts in such a way as to obtain the highest number of necessities, comforts, and luxuries with the least possible amount of labour and self-denial required for such goods to be provided in the light of the existing knowledge level. A. Marshall also referred to the homo oeconomicus model. In his opinion, a human, as a rational being, aims at maximising utility while weighing the pros and cons of his decisions (i.e. the level of satisfaction and contentment) (Marshall, 1961, pp. 26–27). Against this background, the Japanese political scientist M. Kinhide described the Western lifestyle as "erabi" (active, efficient) based on the belief that a human is free to shape the environment for their own purposes. This view implies a behavioural sequence whereby a person sets a goal for themselves, creates a plan to achieve it, and then changes the environment in accordance with their plan (Kinhide, 1976, pp. 45–46). From the point of view of behavioural economists, a human is not rational in the economic sense of the word because they make predictable and systematic mistakes, which D. Kahneman and A. Tversky called systemic cognitive errors (Kahneman and Tversky, 1979, pp. 263–292).

There is no doubt that people have always had to take information asymmetry into account. The origin and functioning of all social groups (collectivities) depends on the views and behaviours of individuals who belong to these collectivities. It is a human, as a social being in a given collectivity, who exploits natural resources, which leads to their depletion and environmental degradation. Because anthropopressure caused by human activity and consumption is of a nationwide nature and environmental protection is regarded as one of the inalienable public goods of a mixed nature, the environment, and its protection have become of interest to institutional economics. Externalities, being the focus of new institutional economics, are the most important market phenomena. These effects (both positive and negative) arise when a person or an enterprise undertakes actions affecting

the situation of other people or enterprises and are not compensated accordingly. Environmental degradation and other social phenomena are manifestations of market failure, as evidenced by the period of the four industrial revolutions.

1.4 Industrial revolution: From industry 1.0 to industry 5.0

The fourth phase of economic transformation preceding the phase of sustainable development covers the period from the first to the third industrial revolution. A revolution is said to take place when changes in technology occur in an exceptionally large number of areas of life and introduce many fundamental changes in production or consumption. Although the term revolution has often been misused in the literature, fewer and fewer scientists agree today with the statement that industrial revolutions contributed to the increased rate of economic growth and welfare of society in a sudden and significant way. For centuries, the development of civilisation had been gradual and spread over time, which was due, among other things, to the limited flow of information, knowledge, and capital at that time.

The industrial revolution was a transformational period in the history of the world, ushering in a host of major technological, social, economic, and political changes that continue to define the nation's political, social, and environmental landscape today (Hillstrom and Hillstrome, 2005, p. vii). Although the term "industrial revolution" was first used by the Frenchman Jerome Adolphe Blanqui in 1837 (1798–1854), an advocate of industrialisation and free trade (Blanqui, 1837, p. 209), the genesis of the first industrial revolution dates back to the 1860s. It was initiated by James Hargreaves' invention of the spinning machine around 1765, which resulted in a dynamic increase in the textile production (Magill, 2011, p. 623). The steam engine was another landmark invention (1769). It introduced a completely new mechanised production process and contributed to the transition from a typically agricultural society to an industrial society. The implementation of these two most popular inventions resulted in a large increase in the production of textiles, food, and house building and created a growing demand for energy resources (mainly coal), steel, and wood. The revolution meant a shift from artisanal and manufactory production to mechanised factory production. The invention of the steam engine, which was also used in the mining and textile industries, played a major role. Steam was used to develop the first railroads and steamships. The substitution of charcoal for coke in metallurgy was also a groundbreaking achievement (Steams, 2021, p. 61), which allowed for the dynamic development of the engineering industry both in Europe and America.

The second industrial revolution took place in the second half of the 19th century and the first half of the 20th century. That period was marked by the rapid development of science and technology, accompanied by the emergence of many new technological solutions. The second industrial

revolution was a technological shift during the 19th century, resulting in, among others, long distance communication, the first flight, oil as a substitute and primary energy source, mass production, synthetic raw materials, chemical synthesis, Edison's lightbulb with tungsten-based filament, etc. (İşcan, 2019, p. 23). Contrary to the first industrial revolution, the second industrial revolution relied on heavy industrial production. Most innovations took place between 1851–1900, starting with the foot-powered sewing machine for home use (1851), underwater telegraph (1851), vapour-compression refrigeration system (1856), stone crusher (1858), steamroller (1859), commercial oil well drilling system (1859), bicycle (1869), telephone (1876), cream separator (1878), internal combustion engine (1885), portable camera (1888), typewriter (1890), oil-burning engine (1892), and led to the front-engine automobile (1897). The age of aviation began during the era of the second industrial revolution. Inventions of the second industrial revolution helped our civilisation to make tremendous changes in transportation, communications, entertainment, and consumerism. The new technologies and inventions, e.g. powerful steamships and faster trains with refrigerator cars, helped to deliver perishable goods all over the world (McNeese, 2000, pp. 1–2). Commerce, industry, and trade grew by leaps and bounds. On the other hand, Europe became so industrialised that the numbers of farms and farmers dramatically declined. This era of mass production, which began at that time, has left its mark on the natural environment. The second industrial revolution contributed not only to changes in the existing human lifestyles, but above all, in human attitudes and as a consequence, led to the emergence of a new societal model.

The third industrial revolution, referred to as the information revolution, was based on knowledge capital (as an additional production factor) and its key role in economic development. In the 20th century, the spread of electricity led to the development of centralised communication tools such as the telephone, radio, television, and computers. After the Second World War, these tools became the media that ushered in the more complex and spatially extensive third industrial revolution, which was an era of oil, cars, suburbanisation processes, and mass consumer culture (Rifkin, 2011, pp. 22, 27). The industrial revolution was triggered by the industrial use of programmable logic controllers (1968), which gave rise to an era of industrial automation based on advanced electronics and information technologies. The first IT systems or planning and control were developed at that time. (Xu, David and Him, 2018, p. 90). Anderson stated that "the third industrial revolution is best seen as the combination of digital manufacturing and personal manufacturing: the industrialisation of the Maker Movement" (Anderson, 2010, p. 41). The third industrial revolution included the usage of fossil-based energy sources, which became a major global problem of excess usage of food, animal, water, and other resources. The third revolution, termed the green revolution, affected the quality life of humankind (İşcan, 2019, p. 23). A characteristic feature of the third industrial revolution is the

fusion of technologies connected with the Internet and renewable energy sources. According to Rifkin, the third industrial revolution is based on five pillars: "(1) shifting to renewable energy; (2) transforming the building stock of every continent into micro-power plants to collect renewable energies on-site; (3) deploying hydrogen and other storage technologies in every building and throughout the infrastructure to store intermittent energies; (4) using Internet technology to transform the power grid of every continent into an energy internet that acts just like the Internet (when millions of buildings are generating a small amount of renewable energy locally, on-site; they can sell surplus green electricity back to the grid and share it with their continental neighbours); and (5) transitioning the transport fleet to electric plug-in and fuel cell vehicles that can buy and sell green electricity on a smart, continental, interactive power grid" (Rifkin, 2012, p. 9). The above pillars provided the infrastructure for the third industrial revolution, which has changed energy distribution in the 21st century.

The development of technology, however, has been so rapid that the fourth industrial revolution, called the era of Industry 4.0, occurred in the middle of the second decade of the 21st century. The fourth industrial revolution is based on information and communication technologies – the so-called ICTs that affect the speed and quality of transmitted information. A galloping pace of broadband network development has been impressive, enabling more efficient data transmission. The fourth industrial revolution builds upon the rapid exchange of information between people, machines, and computer systems. Widespread networking technologies, cloud technology, Internet of Things (IoT), virtual reality, 3D printing, and Artificial Intelligence (AI) are the main features of Industry 4.0. Due to them, the digital world continues to blur with the physical world (see more in Chapter 13 written by Anna Grygiel-Tomaszewska & Lech Kurkliński). According to Furmanek, the fourth industrial revolution includes technologies that systemically apply: (1) cyber-physical modelling (cyber-physical systems); (2) IoT, Internet of Services; (3) cloud computing capabilities; (4) omni IoT (Furmanek, 2018, p. 276).

In Era 4.0, smart factories have become intelligent factories. Thanks to AI, cars are driven by autonomous controllers; nanobots provide treatment to humans, etc. The IoT and AI in the fourth industrial revolution change the work models by establishing relations between equipment and environments questing for clean energy and nanotechnology in the production process (İşcan, 2019, p. 25). The sharing economy is one of the trends seen in the fourth technological revolution. Although the concept of a sharing economy, i.e. sharing or co-sharing of resources, is not a new phenomenon in the market (Lessig, 2008, p. 118), the development of mobile technologies and online communities in the Industry 4.0 era has made human communication easier, which in turn allowed for the exchange of resources to take on a completely different dimension. The attractiveness of the sharing economy and collaborative consumption stem from the social tendency to use certain goods or services when needed (usually on demand) rather than

to own them. Thus, the idea boils down to "you don't have to have to use" (Botsman and Rogers, 2010, p. xvi). Industry 4.0 brought a solution to customers' excess behaviour, encouraging them to be more efficient. Industry 4.0 covers the entire value chain, from ordering and supplying components for ongoing production, to shipping goods to customers and after-sales services. What is more, the Industry 4.0 environment provides access to virtually any useful information at any time and from anywhere, enabling the production of customised products and short runs in a cost-effective way. Manufacturers who implement such solutions can reduce production costs and respond to customer requirements in a flexible manner. In the fourth industrial revolution, labour, a once extremely important part of production, is being marginalised in its pure form, and production is becoming increasingly capital intensive. Machines are not only replacing human muscle power but are also beginning to oversee logistics and resource optimisation in the services field. As a result, the fourth industrial revolution is characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres. However, it is the opposite of the third industrial revolution characterised by induced energy efficiency and production of renewable resources (İşcan, 2019, p. 28). Compared to the three previous industrial revolutions, the fourth one is evolving at an exponential rather than a linear pace.

Although many companies are not yet even partially adapted to the fourth industrial revolution, there is already increasing talk of the coming era of Industry 5.0, also known as the fifth technological revolution or the fifth industrial revolution. The fifth industrial revolution is defined as a cyber-physical system (CPS) comprising people, AI, and the physical systems of enterprises connected through the high-speed Internet and, in particular, the application of robot collaboration (cobots) in manufacturing (Pathak, Pal, Shrivastava and Ora, 2019, p. 23). The term Industry 5.0 was first used by Sachsenmeier who, in 2016, described the imitation or abstraction of the "Inventions of nature" called Bionics as the next disruptive revolution in the industry (Sachsenmeier, 2016, p. 225).

Industry 5.0 is an industry that returns focus to the human aspect of manufacturing. A human and a machine find ways to work together to improve the quality and efficiency of production. Contrary to Industry 4.0 that focuses on smart manufacturing, Industry 5.0 has a broad focus on all aspects of any work (Demir, 2021, p. 64). The interaction between human and AI is paramount in Industry 5.0. The concept of Industry 5.0 is therefore about the return of the human touch to industry, i.e. increasing the scope of cooperation between humans and intelligent production systems. This marriage is supposed to ensure the combination of the best features of two worlds – the speed and accuracy guaranteed by automation with the cognitive skills and critical thinking of humans.

The fifth industrial revolution may also bring more benefits to the environment because of the development of systems that use renewable energy

and eliminate waste in business. Once again, there is a return to intergenerational human responsibility for the environment. Industry 5.0 is the next step in the business revolution. It is rapidly changing corporate structures, business processes, and work culture. Industry 5.0 refers to business activities of enterprises taking advantage of the opportunities offered by new technologies and tools created in the era of digitalisation, such as AI, Big Data, automation of business processes, or the concept of the IoT. These businesses care about the security of their potential in the era of digitalisation. It is a completely new approach, allowing for the proper transformation of enterprises, and thus building a competitive advantage and ensuring a stronger position on the market. Industry 5.0 is also set to be the next step towards mass personalisation of products. In the Industry 5.0 era, products and services offered will be customised to fit customer needs (Ortiz, Marroquin and Cifuentes, 2020, p. 25).

Cognitive technologies enabling machines to perform tasks thus far reserved exclusively for humans are to be the driving force behind the fifth industrial revolution. Image recognition and speech interpretation are the perfect examples. Thanks to cognitive technologies, intelligent robots will work in complete harmony alongside humans even in small- and medium-sized production facilities. Collaboration between humans and the so-called cobots will result in extensive automation where the role of the former will change considerably. Although the spectre of unemployment has always loomed over automation, Industry 5.0 effectively chases it away, bringing out the best in people and robots. Tedious, repetitive tasks will be given to machines while flesh-and-blood workers will take care of what is creative and requires critical thinking, foresight, and a dose of sensitivity. Thus, the key determinant of the fifth industrial revolution is supposed to be "co-competition" – a combination of competition and cooperation between humans and robots, but with the environment in mind.

1.5 The past has a future: From American just transition to the European Green Deal

We are now living in the Anthropocene, an epoch dominated by human activity, the beginning of which is marked by the industrial revolution in the 18th/19th century. Industrial expansion, accompanied by dynamic scientific and technological development, played a key role in environmental degradation and landscape reshaping. Increased environmental degradation (soil, water, and air), civilisation development (industry, transport, and agriculture based on artificial fertilisers and plant protection products, settlement development, and communication networks) and irrational management of environmental resources and produced waste are considered to be the primary sources of anthropopression (i.e. human impact on the natural environment). In the world literature, there is no shortage of scientific publications devoted to the negative effects of human activity on the environment.

The subject matter became popular in the 1960s. Environmental ethics and ecological philosophy were developed in the USA at that time. In world literature, the book *Silent Spring* by Carson, published in 1962, gained the greatest fame. It begins with the chapter "A Fable for Tomorrow" with a vision of an American town whose inhabitants suffer from cancer, where there are no small children and there is a terrifying silence in the spring because all birds were poisoned by chemicals. The author accused the chemical industry, farmers, and scientists of using ever-increasing amounts of synthetic pesticides (especially DDT; Paul Müller received the Nobel Prize for the discovery of its insecticidal properties in 1948) and upsetting the balance of nature, which resulted in the poisoning of water, soil, air, and the growing incidence of cancer among people. It is widely believed that Carson's controversial publication contributed to the rise of the green movement and became the basis for worldwide discussion on human impact on the environment. Only at the end of the 1960s was greater emphasis put on the issue of sustainable development due to growing threats of the rapid depletion of non-renewable natural resources, environmental degradation, climate warming, a rapid pace of population growth, and growing socio-economic disproportions.

Sweden contributed to the dissemination of the sustainable development idea by organising an international conference on the human environment in Stockholm from 5 to 16 June, 1972. At the conference, delegates from 113 countries debated the future of the world with an emphasis on the concept of sustainable development. Since then, a number of documents have been written on the subject matter worldwide. A report entitled "Our Common Future" published by the World Commission on Environment and Development in 1987, also known as the Brundtland Report (World Commission on Environment and Development, 1987), contributed to promoting the idea of sustainable development. The report defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The report reiterates that the environment and development are inextricably linked and should therefore be treated as a single issue. In turn, Agenda 21 also reiterates that sustainable development requires the integration of the three pillars: economic, social, and environmental. Another key document on sustainable development was the strategy "Europe 2020: A European Strategy for Smart, Sustainable, and Inclusive Growth" adopted by the European Commission in March 2010. One of the main objectives of "Europe 2020" was to move towards a sustainable, resource-efficient and low-carbon economy. "Transforming Our World: the 2030 Agenda for Sustainable Development" is another significant international document. This document, a global blueprint for development, aims at creating a new partnership by 2030 in order to eradicate poverty, create a decent life for all, ensure world peace, and transform economies in accordance with sustainable development. The document contains 17 Sustainable Development

Goals (SDGs) and 169 related targets, monitored through the corresponding 304 indicators, the number of which is steadily increasing.

The SDGs focus on the causes of poverty and recognise the universal need for development for the benefit of all people. The goals cover the three dimensions of sustainable development: economic growth, social inclusion, and environmental protection. Unlike the Millennium Goals, the 17 SDGs apply to all countries. They revolve around the claim that tackling climate change is necessary to achieve sustainable development and eradicate poverty. One of the main innovations of the 2030 Agenda is an assumption that working towards sustainable development requires simultaneous progress at three levels: economic, social, and environmental, which should be dealt with in an integrated manner (see more in Chapter 12 written by Agata Adamska & Tomasz Dąbrowski).

Apart from the most important documents mentioned above, the concept of sustainable development is also referred to in Green Papers, i.e. sectoral documents of the European Commission covering a specialised fragment of the European Union integration, which aim to initiate discussion or consultation on a given topic. As a result of the work on Green Papers, White Papers are produced, i.e. documents of the European Commission containing common policy change proposals in the form of non-binding declarations. In addition, the concept of sustainable development is also raised in communications from the European Commission and opinions of the European Economic and Social Committee.

Just Transition and Green New Deal are currently the centre of attention for all institutions supporting sustainable development. The origins of Just Transition date back to the American trade union movements of the 1970s and 1980s. Rachel Carson's pessimistic vision of the world devastated by people and industry was a kind of a boost for action aimed at promoting sustainable development and just transformation. In the 1970s, Leonard Woodcock of the United Automobile Workers proposed financial compensation for workers who had lost their jobs because of employer pollution abuses. He fought for employees to have the right to bring a class action suit against their employers and to recover lost wages and benefits, lost seniority, the cost of retaining, and moving expenses (Kazis and Grossman, 1982, p. 226). As the above example illustrates, a key role in the development of a Just Transition was played by US trade unions, which recognised the inevitable climate change and the problem of rapid job losses in the fossil fuel sector (Scandrett, 2020, p. 346). The issue of occupational illnesses arising from the harmful effects of toxic substances in certain industries was of particular interest in this area. The lack of any compensation in the event of health loss contributed most strongly to the popularisation of calls for procedures to limit the use and production of toxic substances that degrade the environment and damage human health. For this reason, some measures were taken to reduce the harmful effects of such substances on the environment, in particular in the areas around factories and workplaces inhabited by local communities.

In the early 1990s, some steps were taken in the USA to integrate labour demands put forward by trade unions with pro-environmental demands. Among other things, the creation of a special fund was proposed to cover the costs related to job losses resulting from the implementation of environmental demands. The unions' proposal included instruments aimed at both workers and local communities affected by the transformation (ITUC, 2008, p. 12). Although these demands were never fully met, they returned with redoubled force in the second decade of the 20th century in a new context, mainly in connection with the economy decarbonisation process (thanks to the Paris Agreement in 2015 and the Just Transition Declaration in 2018). Just Transition became the official policy of the International Trade Unions Council (ITUC). According to ITUC, Just Transition is "a tool the trade union movement shares with the international community, aimed at smoothing the shift towards a more sustainable society and providing hope for the capacity of a green economy to sustain decent jobs and livelihoods for all" (ITUC, 2009, pp. 1–2). Anabella Rosenberg defines the term "Just Transition" as the conceptual framework in which the labour movement captures the complexities of the transition towards a low-carbon and climate-resilient economy, highlighting public policy needs, and aiming to maximise benefits and minimise hardships for workers and their communities in this transformation (Rosenberg, 2010, p. 141). For Mark Swilling, "a just transition is a process of increasingly radical incremental changes that accumulate over time in the actually emergent transformed world envisaged by the SDGs and sustainability" (Swilling, 2020, p. 7). McCauley and Heffron defined a Just Transition as the fair and equitable process of moving towards a post-carbon society (McCauley and Heffron, 2018, p. 1). In summary, the term "Just Transition" is used to describe changes that involve moving away from technologies harmful to humanity and the climate towards a low-carbon economy and ultimately, a zero-carbon economy. This term always refers to the issue of social costs and protection of employees in industries, which are currently undergoing the transition process. In other words, it is a process of moving from a high-carbon economy to a low- or zero-carbon economy, with particular attention paid to the employment needs of local communities as well as the environment in which they live. Transformation is "equitable" because it assumes that those living in transition areas are not disadvantaged and left behind but presented with a viable alternative (Snell and Fairbrother, 2013, p. 148).

The phrase "Just Transition" was included into the preamble of the Paris Climate Agreement negotiated at the twenty-first Conference of the Parties (COP21) to the United Nations Framework Commission (UNFCCC) on Climate Change held in Paris in 2015. According to the Paris Agreement, the Nationally Determined Contributions must "take into account the imperative of the just transition of the workforce, and the creation of decent work and quality jobs". Three years later, in December 2018, during the COP24 UN Climate Conference in Katowice, Poland, the notion "Just Transition"

emerged onto the global policy scene as a geopolitical priority, and launch of the Solidarity and Just Transition Silesia Declaration signed by over 50 countries and parties to the climate convention took place.

In the European Union, the Just Transition process is closely linked to the concept of the European Green Deal (EGD) adopted by the European Commission in its Communication on the European Green Deal – Communication From The Commission: The European Green Deal (COM/2019/640 final) on 11 December 2019. The EGD is a legal consequence of commitments arising from the ratification of the Paris Agreement by the European Union on 5 October 2016. This document presents the EU's growth strategy to transform the Union into a climate-neutral, equitable, and prosperous society with a modern, resource-efficient, and competitive economy. Although the EGD belongs to the so-called soft, non-mandatory law, it is the exercise of the European Commission's competence to safeguard the interests of the EU and its citizens in respect of the issues that cannot be effectively resolved at the national level.

At the same time, the Just Transition process is inextricably linked to the proposal for a European Climate Law, adopted on 4 March 2020 (COM(2020) 80 final), which aims to achieve the goal of climate neutrality by 2050. This, in turn, is intended to achieve the long-term climate objective set out in Article 2 of the Paris Agreement, which is to limit the increase in global average temperatures. The EGD covers the nine main aspects: (1) increasing climate ambition; (2) clean, affordable, and secure energy; (3) the industry for a clean and circular economy; (4) energy and resource-efficient buildings; (5) sustainable and smart mobility; (6) farm to fork (including precision farming); (7) biodiversity and ecosystems; (8) zero-pollution and toxic-free environments; and (9) strengthening knowledge and empowering citizens.

At the summit of 27 Member States in Brussels held on 11 December 2020, the European Union leaders agreed on the goal to cut greenhouse gas emissions by at least 55% by the year 2030, compared to the levels reached in 1990. This level of ambition for the next decade will put the EU on a balanced pathway to reaching climate neutrality by 2050. This decision was a revision of the EU's previous goal of cutting at least 40% of greenhouse emissions by the end of 2030. According to the European Commission, the EU greenhouse gas emissions were reduced by 24% between 1990 and 2019, while the economy grew by around 60% over the same period (European Commission, 2020a). Reducing greenhouse gas emissions by at least 55% by 2030 requires significant additional investment needed to decarbonise the power generation, industry, transport, and to improve the energy efficiency of buildings. The European Commission's experts estimate that with the 55% greenhouse gases target, annual investment in the energy system will need to be around EUR 350 billion higher in the coming decade (2021–2030) than in the previous decade (European Commission, 2020b).

A cost-effective, equitable and socially sustainable socio-economic transformation is necessary if the goal of a climate-neutral Europe is to

be achieved. Achieving such a goal is a major challenge and involves enormous effort on the part of all Member States. However, the effort and costs required by the climate transition are not the same for all Member States. It is largely due to fundamental differences in the existing energy policies between individual countries and, consequently, different energy mixes (see more in Chapter 2 written by Maciej Mróz).

Since finance is always at the heart of each policy, the Just Transition requires huge financial support. In response to the challenges facing Member States, the European Commission announced the establishment of the Just Transition Mechanism in January 2020. The mechanism aims to provide support to countries facing serious socio-economic challenges in their transition towards climate neutrality. The core element of the Just Transition Mechanism is the Just Transition Fund. The Just Transition Fund is a new instrument with an overall budget of EUR 17.5 billion, of which EUR 7.5 billion comes from the Multiannual Financial Framework (MFF) and EUR 10 billion from the NextGenerationEU (European Commission, 2020c). All Member States will have access to funding, but the instrument focuses primarily on regions where the energy transition poses the most serious challenges. Each Member State's share in the Fair Transformation Fund allocation depends on the weighted sum of the shares of greenhouse gas emissions from industrial plants (weighting 49%), employment in coal and lignite extraction (weighting 25%), employment in industry (weighting 25%), peat production (weighting 0.95%), and oil shale production (weighting 0.05%). A given country's wealth is also taken into account. It gives a strong impetus to those countries where the share of renewables in the energy mix is still low, far from the thresholds set by the Climate and Energy Package.

The EU Member States wishing to make use of Just Transition Fund resources will also have to commit to match funding received from this fund with an equal amount obtained from the European Regional Development Fund and the European Social Fund Plus and make additional national resources available. The Fund will primarily be used to provide grants to the regions. With resources from this fund, it will be possible to support workers in developing their skills and competences needed in the labour market of the future, to help the small- and medium-sized enterprise sector, start-ups and business incubators, providers of consultancy services, research and innovation activities, and entities implementing technologies for clean energy and renewable energy sources. However, investments in nuclear power plants, the tobacco industry, and the fossil fuel sector are excluded.

The second pillar of the Fair Transformation Mechanism is a dedicated scheme within InvestEU. In contrast to the Fair Transformation Fund, InvestEU will be focused exclusively on private investment in energy and transport infrastructure, gas and district heating and decarbonisation projects. The aim is to support investment in low-carbon energy, i.e. investment in RES and energy efficiency systems. The third pillar of the Fair Transition

Mechanism is the Public Sector Loan Facility, established jointly with the European Investment Bank. It is an instrument targeted at the public sector through interest rate subsidies or investment in energy infrastructure, transport, district heating, and energy efficiency measures (including building renovation). It is intended to use the so-called leverage effect, which will allow public funds to generate resources many times larger. Attracting private sector finance through investment from public funds is expected to contribute to the shared climate goal.

The Fair Transition Mechanism enables all Member States to achieve the energy transition as efficiently and realistically as possible, relying on the concept of a low-carbon, closed-loop economy (see Chapter 4 for more details). The essence is to heal an economic system where the volume of waste production is steadily increasing and move it towards a self-renewing cycle of raw material production and subsequent use of the resulting waste in other industries. The idea is intended to make the goal of climate neutrality real. Although the European Union has declared that it will achieve climate neutrality in 2050, many European countries are planning to achieve this goal earlier. Norway stands out in this group, stating its zero-carbon date as early as 2030. Finland declares a date of climate neutrality in 2035, Austria and Iceland in 2040, and Sweden in 2045. The world's biggest polluter of the atmosphere, China, declares a target of reaching climate neutrality in 2060 (Nordic Council Ministers, 2020, p. 3).

National transition scenarios will involve far-reaching improvements in energy efficiency and rapid development of renewables and electromobility. The transition to clean energy should lead to a system in which the largest share of the EU's primary energy supply will come from renewable energy sources. However, we should not forget that each country needs to maintain its energy sovereignty in the long term, i.e. the ability to meet its own energy needs without large-scale imports of electricity, hydrogen, or synthetic fuels. The move towards zero-carbon requires different measures to be taken, not only in the field of electric power engineering. The transition requires an increased use of RES technologies in heat generation and increased use of alternative fuels in the transport sector through the development of electro-mobility, hydro-mobility, and zero-emission urban transport. A zero-greenhouse gas economy requires a smart and appropriate infrastructure that ensures an interconnection and integration of sectors, not only across Europe but globally as well. The transition to a net zero greenhouse gas economy is not only about green technology and green jobs but also about people and their different habits. Consumers have a powerful role to play in both driving the transition and achieving the SDGs. Individuals' shape their own carbon footprint, whether it is through buying a house, the groceries, or a car. Lifestyle choices can fundamentally help move towards climate neutrality, while improving quality of life.

There are no effective solutions that can stop climate change in its tracks. The damage caused by the economic transformation driven by successive

industrial revolutions over many centuries has impacted the economy such as a malignant tumour would a body. Many coordinated actions, methods, instruments, high expenditure, and changes in habit are needed to stop the spread of the disease and to cure the body. Only a holistic approach of all of the countries of the world to the problem of sustainable development can bring us closer to the state of equilibrium between people, economy, and the environment, and overcome the climate crisis. The outbreak of the Sars-COV-2 pandemic or the announced Nipah virus pandemic (NiV) does not mean that the climate crisis has disappeared. It is here and will continue to affect current and future generations for many years to come.

1.6 Digital transformation towards sustainable society

The dynamic development and growth in the use of ICTs, including digital technologies, is a driver of change in shaping modern economies (United Nations, 2019). Rapid technological advances, accelerated by the COVID-19 pandemic, and the combination of digital technologies in novel and innovative ways are supporting digital transformation of socio-economic systems in new and often unpredictable directions. Although digital transformation has spread in all countries, it will be difficult for them to match the pace and level of the digital transformation development in the USA and China, which dominate the world economy. These two countries are responsible for 75% of patents related to blockchain technologies, 50% of global spending on the IoT, more than 75% of the cloud computing, and 90% of the market capitalisation value of the world's 70 largest digital platforms (United Nations, 2019).

Despite the fact that it is not a new concept, Digital Economy, also called Internet Economy by some authors, New Economy, New Digital Economy, or Web Economy, is difficult to define due to its strong dependence on the high dynamics of technological changes underlying it. Its definition, like its name, has evolved over the years. Don Tapscott was one of the first to describe the digital economy in his book *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*, published in 1995. He listed 12 features distinguishing the digital economy from the industrial economy: knowledge, digitisation, virtualisation, molecularisation, integration and collaboration through the Internet, exclusion of unnecessary intermediaries, convergence, innovation, prosumers, real time, globalisation, and the era of threats and anxiety (Tapscott, 1995). Subsequent authors have defined the digital economy in narrow or broad terms highlighting three elements necessary for its development: information networks, ICTs, and actions taken by organisations and people. To understand the digital economy, it is necessary to take into account its concept, structure, and mechanisms, which, as a result, influence its social dimension.

Some definitions, especially the first ones, emphasise the use of Internet Protocol (IP) – enabled communications and networks in digital economy

(Brynjolfsson and Kahin, 2002). Johansson, Karlsson and Stough (2006) highlight the role of rapid development, adaptation, and use of ICTs innovations in the transformation of the economy and all sectors towards the digital economy. Due to this evolutionary process, society has access to new products, production processes, and services.

The definition proposed by Knickrehm et al. (2016) takes a broad approach. "The digital economy is the share of total economic output derived from a number of broad 'digital' inputs" (Knickrehm et al., 2016, p. 2). These digital inputs include digital skills, digital equipment (hardware, software, and communications equipment), and the intermediate digital goods and services used in production. On the other hand, since there is no generally accepted definition but there is the need for developing a common basis for the analysis of problems and measures, the United Nations stresses the importance of dynamic flexibility necessary when technological progress and changes in each area are so dynamic. What is specific about the definition is the distinction between digitalised economy defined as broad in scope (e-Business, e-Commerce, Industry 4.0, Precision agriculture, and Algorithmic economy) and digital economy defined as narrow in scope (Digital services, Platform economy) along with Sharing and Gig Economy being borderline between them, the core of which is Digital (IT/ICT) sector (United Nations, 2019). This distinction highlights digitalisation of many economic sectors that apply digital products or are transformed by digital technologies, in which new operations or new business models have emerged.

Lovelock (2018, pp. 5–6) stated that "the digital economy relies on enhanced interconnectivity of networks and the interoperability of digital platforms in all sectors of the economy and society to offer convergent services", thus emphasising not only the broad scope but also the social dimension. Another definition defines the digital economy as "the infrastructure development of the modern society towards full coverage of information society attributes", where the infrastructure development concentrates in the three main areas: telecommunication infrastructure enabling communication, services enabling the content transfer, and legislation supporting digital identity (e.g. electronic signature) (Kehal and Singh, 2005, p. 99). This definition highlights the fact that an information society is the effect of convergence resulting from a technological revolution, which leads to an economic revolution, and, in turn, reinforces a social revolution.

Researchers and practitioners have plenty of scope to study the digital economy from the perspective of: its share in GDP, impact on the ICT availability, transparent legislation environment, tax regulations, measures, and digital policy supporting the development of infrastructure necessary for the digital economy and benefits for humanity (e.g. new ways of shopping – e-commerce, digitisation of goods and services, increased access to information and products without any geographical borders), as well as social costs (Kehal and Singh, 2005; Druică, 2012). Social costs may result from:

a digital divide between regions, nations, rural and urban areas, digital exclusions, threats to data security, lack of trust in digital transactions, replacement of human relationships with social media contacts, and loss of jobs to robots and automated processes. Consequently, a number of key areas of the digital economy such as electronic transactions and contracts (e-commerce), and electronic finance need to be regulated and safeguarded in cyberspace: electronic transactions and contracts (e-commerce), electronic finance (transactions, operations, regulations, taxation, and customs duties), intellectual property laws (trademarks, copyrights, and patents), information security (cybersecurity, cybercrime), consumer protection (e-commerce), worker protection (rules and regulations for remote work, human-robot collaboration) (see more in Chapter 7 written by Włodzimierz Szpringer). The digital economy is changing the labour market, creating demand for new skills related to ICTs and other fields, which affects employment levels in various sectors (Johansson, Karlsson and Stough, 2006). The COVID-19 pandemic as a way to accelerate the development of digital society requires new competences necessary in the virtual world, which may have been a way to foster the Digital Society (Serpa et al., 2020), and to entail new competences linked to the virtual world (Sá and Serpa, 2018).

Due to the dynamic development of digital technologies and digital economy, many new concepts have emerged, such as digitisation, digitalisation, digital transition, and digital transformation. They have evolved with technological progress and changes in the business environment. It is worth indicating the differences between these concepts.

"Digitisation is the conversion of analogue data and processes into a machine-readable format" (OECD, 2019, p. 18). In recent years, there has been an intensification of digitisation in different socio-economic system areas, resulting in the transfer to the virtual world, not only of data and information but also of products, processes, and relationships between actors, actors and devices, and between devices. Digital forms enable an increase in search speed, replication, and sharing of virtual products or their use in real time streaming at much lower costs, which may even be close to zero (Goldfarb and Tucker, 2019).

Digitisation is a significant and essential component of digitalisation, which is in turn the driving force of the digital economy (Nowicka, 2019). There is a consensus in the understanding of the term digitalisation, although it is sometimes equated with digitisation. Definitions of digitalisation indicate changes in business and organisation based on the application of digital technologies (Brennen and Kreiss, 2014). They also underline changes in the value creation process or organisational changes, leading to a new operating model (i.e. types of goods and services provided to customers) or a new business model. The OECD (2019, p. 18) defined digitalisation as "the use of digital technologies and data as well as interconnection that results in new or changes to existing activities". The application of modern technologies results in changes to existing goods, industries, and occupations.

Digitalisation affects societies and people as well, and is expected not only to improve people's lives but also to ensure cybersecurity and increase human well-being (Salminen and Zojer, 2020).

The term digitalisation is closer in meaning to the term transition used in business. On the other hand, according to the approach presented in this chapter, digital transformation requires deeper changes in the economy and society, whose scale, scope, and complexity are relatively significant or unprecedented. Thus, digital transformation "refers to the economic and societal effects of digitisation and digitalisation" (OECD, 2019, p. 18). It implies a much wider and significant change of economic and social parameters, such as the development of an information society (Lovelock, 2018). Digital transformation, together with the use of digital technologies, e.g. those classified as social, mobile, analytics, and cloud (SMAC) has significantly impacted many areas of society, including private life, social inclusion, digital connectivity, public administration, industrial structure, and social activities, among others. Thus, digital transformation facilitates participation in economic and social activities but it also raises justified concerns about privacy and security of data shared by society via social media, mobile applications and advanced analytics, and cloud storage services. Digital transformation, along with digitisation and digitalisation, accelerates global societal changes and makes the digitality of society itself possible (Bowen and Giannini, 2014).

A dynamic development of digital technologies and the digital economy contributes to the development of digital society (Bax, 2011; Helbing, 2015). A society in which the Internet and intensified interconnections in the virtual world are central becomes more digital because digital technologies increase access to information, its storage, and dissemination (Serpa, Ferreira, and Sá Santos, 2020), enabling new avenues of engagement. The society becomes more digital as a result of adopting and integrating ICTs, computer, and business sciences and humanities whether at home, at work, at educational institutions, or at leisure centres (Faulkner and Lie, 2007). Digital technologies have the potential to build a sustainable economy and society, as emphasised in the United Nations SDGs. The document stresses that access to ICTs and affordable access to the Internet is one of the goals of the global economic transformation.

Society is one of the beneficiaries of the digital transformation. The technological development increases quality of life and contributes to human well-being, but it may also bring threats of employment levels, unequal distribution of wealth and information (Nakanishi, 2019), ethical, legal, and social challenges and increase the need for security and privacy that should be protected (Center for Research and Development Strategy: Japan Science and Technology Agency, 2016). However, failure to adapt to changes and digital transformation would be a much greater threat to economies, societies, industries, and organisations and it could even lead to digital destruction (Goliński, 2018).

One of the European Commission's goals is to build a truly digital European society that can benefit from the digital single market. The united Europe aims at creating an inclusive digital society through building smarter cities, improving access to eGovernment and eHealth services, and developing people's digital skills (European Commission, 2021). The Commission supports smart digital technologies such as autonomous vehicle development. It also encourages smart use of energy in buildings and transportation so as to impact the environment in a positive way. Such measures and funds allocated for employees to help them develop skills and competencies necessary in the future labour market are intended to support a cost-effective, fair, and sustainable socio-economic transformation towards a climate-neutral Europe.

The COVID-19 pandemic has accelerated the adoption of digital technologies and digitalisation; therefore, its impact should be considered while analysing trends towards sustainable development of society (Serpa et al., 2020) and consumers. The pandemic has contributed to changes in several areas and services, which did not undergo digitalisation before, due to certain barriers and social resistance, i.e. in education and healthcare, or employers' resistance to remote work. It has also influenced consumers' needs and accelerated the digitisation of purchases, particularly in the food industry (Cichosz, Nowicka, Marzantowicz and Pluta-Zaremba, 2020). At the same time, rapid digitisation of many spheres of private and professional life has increased the risk of a digital exclusion of part of society due to their age, income levels, and access to adequate information and communication infrastructure (e.g. broadband Internet, fast LTE or 5G Internet). Elderly persons who cannot use modern technologies and computer equipment and low-income earners who cannot afford to purchase modern equipment or access to ICTs are particularly affected.

Future business practices will probably contribute to the sustainability of society. The Euromonitor International studies from the second half of 2020 demonstrate that the COVID-19 pandemic has brought an enhanced sense of social responsibility, with 51.9% of companies currently prioritising social over environmental issues, and 60.8% of businesses expecting to balance social and environmental issues as the crisis evolves (Euromonitor International, 2020). Businesses embarking on the path to recovery have an opportunity to reinvent themselves, implementing sustainable investing along with the development of sustainable products and sustainable sourcing as the two areas fostering sustainability the most (see more in Chapter 11 written by Magdalena Mikołajek-Gocejna). Above all, the pandemic has highlighted the need to look afresh at the areas and policies relevant to the digital transformation process, different for each particular country.

A social dimension of the analysis devoted to sustainable development is inextricably linked with an ecological dimension. Since there are close links between the social and ecological spheres, ecology is sometimes treated as the intersection of the social and the natural. The Society 5.0 concept

discussed in Section 1.7 points to ecology as a significant element of the social sphere.

Therefore, it is worthwhile to analyse the digital transformation of the economy and society from the perspective of sustainability. The study's aim is to answer the question whether digital transformation of the economy allows the sustainable development assumptions to be implemented in the social cohesion sphere (including, inter alia, reduction of social stratification, provision of equal opportunities, counteracting marginalisation, and discrimination) and whether it enables the improvement of environmental quality through limiting the harmful impact of production and consumption on the environment and the protection of natural resources, among others.

The digital transformation of society and sustainability can be measured and assessed using social order components. Social order includes: demographic changes, public health, social inclusion, education, access to the labour market, public safety, data security, and sustainable consumption habits. As a rule, measures are used that define the conditions necessary for digitisation and digitalisation, i.e. technology infrastructure, IT and communications sector investment, e-commerce, and broadband penetration rates, but they do not give a picture of the entire scope of digitalisation. Therefore, it is worth introducing other measures to make the digital economy visible in economic statistics.

Demographic changes are closely linked with ageing of society, lower birth rates, and shrinking numbers of young people able to work, particularly in rich developed countries. The age structure is an important determinant of the remaining social order group development because it influences such needs as adaptation of public health to new challenges facing an ageing society and ability to integrate through social media. The share of young people willing to undertake work impacts not only education but availability of workers and consumption patterns. The problems of digital exclusion of certain social groups (the elderly and the poor) have been exacerbated by the COVID-19 pandemic and intensified digitisation of many spheres of life. The elderly have generally suffered from a lack of skills in using electronic devices and digital technologies. The poor have been excluded because they do not have adequate resources and in consequence, no access to ICTs and digital skills.

Public health is the next area where digital technologies may be implemented but it has been strongly affected by the pandemic. More and more often, people search for health information online. Modern digital technologies and devices help support health monitoring for sick and elderly people, including, inter alia, remote monitoring of vital functions, and diagnosing people affected by chronic diseases. A growing number of mobile device applications help to maintain a healthy lifestyle. They help to monitor movement and fitness, e.g. physical exercises with vital parameters, the quality and calorie level of consumed meals and their adjustment to a given

person's lifestyle and physical exertion. Automation and robotics are making their way into the healthcare sector (e.g. online appointments) and operating theatres, and allowing medical robots to perform surgical procedures. The events related to the COVID-19 pandemic have significantly changed the way in which health services are delivered by moving medical consultations into the virtual world while reducing healthcare costs, e.g. through mobile healthcare technologies. The future will show to what extent such services will be adopted in the primary healthcare sector, e.g. appointments for check-ups, issuing prescriptions.

Digital technologies may support social inclusion processes, i.e. inclusion of different social groups and minorities, and processes of building virtual communities that share the same values and have similar views or lifestyles. On the other hand, digital social contacts exclude age groups which do not willingly use modern communication tools, social media, or online applications.

Last year, accelerated digitalisation took its place in the sphere of education. Most educational and training activities and courses were moved into the virtual space, which increased access to information and knowledge with virtually no geographical boundaries or restrictions on movement. At the same time, rapid technological progress requires digital skills necessary in the virtual world (Serpa et al., 2020). That is why, in order to promote social well-being, the policies applied should reduce divisions in society through strengthening skills and lifelong learning of all members of society, including, in particular, women, the elderly, and low-income persons (OECD, 2019). Failure to take action to increase education and digital skill levels heightens the risk of digital exclusion. Digital technologies may also help face collective challenges, e.g. by promoting energy efficiency and pro-environmental consumption habits. Digitalisation in education, especially for children and teenagers, carries many risks of raising a society immersed in virtual reality, alienated and devoid of the ability to cooperate with group members.

In the context of sustainable development, access to the labour market is another element of social order that needs to be analysed in terms of human-machine relationships in Industry 4.0 and 5.0 and human resource dispersion caused by intensification of remote work enforced by lockdowns during the COVID-19 pandemic. Competition is growing among professionals with specific skills and experience as they can work remotely regardless of their location. What is more, digital skills are becoming increasingly important, which may result in the labour market exclusion of elderly people with extensive work experience in the real world.

In the context of the human-machine relationship, concerns are raised about the replacement of people by machines and robots, especially in Industry 4.0. Using AI, they can learn faster than people and work without any time limits. According to this pessimistic scenario, many professions will disappear from the market which is why some preventive steps should be taken to help workers develop new skills, prepare them for new jobs

related to handling data and digital technologies, and foster their creative thinking and teamwork. On the other hand, robots will fill in the gaps in the supply of workers in ageing societies. They will also be able to assist workers in occupations requiring physical presence (e.g. improve human work performance with augmented reality), replace humans in hazardous tasks, or intelligently support humans providing them with responses, in accordance with the Industry 5.0 assumptions. The labour market may require new regulations to respond to the challenges of digital transformation.

Public safety versus individual freedom is another area of social order that brings many questions and emotions. It is still difficult to decide whether to put society's well-being and safety (e.g. protection against terrorist attacks or cyberattacks) above individual freedom and the right to privacy, which can be compromised by surveillance systems and applications registering and monitoring each activity, and promoting the required behaviour. The level of surveillance depends on the policies of particular governments and may be higher in cities than in rural areas on account of the higher crime rates in cities.

The risk of blackouts is another threat to society dependent on new technologies and the Internet. The problem of many governments is how to protect their countries against the risk of metropolitan, regional, and national Internet network failures. At the same time, they have to fight against other threats such as cyber bullying and disinformation.

Individual users and businesses have doubts concerning security of data as their collection, transmission, and distribution underpins the digital economy development. All the more, the amount of data collected, including Big Data, has been growing exponentially, as is the risk of cybercrime. Data is collected in each sphere of our lives. It is collected during online transactions and electronic payments, when using social media, news services, or the IoT. To overcome such barriers, resources to manage, and reduce risk need to be developed (OECD, 2019).

Sustainable consumption patterns are the last social order component to be evaluated. The COVID-19 pandemic has contributed to a fall in consumer spending and consumer purchases of many categories of goods and services. At the moment it is difficult to assess the impact of such behaviours on reducing consumerism. A faster growth of online shopping is the second trend, but its sustainability is difficult to evaluate. By selecting products with a smaller footprint, an environmentally conscious society limits negative impact on the environment as, through their purchasing decisions, they put pressure on manufacturers to move towards sustainability.

Social changes achieved as a result of digitalisation and digital transformation have an ecological dimension as well. New digital services and digitisation and a better use of the existing resources and infrastructure contribute to pro-environmental activities. Reducing real world activity in favour of cyberspace leads to a lower demand for mobility and movement of people because traditional shopping for goods and services and interpersonal relations are replaced with virtual transactions (e.g. increase in

online shopping, use of digital educational services, training courses and counselling, use of video and teleconferencing instead of traditional meetings and travels, particularly by air transport with the highest levels of harmful substance emissions into the environment). The reduction of the carbon footprint left by businesses and societies is also a result of lower natural resource consumption and limited transport of digital goods, i.e. goods produced, distributed and often consumed online (e.g. replacement of traditional printed newspapers, books, and other content with their digital equivalents, introduction of electronic documents such as invoices, bills, and prescriptions). Digital technologies also support the development and use of services based on the shared resources and infrastructure as part of the sharing economy (e.g. car sharing, especially electric cars, urban rental of bicycles and scooters, cloud computing). The sharing economy improves the resource utilisation level while reducing negative environmental effects (see more in Chapter 3 written by Katarzyna G. Sobiech-Grabka).

Technological progress contributes to the creation of more sustainable and resource-efficient societies and economies. According to research by Deloitte and the Global Initiative for Sustainable Development, modern ICTs, including digital ones, are essential in meeting as many as 103 of 169 SDGs. The analyses demonstrate that their effective application should accelerate progress towards these goals by 22% (Deloitte, 2019, p. 13). At the same time, it must be emphasised that modern technologies, which will be increasingly used in the coming years, negatively impact the environment, society, and its well-being. The most serious threats include (Marzantowicz, Ocicka and Pluta-Zaremba, 2021, p. 68):

- Production growth accompanied by environmental pollution resulting not only from the digital technology spread but also from constant replacement of rapidly ageing electronic devices and machines, whether due to the need for improved models with higher performance, upgraded and updated in terms of the latest available technology (e.g. smartphones), deliberate shortening of product life cycles, or consumerism of society.
- Increased electric energy consumption due to the widespread use of electronic and robotic devices and ICTs, resulting in higher levels of greenhouse gas emissions and the threat of blackouts.
- Excessive use of resources for production purposes, including scarce raw materials.
- An increase in electro-waste as a result of higher demand, shortening of product life cycles, and a wider use of batteries, especially those fitted in electric vehicles, among others.

Therefore, in the human activity and business digitalisation process, it is crucial to decouple the growth in the use of ICTs and electronic devices from environmental degradation. The increase in electric energy consumption for

transmission and processing increasing amounts of data should not contribute to higher emission of harmful substances. In addition, while designing and manufacturing devices necessary for modern technologies (e.g. smartphones, IoT devices, equipment for collecting and processing Big Data, etc.), it is important to observe the principles of the circular economy so as to limit the electro-waste avalanche and prevent the degradation of natural resources. Implementation of these principles will be facilitated by digital circular supply chains and the use of digital technology as well as the development of eco-innovations (see more in Chapter 5 written by Katarzyna Nowicka and in Chapter 6 written by Barbara Ocicka & Jolanta Turek).

Today, as highlighted in the OECD's report (2019, p. 5), there is a window of opportunity to create a digital future in such a way that digital transformation possibilities are used to improve people's lives, ensuring that no one remains excluded. The focus on people and society as a whole and on the digital transformation ecological objectives is a good starting point to apply this holistic approach to society, which is a characteristic feature of the Society 5.0 concept.

1.7 The digital transformation: From Society 1.0 towards Society 5.0

In the literature and research, the concept of Society 5.0 is considered a successor to the Industry 4.0 concept more often than Industry 5.0 because it goes beyond the industrial sector and focuses on solving social problems with the use of digital technologies (Skobelev and Borovik, 2017, Pereira, Lima and Charrua-Santos, 2020; Vojko Potocan, et al., 2021). The development and deployment of these technologies and the formation of integrated cyberspace make it possible to address many social issues (Lee, Bagheri and Kao, 2015; Shiroishi, Uchiyama and Suzuki, 2019). The social issues are also at the heart of the Industry 5.0 concept described earlier, which emphasises the role of humans and puts them back at centre stage. Humans return to Industry 4.0 machine-dominated factories, with which they collaborate, supported by AI that, by penetrating into people's everyday lives, increases their capacities (Skobelev and Borovik, 2017). Although Industry 5.0 focuses on humans (providing them with customer experience) and on hypercustomisation, the concept of Society 5.0 meets the challenges of transforming economies better due to its holistic approach to social problems.

The concept of Society 5.0 developed by the Japan Business Federation (Keidanren) in 2016, due to ageing population concerns, looks beyond the purely technology-driven Industry 4.0 and promises to revolutionise society for the greater good of humankind (Costa, 2018). Society 5.0 is "a human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space" (Federation, 2016). At the heart of the concept is the active use of digital technologies developed by Industry 4.0 such as AI, IoT, robots,

3D and 4D printing, augmented reality, Big Data and distributed ledger technologies – blockchains in daily life, in the industry, healthcare, education, and other areas of human activities. Technologies and intelligent systems could be seen by society as beneficial rather than threatening (Pereira, Lima and Charrua-Santos, 2020). Moreover, technological innovations which can be considered a tool for social innovation and not only a factor leading to changes in companies and business processes will have an essential role in the transformation process to Society 5.0 (Aquilani, Piccarozzi, Abbate and Codini, 2020). Of particular importance in this process is open innovation that emphasises the need for cooperation between different actors (both the public and private sectors) in the field of innovation, creation of ecosystems for the mutual exchange of innovations and use of big data (Fukuda, 2020) as well as value co-creation "with primary and active role of individuals and the creation of less informal relationships [between people, businesses, universities and the Public Administration] that develop into interactions" (Aquilani, Piccarozzi, Abbate and Codini, 2020, p. 8).

From the historical perspective, social concepts have evolved from hunter-gatherer Society 1.0 living in harmonious coexistence with nature, agricultural Society 2.0 forming groups based on agricultural cultivation, increasing organisation and Nation-building, through industrial Society 3.0 that promotes industrialisation making mass production possible and information Society 4.0 that realises increasing added value by connecting intangible assets as information networks towards super-smart Society 5.0 aiming for a prosperous human-centered and data-driven society (Onday, 2019; Deguchi et al., 2020). According to Yoh'ichi Tohkura, the changing role of information in society underlines the evolution of societal types (Berberich, Nishida and Suzuki, 2020). In hunter-gatherer and agricultural societies, information was used for survival, i.e. seeking food and avoiding danger, while in industrial societies, it was used to accumulate material wealth (Nishida, 2016). It is worth noting the differences between Society 4.0 and 5.0. Both concepts are based on the need to share information and its use in companies' and people's activities but the way of obtaining information is different.

Production, distribution, use, and manipulation of information are the main drivers of business in Society 4.0 (Cabinet Office, Government of Japan, 2017). Collected via cyber network, data, and information are analysed by humans with the support of information systems, while "Society 5.0 is an information society built upon Society 4.0, aiming for a prosperous human-centered society" (Fukuyama, 2018, p. 48). In this system, large amounts of data (big data) are collected from multiple sensors in physical space and then analysed without human intervention in cyberspace by AI, which provides optimal analytics used in physical space to improve lives (Deguchi et al., 2020). Through the application of technological innovation and computer science innovation, this process creates new value for industry and society in ways beyond human capabilities.

Parallel intelligence in which traditional AI theories are extended to cyber-physical-social systems enables understanding and effective dealing with socially and technically complex problems of Society 5.0 and finding agile, focused, and convergent solutions (CPSS) (Wang, Yuan, Wang and Qin, 2018). The key Society 5.0 techniques are consistent with an idea of automation, which determines the direction of the AI technology development and the overall management and control structure of CPSS systems (Wang, Yuan, Wang and Qin, 2018). AI systems are used in areas that have a direct and positive impact on society, e.g. education and healthcare and may influence individuals by encouraging pro-social behaviour (e.g. helping, sharing, and collaborating) that can indirectly lead to socially good outcomes (Berberich, Nishida and Suzuki, 2020). The use of machine learning for efficient car-sharing networks is an example of tools that facilitate helping others or collaboration.

There are two types of relationships specific for the Society 5.0 concept: between technology and society and between individuals and society supported by technology (Deguchi et al., 2020). The first relationship involves connecting people, things, and systems in cyberspace so that in real space, they can adapt more easily to change and live sustainably in safety, security, and comfort. This combination of digital transformation (cyber world) and people's creativity (real world) increases social problem solving effectiveness and efficiency and by creating value, enhances people's quality of life, and sustains healthy economic growth (Shiroishi, Uchiyama and Suzuki, 2018; Nakanishi, 2019). The social and economic problem solving addresses the following areas: population ageing cost reduction, natural disasters, social inequality and equal wealth distribution, security and improvement in people's quality of life, including greenhouse gas emission reduction (Pereira, Lima and Charrua-Santos, 2020).

When commenting on the relationship between the individual and society, it is emphasised that the common good has greater value than individual well-being. Reconciling the goals of society with the goals of the individual aims at finding solutions that support sustainability, e.g. an overall goal is not to insist on people to reduce their energy consumption but to select an energy-mix that supports the development of green energy production and its use (Deguchi et al., 2020).

Due to the specific Japanese culture, society's lifestyles, and above all, the technological advancement level, the question should be asked about the Society 5.0 concept transferability. The analysis of the reasons underlying the concept development demonstrates that the potential exists for creating Society 5.0 in the European Union countries. The most important determinants will be the issues of an ageing society and a shrinking population due to declining birth rates, which will soon be similar to those in Japan. According to projections, the Japanese society will be the oldest society where about 40% of population will be aged over 65 years in 2050 (Granrath, 2017). The Japanese call it a super-ageing society. The challenges

include not only care for the elderly but also adaptation of infrastructure, healthcare, shopping, etc. to support seniors' independence. This is particularly true for urban living, where the scale of challenges is much higher, especially in societies with high urbanisation rates, to which Japan belongs.

A reduction in the labour force level will be a major problem of ageing societies. To meet these and other challenges, Japan is developing advanced intelligent robots to replace humans in manufacturing plants but also in care for the elderly. On the other hand, such solution increases the risk of fewer jobs, especially manual jobs for the less educated.

Furthermore, the challenges include environmental issues, which affect most areas of the world to varying degrees and require a transition to renewable energy in order to reduce CO_2 emissions. The challenge is not only to switch to green energy but to reduce the price of renewable energy sources, to increase energy savings and control its use, to counter blackouts, especially in metropolitan areas and large cities where energy consumption concentrates.

The second no less important argument for the implementation of Society 5.0 objectives in the European countries is that the concept is linked to the seventeen SDGs established by the United Nations (Nakanishi, 2019; Onday, 2019). Both concepts target suburban and rural area development, disaster information sharing systems for better preparedness, efficient allocation of funds in society, security of systems and networks, sustainable energy, health, agriculture and food, logistics, manufacturing, and services. Salgues (2018) highlights that, according to its assumptions, Society 5.0 strives to achieve sustainability (ecology), broad inclusion, efficiency, and thus also the industrial competitiveness of economic actors and individuals who implement them using their intelligence and knowledge. The application of new digital technologies in various industries and social activities makes it possible to achieve economic development based on the SDGs and solve the key problems of modern society (Keidanren, 2016) in harmony with nature.

The EU holistic approach towards implementing the UN's 2030 Agenda for Sustainable Development together with its Member States and the plans for green and digital transformation of the economy contained in the EGD lay stable foundations for societal transition to Society 5.0 in the EU countries. The implementation of the EGD assumptions requires rethinking and updating policies in the areas of, among others: investing in environmentally friendly technologies, supporting industrial and digital innovation with the introduction of a closed loop economy, introducing environmentally friendly forms of private and public transport, decarbonising the energy sector, large-scale infrastructure, transport, food and agriculture, empowering consumers and developing new models based on sharing and renting goods and services, and making buildings more energy efficient, as well as taxation and social benefits (see more in Chapter 9 written by Aleksander Werner). The objectives and measures set out in the EGD focus on the

transition to a carbon-free economy and improvement of competitiveness of the EU economy and businesses but they also have a social dimension. The EGD emphasises the need to ensure that the economic transformation is fair and inclusive and that pro-environmental measures indirectly increase quality of life in the European population, without putting society at the centre. Thus, the EGD objectives provide a solid basis for the Society 5.0 creation and a holistic view of society's problems.

How will Europe and its countries compare to technologically advanced Japan in the future depends on the cooperation between public, private, and individual actors and their willingness to make efforts to provide the transformation from Industry 4.0 to Society 5.0.

1.8 The digital consumer – More or less sustainable?

Understanding the consumer of the future is critical to success in a fast-changing world where the new rules set the directions of development. Digital technology has transformed consumers, who are changing their behaviour at an unprecedented speed. This digital acceleration is often attributed to technology, purchasing power, and social habits of two groups: Millennials and Generation Z (Dingee, 2019, p. 1). Digital consumers have much more power. They search for information about the products they buy and are engaged with companies to create tailored solutions and products for them and to co-create with their suppliers. They want to influence other customers' opinions and choices, especially on social networks, complaint sites, blogs, and videos. They are hyperconnected, i.e. connected to information 24 hours a day, and increasingly mobile. Their power comes from four sources that coexist and intertwine. Demand and increased access to information via the Internet are the two individual sources. The other two network-based sources are networks (e.g. via social media) and the crowd-based rise of group/community buying power (crowdsourcing, crowdfunding, the sharing economy, and the creation of new marketplaces) (Labrecque, 2013, pp. 258–259).

The growth of digital technology applications is inextricably linked with the digitalisation of consumers' lives and changing consumption patterns (Cochoy et al., 2020, pp. 1–2). There is also a growing group of digital consumers who, according to the Gartner Glossary, "use digital channels – Web, mobile and social – to consume content, engage with brands and complete a transaction" (Gartner Glossary, 2021). Digital consumers meet their consumption needs online, without necessarily purchasing products. They may only search for product information, use web services free of charge, or benefit from digital content (audio/video, streaming, games) in exchange for watching ads or sharing their personal data (Tkaczyk, 2016, p. 354). The COVID-19 pandemic has accelerated the digitisation of business, goods, and changes in various areas of life and led consumers to re-evaluate their life priorities, giving rise to new values and spending

criteria. Consumers forced to stay at home during lockdowns or out of concern for their health moved a significant part of their activities to virtual space, which has resulted in a rapid growth of digital consumers in most generations (Cichosz, Nowicka, Marzantowicz and Pluta-Zaremba, 2020; Jílková and Králová, 2021 OECD, 2020). The COVID-19 pandemic has changed consumption by accelerating the digitalisation of areas that have resisted change so far, such as online medical consultations, online education, remote work, and grocery shopping, which consumers preferred to do in the real world before. Additionally, a large part of consumers has limited their spending and purchases, especially Generation Z, who face financial stability risks during the crisis (Euromonitor International, 2021). Baby boomers, on the other hand, have turned to online shopping out of fear for their health. Furthermore, the reduction of activities in the real world has lowered demand for many consumer durables, which has, in turn, reduced consumer spending and shopping, and increased their awareness of excessive consumption.

In the face of digital transformation, it is worth asking the question how consumers will change and whether digital consumers will be more or less sustainable in the coming years. Can the use of modern technologies make consumers pro-environmental? Such an analysis should take into account the impact of the COVID-19 pandemic on consumption trends.

The digital technology ecosystem is leading to somewhat contradictory trends in digital consumer behaviour. Easy access to information via the Internet, together with the growing mobility of digital society, promotes shopping without geographical boundaries, which manifests itself in globalisation and homogeneity of consumption. On the other hand, it sets trends for buying high quality products from local producers and promotes micro and small enterprises. Social media is used in a more intensive way, especially by younger generations of buyers, and this phenomenon is reflected in growing consumerism driven by the opinions of influencers and friends, as exemplified by fast fashion. However, social media, forums, and chats which shape opinions may also stimulate people and companies to take sustainable and pro-ecological actions, including green consumption.

The globalisation of online shopping for consumer goods and homogeneity of consumption as its final result (together with mixing, i.e. hybridisation and differentiation) are significant trends in the digital economy. Year by year, European consumers spend more and more on cross-border markets dominated by the USA and China. Long-distance transport of parcels increases the negative impact on the natural environment. Not without significance are also the challenges of product protection in long-haul transport while avoiding over-packing. On the other hand, the carbon footprint of packaging is generally much lower than the footprint of packaged products and can be further reduced by using eco-friendly recycled packaging. The intensive development of Chinese shopping platforms is leading to increased spending of European consumers, who make their purchasing

decisions based on price and ever shorter delivery times thanks to the location of warehouses in European countries. Unfortunately, their choices lead to a fall in the domestic e-commerce demand and reduced competitiveness of European micro and small enterprises, which sell products of similar quality but usually at higher prices. The loopholes in the customs and VAT regulations which allow consumers to avoid these charges are also not without significance for competitiveness. Therefore, new regulations are needed to even out competition (see more in Chapter 8 written by Katarzyna Kimla-Walenda and in Chapter 10 written by Piotr Karwat).

The digitisation of life encourages more sustainable consumption patterns even though digital consumers have much wider access to goods and services from around the world. They are less impulsive and less sensitive to price and their consumer practices are more thoughtful and conscious. Certain consumer groups such as Millennials and Generation Z for example, display specific features which are relevant. These groups want to be well informed about brand ethics and look for sustainable products. Young consumers expect the companies whose brands they buy to take action in the field of environmental protection and social injustice (e.g. labour exploitation in low-cost countries). By applying pro-environmental criteria in the selection of goods and services suppliers, consumers may exert pressure on companies to take pro-environmental action and implement eco-innovations (e.g. designing products and packaging with a closed life cycle and climate-neutral packaging in line with the assumptions of the sharing economy), thus contributing to strengthening the competitive position of entities, which implement the goals of sustainable development (Marzantowicz, Ocicka and Pluta-Zaremba, 2021) (see more in Chapter 4 written by Paweł Bartoszczuk). They also can, in a conscious or even organised manner (e.g. social media campaigns), boycott products whose manufacturing processes do not meet regulatory standards or even threaten the environment. They can even force companies as well as their suppliers to take responsibility for non-ecological actions (e.g. production of Fair Trade food or clothes).

Digital consumers can be more ecological thanks to opportunities offered by digital technologies in everyday life such as smart houses, electric cars, better use of resources, e.g. e-car sharing or sale of used products (e.g. upcycling clothes). They can resell products to other consumers (Consumer to Consumer - C2C) or companies (Consumer to Business - C2B) through social media or online platforms. It is worth paying attention to this trend, which may contribute to changing business models of some clothing manufacturers or retailers. Noticing the potential in the sale of second-hand clothes, Zalando, one of the clothing industry giants, introduced services of buying clothes from consumers and then selling them in its online shop with the right to return the product within 30 days. Such transactions are made in the virtual space, apart from delivery to a customer by a courier company. This is an example of a Consumer to Business model (C2B) that, to a certain extent, cannibalises the online retailers' core business of selling

new clothes and accessories. However, as with Amazon's introduction of e-book readers, companies can benefit from expanding their offer to a new consumer segment, i.e. is pro-environmental buyers who care about sustainable consumption.

The first experiences related to consumer digital behaviour demonstrate that consumers have changed the way they live, work, and do shopping (Zwanka and Buff, 2021). Their requirements towards companies have increased. Consumers demand that companies pay attention not only to their income and profit but also take the well-being of society and the planet into consideration (Euromonitor International, 2021). Moreover, companies should support consumers in their striving for a more fulfilled, balanced and self-improved life to help them survive in adverse conditions. Digital consumers are cautious and frugal since the business environment is uncertain. Their priorities are value-added and health-promoting products and services, and activities closely connected with health and wellness, self-care, or mental well-being. Such an attitude encourages consumerism reduction, which is the key to success in meeting the UN's sustainable goals and achieving climate neutrality in Europe by 2050. It is now difficult to know whether, after the pandemic, digital consumers will return to their old habits and lifestyles that promoted excessive shopping.

AI, together with machine learning, is considered to be one of the key technologies in the digital economy and Society 5.0 development. Together with other digital technologies, they constitute an ecosystem designed to support humans in everyday life, help them make decisions, or adapt their environment to their needs. The possibilities of AI applications are growing as a result of the development of IoT that is increasingly used in a wide range of devices. Learning algorithms detect patterns in consumer digital behaviour. They apply AI and influence search results, displayed messages or advertisements (e.g. Amazon or Netflix webpages). In the future, excessive control of people, decision-making without human intervention (Growiec, 2018), or human skilled labour will be substitutability the biggest threats of AI (Autor and Dorn, 2013; Frey and Osborne, 2013).

AI has a number of applications in e-commerce as companies can save their sources and time, but, above all, they can respond to customers' needs. The use of chatbots makes it possible to answer customers' questions in real time and to ensure immediate contact with the company, which is what Generation Z consumers expect. AI, together with machine learning and Big Data analytics, provides support to online stores with demand management and dynamic supply-demand matching, use of dynamic pricing, demand sensing, and customisation of promotions and loyalty programmes. In the real world, AI supports product flow management or the work of robots.

The inclusion of different things into the realm of e-commerce customers illustrates people's dependence on everyday devices and on decisions regarding customer preferences taken by such devices. Solutions consisting in installing buttons on household appliances to automatically order products

(e.g. washing powder, dishwasher tablets, coffee for coffee machines) can be regarded as the first step in this direction. The decision to order is still left in the hands of humans. Automation of replenishment and online ordering by smart devices such as refrigerators, coffee machines, and washing machines will be the next step awaiting the digital society. Smart appliances can keep track of an inventory and suggest what to buy and when. In the third AI development stage, appliances will make independent decisions, automatically connect to the e-shop and purchase products. Thus, they will replace appliance users in making everyday routine purchasing decisions. Will AI follow the existing consumer choices or will it suggest buying other products? Because of this, AI should not also be "human-adaptive, i.e. adapting to human behaviour and preferences, but also human-adaptable, i.e. giving users the opportunity to directly tell it about their preferences and what they do not like" (Berberich, Nishida and Suzuki, 2020, p. 631).

The esize.me system designed by eobuwie.pl online shop is an interesting example of a breakthrough AI and machine learning innovation, which brings together the physical and digital realms. You can scan your feet in 33 places across Poland (23 retail spaces in shopping centres and 10 traditional shops). Scans are made by four cameras in 3 seconds. After the 3D scans have been introduced into the system and linked to a customer account, the e-shop programme will suggest the right kind of footwear out of 500 shoe brands to its e-customers, matching them to their feet (width, length, height, and fit). The system compares a virtual foot model with scans of the inner dimensions of the footwear. The algorithm recommends shoes that fit best. Moreover, AI applied by esize.me continues to learn by using information about customers' preferences and their online shopping history. If a customer consistently selects loose or tight footwear, the system will suggest such types of shoes in the future. The innovative esize.me system has been implemented to increase customer satisfaction and help them make purchasing decisions, which will result in increased sales in the long-term. In turn, the service should limit the number of unsatisfactory purchases and, consequently, reduce return rates due to incorrect sizes.

In the context of a dynamic AI development, questions are asked about its cost to the individual, the sense of freedom, power, and self-determination and, in consequence, the impact on human well-being. Can AI prevent society from making irrational investment, purchasing, and environmental decisions? Will applications replace humans in calculating, e.g. carbon footprint, and will AI suggest and make decisions about human actions or devices (e.g. autonomous cars may drive in such a way as to decrease CO_2 emissions). Will we be held accountable for environmental pollution? Will a person, as an individual, agree to such a level of interference in their decisions and loss of their freedom in the name of the higher value of a sustainable society and their quality of life? Can all this occur in the future at the expense of the individual, e.g. through excessive control and suggestions to make another choice? Such concerns often emerge in the current reflection

on AI. To some extent, we are already delegating, consciously or unconsciously, some decisions to social media communities and invite social media users to evaluate our actions and views. Final decisions, however, still belong to individuals. Besides, decisions are made by living beings, not virtual ones.

1.9 Summary and conclusion

The transformation of the economy is leaving its mark on sustainable development. The world has seen many transitions in the past, from automation to the decline or relocation of entire industries, which led to job losses and economic hardship. The legacy of the past, geopolitical situation, world economy transformation to date, and policy of sustainable development are the most important determinants of the success or failure of our efforts to improve the living conditions of society without exacerbating the natural environment devastation (harmonising the relationship between man and nature). Sustainable development has a growing influence on shaping the modern world and business management mechanisms in increasingly unpredictable conditions. A contemporary challenge for inhabitants of our planet is to choose between being homo oeconomicus and being homo sustinens. To achieve sustainable development, coherence is needed between the three pillars: economic growth, social inclusion, and environmental protection. All human activities should be undertaken with future generations in mind in order to not affect them by disasters caused by the destructive economy of homo oeconomicus. It is essential to create greater opportunities for all people, reduce social inequalities, provide possibilities for basic living standards, and to promote equitable social development in order to achieve the SDGs in the modern world. Thanks to our joint efforts in building a sustainable environment, region, country, and world, our generation and future generations will have a real chance at a better life.

The impact of technological progress and digital transformation of the economy and society is twofold. On the one hand, modern ICTs contribute to the creation of more sustainable and resource efficient societies and economies and are essential in meeting as many as 103 of 169 SDGs. But on the other hand, they can raise risk-conscious people's concerns about privacy and security of data, social exclusion, lack of trust in digital transactions, replacement of human relationships with social media contacts, and loss of jobs to robots and process automations. Today, there is a window of opportunity to create a digital future in such a way that digital transformation possibilities are used to improve people's lives, ensuring that no one is excluded. The focus on people and society as a whole and on the ecological objectives of the digital transformation is a good starting point to apply the holistic approach to society, which is a characteristic feature of the Society 5.0 concept. Due to creating a human-centred society that balances economic advancement with the resolution of social problems, this concept is referred

to as a successor to Industry 4.0. The key to success in a fast-changing world will be understanding the digital consumers of the future, who will change their behaviour at an unprecedented speed, and to build a sustainable society using the possibilities of digital technologies.

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