

## DILEMMAS OF ARTIFICIAL INTELLIGENCE DEVELOPMENT – SOCIOLOGICAL CONSIDERATIONS AROUND INDUSTRY 4.0 AND SUSTAINABILITY

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**Małgorzata Suchacka**<sup>1</sup> – *orcid id: 0000-0002-3769-5892*

**Nicole Horáková**<sup>2</sup> – *orcid id: 0000-0002-1075-053X*

<sup>1</sup>University of Silesia in Katowice, **Poland**

<sup>2</sup>University of Ostrava, **Czech Republic**

**Abstract:** Ongoing progress in the introduction of new technologies, rapid social adaptation to the fourth industrial revolution, implementation of new solutions related to information and communication become incentives to conduct interdisciplinary scientific analyses. The following paper is a review article and the presented analysis to a large extent is based on theoretical considerations referring to studies of other authors. Presenting the sources of this notion in the context of industry 4.0 and sustainable development is a foundation for possible further experimental research. However, the primary aim of this article is to demonstrate the sources of scientific interest in artificial intelligence, directions of research on this notion and potential sociological research areas related to AI. Another goal of this article is to indicate the implications that can be used in planned research projects. The scope of the analysis is largely based on the study of literature.

**Keywords:** industry 4.0, sustainability, artificial intelligence, social development,

### 1. INTRODUCTION

In the last few decades, a wider application of innovative technologies can be observed in numerous sectors of economy and fields of civil life (Deloitte, 2015). This is due to the unavoidably progressing, complete digitalisation of production processes, implementation of new technologies and the enormous social interest in these technologies (Ingaldi and Ulewicz, 2020). The contemporary developed societies rapidly adapt themselves to the fourth industrial revolution by learning new information and communication methods and creating new business models (Wolniak, 2020). The implementation of these solutions provides tangible benefits to the economy, society and natural environment. At the same time it poses new developmental challenges. Today, companies compete with each other on the merits of their human capital and immaterial resources such as employee's creativity, knowledge resources of the professionals and the effectiveness of interpersonal relationship networks. Businesses more and more frequently consider solutions offering a compromise between

sustainable development of society, economy and safety of the natural environment. This is accompanied by a series of new sociological phenomena, of which those related to the usage of artificial intelligence (AI) are the most interesting. Many outcomes of AI application have not been studied yet and there are some which are not even foreseen. Under this assumption, it is necessary to refer to sociological output which contains valuable guidelines – both for direct application in social practice and for further research directions.

## **2. METHODOLOGY**

The development of society has always been the factor shaping and influencing the social sciences which, in response, adjusted the conceptual, methodological and theoretical frameworks to new social phenomena. As a result, this analysis to a large extent will be based on theoretical considerations referring to studies of other authors. The theoretical themes referred to are part of an original and selective attempt to define the basic notions related to AI for a potential experimental research in the future. The scope of the analysis is largely based on literature study.

In order to achieve the aim of the article, three research questions have been formulated:

- What are the sources of scientific interest in AI
- How can we describe the relationship of AI with the concept of industry 4.0 and sustainable development?
- What are the potential directions of sociological research on AI?

An analysis of literature and existing sources was conducted (desk research) to find an answer to these questions. The considerations presented in this article, which are mainly theoretical, will contribute to bridging the cognitive gap in this area by indicating directions of potential sociological research which would take into account interdisciplinary relationships.

It can be said with certainty that it is difficult to identify a single significant source of interest in artificial intelligence. There are a couple of impulses which are of various origin and which drive each other:

- concepts of industry 4.0 and sustainable development,
- practice of contemporary business and social life,
- free, futuristic considerations of philosophical nature conceived by culture creators and thinkers.

Considering the aim of the article, it is worth to focus on the first two sources, although the last one can also provide much inspiration for sophisticated research.

## **3. WHY USING THE CONCEPTS OF SUSTAINABLE DEVELOPMENT AND INDUSTRY 4.0?**

Undoubtedly, the sources of scientific interest in artificial intelligence are the various scientific concepts originating from different disciplines and interdisciplinary approaches. One of the most popular concepts from the sociological point of view is the idea of sustainable development which dates back to the '60s and has been formulated more clearly since the '90s of the XX century. This idea has given rise to many theoretical approaches and scientific considerations related to a series of important social and economic problems. The concept of sustainable development has been incorporated into the principles of building a knowledge-based economy which was

promoted by the Lisbon Strategy launched in 2000. The European Union planned to create a competitive, dynamic and knowledge-based economy during 10 years (Okoń-Horodyńska and Piecha, 2005). The strategy was supposed to bring long-term sustainable growth and create more jobs. Of course, not all ambitious goals in the area of economy, society and ecology have been achieved and the challenges which emerged had to be addressed in the new Europe 2020 strategy. At the foundation of the new scheme is the intellectual capital – smart growth and sustainable development – a development which promotes social inclusion (Niklewicz-Pijaczyńska, 2011:449). An important role is attributed to network, learning and smart organisations. A steady increase in the demand for new knowledge used in knowledge-intensive services and designing innovative products of the high-tech industry sector can be observed in a sustainable economy (Skórska, 2016:241). The entire paradigm of sustainable development in a special way considers the benefits resulting from comprehensive services provided by nature in the bio-ecological and socio-economic dimensions (Michałowski, 2013:104). They are related to natural processes:

- occurring in natural ecosystems,
- transforming matter, energy, information and space,
- caused by geophysical forces and living organisms which directly or indirectly contribute to reducing entropy and maintaining long-lasting, sustainable development of society-economy-environment macro-system (Michałowski, 2013:31).

A sustainable, knowledge-based economy defined this way facilitates efficient knowledge management as well as introduction and dissemination of the results of innovation activity. This leads to a decrease in material and energy intensity of production, improvement of ecological effectiveness of processes, reduction of pollution and, at the same time, fulfilment of the expectation of all key stakeholders (clients, suppliers, competitors, employees, investors, communities, etc.). At the same time, the growth of sustainable, knowledge-based economy constitutes one of the greatest challenges to public authorities, entrepreneurs, representatives of the R+D sector and business support institutions. Researchers indicate that the realisation of the idea of sustainable development on a global scale will not be possible without proper introduction at the micro-economic level (Rutkowska-Podołowska and Pakulska, 2011). This requires deep awareness on the part of managers who are responsible for the shape of HR of a given company. It can be assumed that the basic indicators of a sustainable knowledge-based economy are:

- development of intellectual capital, including human capital,
- strategic thinking and management,
- understanding knowledge as an economic value which allows efficient use of various factors of production,
- effective use of knowledge, information and communication technologies as well as creating learning, smart, fractal or virtual organisations capable of flexible reactions to the needs of the market,
- knowledge and innovation development which takes into account the environmental issues and various ethical and social aspects,
- development of high-tech industry,
- implementation of environmental management systems,
- sustainable consumption of natural resources,
- presumption and using the wisdom of the crowd,

- ensuring an increase in prosperity and the quality of life through the implementation of social innovations and reducing the environmental dangers (Górka and Łuszczczyk, 2014:27), (Powichrowska, 2013:11).

All these indicators are social and constitute material for in-depth sociological research. Improving innovativeness and competitiveness of contemporary economies conducted based on the abovementioned indicators is reflected, in the first place, in new technologies, technological advancement of products and services, eco-innovations and domination of „knowledge workers”. Some researchers and practitioners treat them as the beginning of the fourth industrial revolution. It consists in re-industrialisation which opens new frontiers to the development of a sustainable knowledge-based economy and functioning of the information society. The aim of adopting the assumptions of the concept of industry 4.0 is to accelerate the transformation of production businesses into smart factories in which networks based on information and communication technologies connect machines, processes, systems, products, customers and suppliers (Stadnicka et al., 2017, Bilan et al, 2019). It should be stressed that meeting those requirements is particularly important for management staff of the production businesses because at the foundation of the industry 4.0 are, among others: cyber-physical systems, internet of things, information and communication infrastructure, organisational learning processes and open innovation (Ślusarczyk, 2018; Ulewicz, 2020). This is a result of a hard approach to management, specific procedures or dependency on a network connecting a set of geographically scattered businesses, their branches and usage of intelligent production systems (Pejs and Patalas-Maliszewska, 2016:53). However, industry 4.0 is not just a technological development – it is also sustainable social development. Researchers indicate this fact and highlight the importance of human and social capital as well as the involvement of employees. The essential part is selecting a method of HR management which, to some extent, provides employees with some degree of codetermination. An important and practical guideline for managers is that they should understand the meaning of the ongoing profound social change which facilitates the exchange of knowledge and improves the involvement of employees (Baran and Sypniewska, 2020).

Increasing interest in the concepts of industry 4.0 and sustainable development is related to the possibilities offered by new technologies. These new opportunities, combined with social factors, strengthen innovativeness and competitiveness of the individual national economies at macro, mezzo and micro levels. Taking into consideration the main assumptions of both concepts offers a chance to manage the consequences of revolutionary technological changes and address ethical challenges – especially in the context of AI development. An interesting topic in the social sciences is studying the attitude towards the concept of sustainable development which takes into consideration new methodological approaches enabled by new technologies provided by the Internet (Ballestar et al., 2020). As the diversity of research increases, the scientific community should recognise the need to organise current knowledge and define notions, especially in the area of social sciences, in order to be able to pursue further research in a methodologically correct manner.

#### **4. PRACTICE OF CONTEMPORARY BUSINESS AND SOCIAL LIFE – DANGEROUS EXPERIMENTS OR TECHNOLOGICAL CURIOSITIES?**

Social development has become an even more interesting topic since the new technologies began affecting the societies in a revolutionary way. It was the moment when the changes started to occur at an increasing pace. Humans, as individuals with limited cognitive capabilities, are not able to learn control of all of the new technologies which require error-free ease of use without the aid of third parties. This leads to numerous consequences such as new social problems or frustration but also creative

solutions, new companies, workplaces and jobs. Managers analyse various possibilities and search for the most effective ways to utilise new technologies. Discovering new applications of these technologies could give the world additional chances to avoid or solve not only the problems of everyday life but also those urgent ones related to supporting medicine, power industry and environmental protection initiatives. Of course, actions of business practitioners are motivated by projected financial profit. This can be highly relevant in the case of pragmatic actions which do not raise any doubts from an ethical point of view. However, more and more frequently big companies, in cooperation with scientists, accept challenges related to creating prototypical solutions and endeavour to solve serious global issues. Such coordination of efforts, although justified, can sometimes cause major problems leading to very dire social consequences.

An example of such an unsuccessful experiment is a test of artificial intelligence named Tay, created by Microsoft Corporation. It had to be shut down only after one day after its launch due to a series of controversial tweets it posted on Twitter. Within 24 hours, based on data from the virtual reality, Tay had started to simulate a teenage girl and had transformed from an easy-going fan of humanity into a robot telling offensive jokes and even praising Hitler for the genocide of the Jewish people. It developed itself based on contacts with real people (Forbes, 2016).

An example of AI application which brings serious hopes is the cooperation between business and science in research on so-called xenobots. These tiny robots owe their name to the cell donor – a species of frog called *Xenopus laevis*. Researchers at Harvard, Tufts, and the University of Vermont studied regularly contracting heart muscle cells and passive skin cells. Using evolutionary algorithms thousands of candidate life forms were created and evaluated. Depending on the body shape they behaved differently. The most promising designs were kept by the computer and modified further. At the end of this complex process, researchers were able to manually create a biomachine which has roughly 10 days' worth of energy to complete a specific task. Although the xenobots are built from living cells, they do not reproduce or eat – after finishing their job they die and decompose. In the current research, they serve as a tool for helping understand how cells cooperate toward creating tissue. In the future, the xenobots may find application in medicine – build from patient's cells they could transport and administer drugs or destroy cancer cells with no risk of being rejected by the body. These robots ultimately could be produced in thousands using a 3D bioprinter. Using the xenobots would also be valuable in the area of environment protection, for example in gathering microplastic fibres in the oceans (chip.pl, 2020).

Major ethical questions are raised by using artificial intelligence in the widely understood social control. An example of such application can be Amazon Echo devices, nevertheless Amazon assures that Alexa does not record users' conversations unless they issue a particular command. Such situations raise ethical doubts and highlight the need to conduct research which could delineate the criteria for assessing whether a given AI model is harmless and trustworthy. This problem seems to be noticed by companies – especially by those related to the implementation of technological solutions in the business practice. As a result, they meet the expectations which have not yet been officially formulated. There is even a trend resulting from an opportunity to avoid a top-down legal regulation of a given trade. Businesses imposing ethical regulations on themselves may slow the legislative works of the policy-makers and put them off guard. Companies introduce their ethical codes and set up ethics committees comprised of specialists in the technology used who examine various aspects of using these technologies. This self-regulation does not always go hand in hand with the neutrality of the ongoing research which is funded by the business sector. Frequently in this context, companies are accused of being interested solely in the good

image of their name or lobbying in their own interest using so-called ethics washing of their true activity (Venturebeat, 2019).

The practice of contemporary business and social life indicates that various spheres of life – economy, society and science – intertwine with each other and it is very difficult to delineate the areas of influence. Studying particular cases requires meticulousness, methodological attention to detail and orientation on specific research objectives.

## **5. IMPORTANT TOPICS OF SOCIOLOGICAL RESEARCH ON AI IN FUTURE**

As already mentioned in the previous text, when developing and using AI, an interdisciplinary approach is particularly important in order to overcome obstacles and solve problems in a meaningful way. The widespread use of AI not only requires technological problem solutions or raises questions regarding the handling and processing of data, but the range of challenges is much larger and includes the following areas. In addition to economic, organizational and managerial questions, AI also poses new problems for legislation, governments and politics. New challenges also arise in social relationships and in ethical questions. (Dwivedi et al., 2019). Even if the challenges in all areas are closely linked, the focus in the following is on social, ethical, managerial and governmental questions.

We can assume that cooperation between man and machine will increase in the future and will affect not only the world of work and production, but also more and more everyday life. So far, it looks like humans and machines are in competition, with AI having a decisive advantage. The use of artificial intelligence is associated with fears in many people: the fear of losing their job, fear of no longer meeting the requirements or of “inhuman” treatment, e.g. in the field of healthcare. There are numerous questions and research opportunities for the social sciences that deal with the cooperation between man and machine, e.g. how AI is perceived by the population, what fears and reservations exist and how these can be reduced. New models for the distribution of resources and profits are also under discussion. Because as the physicist Stephen Hawkins noted in 2016: “If machines produce everything we need, the outcome will depend on how things are distributed. Everyone can enjoy a life of luxurious leisure if the machine-produced wealth is shared, or most people can end up miserably poor if the machine-owners successfully lobby against wealth redistribution. So far, the trend seems to be toward the second option, with technology driving ever-increasing inequality.” (reddit.com, 2016) The introduction of AI presents management with major challenges, because there is often little technical knowledge about AI on the part of management, the advantages that the use of AI brings and how the human workforce should interact with AI. To summarize the problem: “organisations face significant issues where the lack of a strategy relating to implications of AI could affect critical business areas and fail to address concerns from the human workforce” (Dwivedi et al., 2019). An ethical but also a sociological problem is the question of responsibility: who is responsible when a machine makes a mistake and how can fault management be reorganized and maintained? Artificial intelligence should make decisions based on algorithms, e.g. when selecting applicants, creating profiles and controlling people, e.g. when coordinating police operations or as chatbot have conversations with customer. The use of algorithms should lead to greater fairness because everyone is judged according to the same rules. But many examples show that the opposite is the truth: we are dealing with sexist chatbots, are caught in our advertisement bubble or judged by racist profiles. All of this happens because the algorithms are created by people who incorporate their - conscious or unconscious - stereotypes, values, prejudices or bias into the algorithm. “Models are opinions embedded in mathematics” states Cathy O’Neill (2016). The task of the social sciences must firstly examine and point out these relationships and at the same time address the role of humans as creators of algorithms and artificial intelligence.

In order to convince people that AI does not work against them, but also brings many advantages in everyday life, it is important to know the social needs and to align them with the development of innovations controlled by AI. Here, the social sciences can make an important contribution by firstly identifying these needs and then acting as intermediaries to the computer sciences in order to promote the development of people-centered design. At the same time, it is important to identify the cultural barriers that can be different in each society when using AI and to counteract them in a targeted manner. However, it is also important to keep in mind that, "if AI is accepted with enthusiastic fashion, it might explosively spread before the realistic aftermaths from its use get properly perceived and reflected by the demand for AI goods and services" (Dwivedi et al., 2019).

Data security and the question of what happens to the data collected, which authorities have access to it and who ultimately uses this data for what is also a relevant topic for sociological research. Above all, cultural and social requirements as well as current moods in society must be included in future studies.

## 6. CONCLUSIONS – INTERDISCIPLINARY CHALLENGES

The widespread introduction and use of AI in different areas of human life is likely to lead to problems and challenges, but also creative solutions. As already mentioned above, meaningful research on AI can only be done on an interdisciplinary basis. A good starting point could be the beginning research on Industry 4.0, its impact on sustainable development in terms of society, economy and resources - also in connection with AI, to identify urgent questions and to build up future research designs. Here it is of great importance not only to examine the global effects, but in particular to include the micro level in order to show concrete changes, challenges and solutions. As the practical examples in the text show, above all ethical questions, problems in the cooperation between man and machine, the social attitude towards AI, as well as the question how the improvements through AI can be used by all social classes should be in the research addressed.

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