

## SOCIAL INNOVATIONS AS SUPPORT FOR INDUSTRY 4.0

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**Abstract:** The main subject for consideration concentrates on the social innovation defined as a tool to support the change related to Industry 4.0. It seems obvious that the Fourth Industrial Revolution transforms social life, the Internet of things (IoT), cloud data, big data, autonomous robots, additive manufacturing, augmented reality, etc., which are listed as basic elements of Industry 4.0. It also transforms the economic sphere, especially work organisation and the labour market. Current prognoses of the possible economic and social impact of digital technology often highlight positive aspects, but we also need to predict and study possible negative consequences. In order to design a 'more satisfactory' social environment that takes into account the needs of the present, we need new ways of social functioning. It is assumed that social innovations can be treated as instruments useful for overcoming challenges posed by Industry 4.0. The analysis will be theoretical, hence such notions as social innovations, Industry 4.0 and others will be defined. This discussion will help to understand and solve future social problems.

**Keywords:** innovation, social innovations, Industry 4.0, smart industry, labour market.

### 1. Introduction

Bernard Marr, citing (Forbes, 13 August 2018) the words of Klaus Schwab, the leader of the World Economic Forum, proclaimed: “we’re on the cusp of the Fourth Industrial Revolution, or Industry 4.0. It’s quite different than the three Industrial Revolutions that preceded it – steam and water power, electricity and assembly lines, and computerization – because it will even challenge our ideas about what it means to be human,” and asked rather a rhetorical question: “Are you ready?” Just like in the case of previous revolutions, it is “one of the greatest promises [...] to improve the quality of life for the world’s population and raise income levels” (Marr, 2018). To some extent, we can predict the areas of transformation, as we currently know the results of transformations that took place in case of previous revolutions. We also know that “Industry 4.0 follows three preceding technological transformations: steam power, which was the transformative force of the nineteenth century;

electricity, which transformed much of the twentieth century, and the era of the computer beginning in 1970” (Piccarozzi, Aquilani, Gatti, 2018, p. 1). The subsequent innovations of digital technology made way for new innovation, whose difference in quality is aptly defined by Erik Brynjolfsson and Andrew McAfee in *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*: “Computers and other digital advances are doing for mental power – the ability to use our brains to understand and shape our environments – what the steam engine and its descendants did for muscle power. They’re allowing us to blow past previous limitations and taking us into new territory” (Brynjolfsson, McAfee, 2014, p. 10). Nowadays, what we can be sure that the transformation of culture and politics, as well as the change of social and economic institutions, is the result of these technological innovations (Prokurat, 2016).

Referring to this consideration, particularly important are the transformations concerning production. In this context, Industry 4.0 can be considered the implementation of the concept of smart factory, i.e. such a form of production organisation, where complex cyber-physical systems are responsible for controlling physical processes (Schwab, 2016, p. 12; Rapacki, 2018, p. 215), and the activities undertaken are of automated nature, enabling complete or partial replacement of physical and intellectual human work. Taking the above into account, “we must have a comprehensive and globally shared view of how technology is changing our lives and those of future generation, and how it is reshaping the economic, social, cultural and human context in which we live” (Schwab, 2016, p. 8). This applies to transformation associated with work since the Voltaire’s saying: “work saves us from three great evils: boredom, vice and need” (Voltaire, 1931, p. 106) is still relevant for the whole mankind. These simple categories, which Voltaire associates with work, are considered to be existential dimensions of work that give meaning to human life, give the sense of control and establish material base that ensures survival being the basis for its quality at the same time.

We also know that “humans were always far better at inventing tools than using them wisely” (Harari, 2018, p. 7). This observation, made by Yuoval Noah Harari, proves that there is disproportion between the efforts made by us to create technological innovations and those that concern our quality of life, assuming – in line with modernity paradigm – that the technology is a remedy for everything that ails us. Currently, we know that technology is a source of several social threats that require regulations and sometimes even remedial activities.

The purpose of this discussion is description of the predicted negative consequences associated with Industry 4.0 and the results of its implementation for the activity associated with work, as well as a study on social innovations as potential tools that will be used as support to remove the problems. The analysis will be theoretical and will include definitions of such terms as Industry 4.0 as well as prediction of its negative consequences associated with the labour market, social innovations and their remedial potential. It is assumed that the effects of technological innovations violating the existential dimensions of work can be balanced by the

widely understood social innovations. This reflection is to be the support for understanding and solution of future social problems associated with the implementation and diffusion of technological innovations.

## **2. Industry 4.0 – predictions of negative social consequences associated with the labour market**

Identification of potential negative consequences associated with overall implementation of Industry 4.0, important from the point of view of work being a human activity, requires initial general characteristics of the new quality of production brought by the last industrial revolution. As emphasised by Klaus Schwab: “the fourth industrial revolution [...], is not only about smart and connected machines and systems. Its scope is much wider. Occurring simultaneously are waves of further breakthroughs in areas ranging from gene sequencing to nanotechnology, from renewables to quantum computing. It is the Fusion of these technologies and their interaction across the physical, digital and biological domains that make the fourth industrial revolution fundamentally different from previous revolution” (Schwab, 2016, p. 12).

It is assumed, that the term “Industry 4.0” – in the sense used in this paper – appeared for the first time in 2011, during Hanover Fairs, in the strategy on the development of computerisation, presented by the German government, the main idea of which covered an attempt to combine the latest digital technologies with real production, thus establishing smart factories (Schwab, 2016, p. 12; Morrar, R. et al., 2017, p. 14; Piccarozzi, Aquilani, Gatti, 2018, p. 2; Sobieraj, 2018, pp. 17-18). The main goal of this concept was to minimise a share of humans in production processes, which enables to shorten the time of production and lower its costs. The technology basis would be different forms of communication, such as: Internet of humans (social and business networks); Internet of things (smart mobility and data sourced from sensors); Internet of services (smart networks and logistics) (Tapscott, Tapscott, 2019); Internet of data (smart buildings and apartments) (Rapacki, 2018, p. 215), as well as robotisation and automation of production processes; the use of cloud-based computing structures; establishment of analytical and computing systems (big data, artificial intelligence, deep machine learning); implementation of autonomous production processes and processing at production lines with full control of the process course; introduction of additive manufacturing (3D printing); innovative business models, such as *freeeconomics* or *sharing economy* (Sobieraj, 2018, pp. 18, 22). An important aspect of functioning of smart factories is mass-customisation, which enables to maintain low costs with high customisation of product features, meaning maximum adjustment to the market needs. The combination of these elements enables to create “the embedded manufacturing systems [...] vertically networked with business processes within factories and enterprises and horizontally connected to dispersed

value networks that can be managed in real time – from the moment an order is placed right through to outbound logistics. In addition, they both enable and require end-to-end engineering across the entire value chain” (Kagerman et al., 2013, p. 5). The technological convergence taking place within the Industry 4.0 also introduces new understanding of economic growth that is no longer based on constant use of new resources, but on the optimisation of use and reorganisation of the already existing ones (Sobieraj, 2018, p. 22).

Techno-optimists see the Fourth Industrial Revolution as a remedy for demographic, economic and environmental problems (Kagerman et al., 2013; Manyika et al., 2013; Schwab, 2016; Morrar, R. et al., 2017; Piccarozzi, Aquilani, Gatti, 2018); however, one should be aware that such advanced delegation of work process to digital and physical systems must lead to total transformation of work environment. The most probable directions of changes associated with the implementation of Industry 4.0 include:

- Reduction of job positions – i.e. a progressing decline in demand for human work and an increase of the so-called “lights out manufacturing” (Rifkin, 2014, p. 138). Hence, the very employment becomes problematic. The unemployment (Rifkin, 2014, pp. 135-148; Ford, 2016, pp. 58-60), temporary unemployment<sup>1</sup>, non-linear employment or “nonemployment”<sup>2</sup> (Skinner, 2018, pp. 131-132) will become common social phenomena (Grabowicz, 2017, p. 56) which, as a consequence, can result in social pathologies. Even now, one can clearly identify the correlation between the level of unemployment and crime rate (Lubiński, 2017, pp. 74-77).
- Liquidation of traditional jobs, including traditionally understood professions (Prokurat, 2014, e-book); it is predicted that nowadays only 9.59% of population performs a job that will be in increasing demand, 71.71% of population works in a profession whose nature will change, and 18,70% of professions will be replaced with digital-physical systems (*The Future of Skills*).
- Creation of new jobs associated with operating digital-physical systems and physical systems that we cannot even predict now. Therefore, we cannot adjust the education to their needs – education in its current form will not eliminate the problems emerging on the labour market (Prokurat, 2014, e-book).
- Demand, mostly for highly-qualified and very flexible jobs (Brynjolfsson, McAfee, 2014; Schwab, 2016; Prokurat, 2014; Rapacki, 2018, pp. 216-217) – the establishment of dual labour market with division into “profitariat” (workers owning cars)/ “cognitariat” (knowledge workers)/“digitariat” (digital social class) – a creative social class which, in fact, shapes the market and precariat employed in low-paying industries (Prokurat, 2014). This may lead to pauperisation of whole occupational groups as well

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<sup>1</sup> Unemployment associated with work performed on the basis of *work on demand*; this applies to all professionals who are employed to work “on a specific project,” e.g. programmers, designers.

<sup>2</sup> A term used to define the increasing phenomenon concerning the so-called “non-employed” people who, by choice, do not enter the labour market (Skinner, 2018, pp. 131-132).

as social polarisation resulting in numerous conflicts. As noted Thomas Piketty, lack of improvement of living conditions, combined with income disproportions, must lead to social unrest (Piketty, 2015; Wilkinson, Pickett, 2011; Ford 2016).

- Presence of the so-called Solow's Paradox, that is an increase in productivity associated with a decrease in work effectiveness (Solow, 1987, p. 36) – the increase in automation leads to displacement of employees, who are forced to undertake ineffective work (e.g. in services), which, due to low susceptibility to robotisation (Frey, Osborne, 2013, p. 45), causes that “eventually the labor productivity growth rate comes close to a zero” (Giedrojc, 2019, p. 246). Hence, part of the work done by humans will become irrelevant, not only in terms of economy.
- Replacing “live work” with “dead work”, i.e. replacing the work performed by humans with widely understood machines. This applies, in particular, to designing work related to establishing smart industry systems or highly qualified work that, when the system is ready, will no longer be needed (Rapacki, 2018, 219; Ford 2016) – the employment instability concerning even those groups that are in demand on the labour market can lead to even greater deterioration of bargaining position of the employees (Grabowicz, 2017, p. 59) and to the loss of the sense of security and control. When such a state applies to the majority of community, it may become a source of numerous social pathologies.
- Splitting human work with digital and physical systems – this brings the possibility of dehumanisation of work environment, the lack of possibility to meet the need for affiliation, which results in low work motivation, obviously in case of humans. A negative effect of “upward comparison” may also be problematic. It is already known that automation improves the work efficiency and this comparison is unfavorable for humans (Brynjolfsson, McAfee, 2014, pp. 25-58); therefore, this violates foundations of identity – “who am I if I can be replaced with a machine”. In such a case, the performed work ceases to be meaningful. The attitude of people assessing themselves through the prism of the machine, treating their humanity only as work performance efficiency, can also be treated as “dehumanising” (Osika, 2017, p. 72).

The consequences listed above, related to the implementation of Industry 4.0 and the transformation of the nature and forms of work associated with it, seem to violate the existential dimensions of work mentioned before; the highly uncertain employment or its complete lack put humans in a completely new situation, where boredom, crime and poverty of whole social groups become real threats to modern communities. As James Manyika, Michel Chui, Jacques Bughin, Richard Dobbs, Peter Bisson, Alex Marrs note in the report concerning the potential impact of Industry 4.0 on the labour market: “given the large numbers of jobs that could be affected by technologies, such as advanced robotics and automated knowledge work, policy makers should consider the potential consequences of increasing divergence between the fates of highly skilled workers and those with fewer skills. The existing problem of creating a labor

force that fits the demands of a high-tech economy will only grow with time” (Manyika et al., 2013, p. 151). From this perspective, it is necessary to recognise the potential of adaptive activities; in this paper, one of the possible options are social innovations.

### **3. Social innovations as adaptation to the effects of Industry 4.0 implementation**

The assessment of causal potential of the determined activities must be based on awareness what these activities are, what is their scope. Therefore, it seems necessary to offer some insight into the category of social innovations. There is no doubt that such activities fall into the wider meaning of innovation that is proposed to be understood as a change designed by humans on purpose, having features of a novelty (Baruk, 2006, p. 102). This novelty may refer to products, production methods, management methods etc. Marta Wronka-Pośpiech, in her overview study on social innovations, lists five manners of defining them as: a social transformation; a form of organisation management; a form of entrepreneurship; products, services or programmes (the aim of which is to meet the social demand); activities that strengthen the position and improve the effectiveness of social institutions (Wronka-Pośpiech, 2015, p. 126). The above-mentioned classification, on the one hand, proves how wide is the meaning of this term, on the other hand, it specifically defines the subject of innovation, as every time the *novum* concerns the community and meeting the needs of its members. What seems crucial in social innovations is their efficiency, greater than the efficiency of previously used solutions, and a better use of resources (Wiktorska-Święcicka et al., 2015, p. 29). They also increase the ability of a given community to act. As emphasised by Rabeh Morrar, Husam Arman and Saeed Mousa: “the concept of social innovation denotes the processes and factors that lead to a sustained positive transformation to the network society [...]. It is defined as an innovative solution to the increasing challenges that face society – one that is more effective, more efficient, more sustainable, or more equitable than existing practices” (Morrar et al., 2017, p. 15). In accordance with the above findings, “innovation is every novel change, while social innovation is such a novel change that remodels the manner of community functioning, that is, it establishes a new manner of relations, new structure, it reconfigures the course of social processes, it creates new behavior patterns etc.” (Osika, 2016, p. 375). Alex Nicholas and Alex Murdoch identify social innovations with a series of social changes, the basis of which is the knowledge potential and cultural capital of a given community, determining the creative reconfiguration of social relations (Nicholas, Murdoch, 2012, p. 2). The core of these changes is better adjustment of current needs of a given community, starting from local solutions to global ones, but the final objective of social innovations is the improvement of quality of life of the members of a given community. Therefore, one can consider that social innovations are

a type of community intervention, i.e. they have an influence on people “who need to reorganize their actions to solve a given social problem” (Bańka, 2018, p. 73). It seems necessary to make one more clarification: social innovations can be based on technological solutions that constitute instrumental support for new social solutions, but, in fact, this innovation concerns social changes and cannot be reduced only to the use of IT (*Information Technology*) or CMC (*Computer-Mediated Communication*) technologies.

Taking into account the above, from the perspective of this consideration, the approach defining the social innovation as community intervention is crucial. This seems justified, as the implementation of Industry 4.0 remodels the dimension of work and requires adjustment within the manner of functioning of the whole society. This applies both to formulated suggestions for the authorities and for the people concerned, to whom work, understood professionally, will cease to be the centre of activity out of necessity. At the same time, it means that the existential dimension, which work currently fulfills, will disappear. We need to consider how to fill in this gap and with which elements: how to replace the sense of meaningful work, the feeling of control that gives the sense of freedom, and what material resources will it provide? In both social and individual context, these questions are currently the most pressing ones, and it seems that answer can be found in activities (i.e. social innovations), the goal of which is a new type of relations, a new structure, reconfiguration of social process course or creation of new behaviour patterns. Such ideas and attempts at their implementation are being already undertaken. Here are some examples:

- Universal basic income – to a varying degree, this proposal seems to be supported by both liberals and conservatives (Ford, 2016). As early as in 1979, Friedrich Hayek referred to this concept in his work *Law, Legislation and Liberty* (Hayek, 1979, pp. 54-55). In general, it is assumed that the value of such income should correspond to an existential minimum. This idea is very controversial (Ford, 2016; Strawiński, 2017; Lubiński, 2017; Kozak, 2018); however, nowadays it seems to be a robust, even though not perfect, social solution which can combat the negative effects of technological unemployment and make “life financing” possible. Guy Standing, an avid supporter of this solution, believes that it starts to become a fact: “launch of several basic income pilots around the world. One started [...] in Finland with others planned in Ontario, Canada, Oakland, California, Aquitaine and Catalonia, and discussions are ongoing in Fife and Glasgow. A US NGO, GiveDirectly, is raising \$30 m for a 12-year experiment in Kenya” (Standing, 2017). Standing emphasises that a universal basic income is not only about material resources, but also about the sense of justice, security and the awareness of participation in social life (Standing, 2017a). The programme introduced in the 1970s in Dauphin, Canada, lasted for five years and its results were published in 2011, developed by Evelyn Forget, an economist from the University of Manitoba. It transpired that, contrary to the skeptics' belief, allowances did not demotivate people to seek employment. This skeptics' belief was proved only in case of young mothers and

students, but this solution improved the overall physical fitness (fewer medical appointments) and psychological state of the community (Strawiński, 2017).

- Education – Manyika et al. emphasise in their report, that “advanced economies are already facing a shortage of high-skill workers, particularly in technical fields. Secondary and tertiary curricula need to be aligned with those needs. Critically, policy makers – as well as employers – can no longer focus only on building the skills of young people entering the labor force. They will need to support the whole workforce, including through retraining” (Manyika et al., 2013, p. 151). It is significant encouragement to create forms of supported structurally lifelong learning, which do not concentrate on professional qualifications, but rather on the development of skills as “something that whatever job you’re in there’s something that you can do about. And if you invest the right skills, you can leave yourself in a better place to benefit from the opportunities of the future” (*The Future of Skills*). Modernisation of education systems (Nuissl, Przybylska, 2016) should also be accompanied by innovative support programmes for grassroots forms of learning. An example can be the Fab Labs/FabLearn Labs (Blikstein et al., 2016), the essence of which is knowledge and skills sharing on the basis of coaching or Internet mentoring. Voluntary organisations or education crowdfunding can also be considered the grassroots forms of learning (Rifkin, 2016, pp. 125-131); in both cases, digital communication technologies (DCT) are used to share knowledge. The general availability of all forms of education at every life stage enables to experience the sense of agency (which makes life meaningful) and the sense of control (which enables to fulfill these dimensions of existence that, till now, were fulfilled during work performance). In short, learning enables us to develop without leaving a spare minute for detrimental activities.
- New forms of employment – in this case, it is mostly about sharing economy solutions that need to be identified both with the concept of sharing various resources with other members of the community to use them better and of sharing new models of business practice that use Internet platforms (Hilarowicz et al., 2019, p. 42). Rifkin suggests in this case to abstain from ownership economy and replace it with access economy (Rifkin, 2016, pp. 25-31) – the cost of access is much lower than the cost of ownership, simultaneously ownership can become a source of income. We can also consider *crowdfunding* to be a new form of work – it is about putting own project into action, which is financed by the community that believes in its meaning and chance of success based on donation culture (Prokurat, 2014) that fully implements existential dimensions of work; similarly as “community entrepreneurship” based on benefit corporations, the profit from such ventures is the result of implementation of e.g. social and environmental goals, that is goals that improve the quality of life (Rifkin, 2016, pp. 291-292).



- Development of socially useful activities (all forms of voluntary service) – lack of paid employment does not have to be linked with lack of activity and the sense of lack of fulfillment. Currently, the traditional forms of voluntary service, such as participation in social life, were extended with all open source forms, the flagship example of which can be Wikipedia. It is crucial to notice that communication platforms and IoT created completely new possibilities in this scope, starting from sharing computing power of one's devices through search for new drugs to predicting climate change in searching for new planets, etc. (Tapscott, Williams, 2006, p. 30). Including non-professionals in large research or social projects is an innovative solution.
- Establishing a culture of “new” values – creating social initiatives, the goal of which is to boost creativity and develop community cooperation, as the sources of high quality of life. In the economy paradigm, work was a source of wealth that not only conditioned survival, but also expressed one's social position and defined one's identity, etc. Nowadays, this simple correlation is not so obvious anymore. This is due to several factors, including the sense of wealth in developed countries as well as research on the sense of life satisfaction, proving that material values are not able to ensure our well-being, therefore, work or other activities we undertake should also refer to other values. In a certain sense, out of necessity, now such values are: environmental protection, community life, own creativity, etc. It can be observed in social movements, in transformation of lifestyles, new social discourses (Rifkin, 2016, pp. 309-311; Osika, 2018, pp. 366-367). In this scope, social innovations should influence the implementation and development of these values, strengthening of internal non-material motivation – e.g. by establishing communities around these values, organising events, taking up networking activities that enable to establish community capital and the sense of meaning and safety (Gilchirt, 2004). Another possible option will be creation of virtual or real places, where one can develop one's own interests. Such functions can be fulfilled by the above-mentioned FabLabs, whereas in the virtual dimension they can be implemented by social platforms, blogs, photoblogs, vlogs and websites that can also become a source of income.

The proposed solutions are only an outline of activities that, even at this moment, start to set a direction of changes. Their description, allegedly, cannot be comprehensive, as innovation is a process that “is happening”. Therefore, these examples should be treated as emerging trends in the transformation of work itself and the meaning it starts to play in our lives, rather than an exhaustive description.

## 4. Summary

According to techno-optimists, Industry 4.0 results in the fact that “our workplaces and organizations are becoming ‘smarter’ and more efficient as machines, and humans start to work together, and we use connected devices to enhance our supply chains and warehouses. The technologies of the Fourth Industrial Revolution might even help us better prepare for natural disasters and potentially also undo some of the damage wrought by previous industrial revolutions” (Marr, 2018). Irrespective of the fact whether we share this hope or not, it is evident that the changes introduced by Industry 4.0 remodel the nature and forms of work, thus forcing social changes. It is better for them to be a result of our project, rather than a chaotic reaction with unfavorable balance of profits and losses.

The analyses, conducted within this discussion, were of theoretical nature. They included such terms as Industry 4.0 and social innovation, they also involved predicted consequences for the labour market of Industry 4.0, implementation and proposals of innovative solutions that help to mitigate the impact of the Fourth Industrial Revolution. The research has shown the legitimacy of the assumption introduced before, which means that the effects of technology innovation violating the existential dimensions of work, including life “without work,” can be balanced with widely understood social innovations. Some researchers even claim that social innovations should be treated as an element of Industry 4.0 (Buhr, 2016), i.a. because of their innovative potential.

It was assumed that the analysis of Industry 4.0 issues from this perspective could be useful in understanding and solving future social problems associated with the implementation and diffusion of technological innovations.

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