ENTRE 2018
Conference Proceedings
12-14 September 2018
Kraków, Poland

New production patterns and the future of manufacturing relocation trend in the 4.0 era: The perspective of consumers

Michał Młody
Poznań University of Economics and Business, Poland,
michal.mlody@ue.poznan.pl

Abstract

The significance of Industry 4.0 for the future of the global economy is beyond any question, therefore the discussion of business practitioners, politicians and academics about the conditions and potential consequences of implementing this concept is becoming more and more turbulent. The actual value of technologies 4.0 does not result only from the opportunities that they offer, but rather from the integration of huge amounts of data, automation, robotics and production systems in a way that provides companies with a competitive advantage. Innovative business models and the digitization of the value chain aim, among others, to improve customer experience, increase the speed of response to market needs and reduce costs. While some studies provide evidence for the existence of benefits resulting from the implementation of the concept 4.0 from the perspective of enterprises, the attitude from a demand-side perspective both to the technological transformation itself and its potential effects is analyzed to a very limited extent. The article explains the complexity of the 4.0 concept and indicates the selected levels of its use in the economy. In addition, based on the results of questionnaire survey, the general attitude of consumers to the trend of automation and robotization of production as well as their relation to the reshoring of production was presented. The results of the survey showed that

while consumers are aware of the need to implement technology 4.0 and some of the benefits associated with it, they also have a relatively low level of confidence in the new trend. Consumers also expect a gradual relocation of production to Poland, but at the same time a relatively low degree of acceptance of potential negative consequences of this phenomenon is noticeable.

Keywords: industry 4.0; reshoring; offshoring; business model; automation; robotization; 3D printing

JEL codes: D12, D20, F20

INTRODUCTION

Industrial production has undergone significant transformations over the past two centuries. The currently observed transformation is closely related to the transfer of technologies and production solutions, which are part of the Industry 4.0 concept (Wang et al., 2013). The Fourth Industrial Revolution (after mechanization, electrification and computerization / gradual automation) is primarily associated with the ongoing digitization, robotization and development of the Internet of Things (Rodak & Gracel, 2017).

Thanks to the appropriate embedding of technology in organizations, its people and resources, a digital enterprise should communicate, analyze and use data to undertake "intelligent" activities in the real world. Industry 4.0 introduces digital reality, which is accompanied by a gradual evolution of business models implying deep changes in the functioning of the organization.

The potential impact of the implementation of the 4.0 concept goes beyond the area of employment, product innovation and productivity. It is expected that intensified robotization and automation (driven by a continuous drop in robot prices and increased machines efficiency) will comprehensively affect the organization of production within the value chains. From an economic point of view, robots (and other technologies 4.0) can be considered as close substitutes for low-skilled workers and support for people with higher qualifications. Thus, investments in this area may contribute to a change in the size and costs of necessary resources. Under these conditions, Industry 4.0 may contribute to the reshoring, ie company decision to relocate manufacturing activities back to the home country (Dachs et. al 2017, Młody 2017, Moradlou et. al 2016), and hence, the reconstruction of the production base and the gradual reindustrialization of developed economies.

The article addresses three fundamental research questions:

1. What is the attitude of consumers to the transfer of technology 4.0 to the Polish production sector?
2. Whether and to what extent are consumers able to accept the additional costs associated with the production reshoring process using Industry 4.0 technology?
3. What implications for the business models of manufacturing enterprises can be expected considering the effects of the implementation of the Industry 4.0 technologies.

The basic objective of the article is to assess the consumer's attitude both to the transformation of the production sector itself using Industry 4.0 technology and its potential effects, including the relocation of production processes to the home country. The search for answers to the above research questions was based on the conclusions

stemming from the analysis of literature related mainly to the concept of Industry 4.0 and the results of questionnaire surveys carried out among Polish consumers.

DIMENSIONS OF THE INDUSTRY 4.0 CONCEPT

The Fourth Industrial Revolution gradually contributes to changing the way companies operate, and they must decide how and in what way to invest in new technologies and determine which of them meet market needs in the best way. Only a full understanding of the changes and opportunities that Industry 4.0 brings can allow a smooth transition through transformation. For the management team, the transition to real-time access to data and intelligence can both be a challenge and an opportunity, because the integration of digital information from many different sources and locations may speed up the implementation of some processes.

Industry 4.0 is supported by a variety of technologies that integrate the digital world and the real world. OECD (2017) distinguishes three important technological developments that underlie the digitization of production; the Internet of Things (IoT) - enabling the interconnection of machines, stocks and goods; Big Data and dedicated programming - allowing for the analysis of huge amounts of digital data, and cloud computing, which provides access to computing power. Absorption and development of (industrial) robots or autonomous machines is possible thanks to the integration of these systems[1]. However, what is particularly important, the implementation of technologies 4.0 leads to a gradual (or sometimes abrupt) modification of the business model of the company (Figure 1).

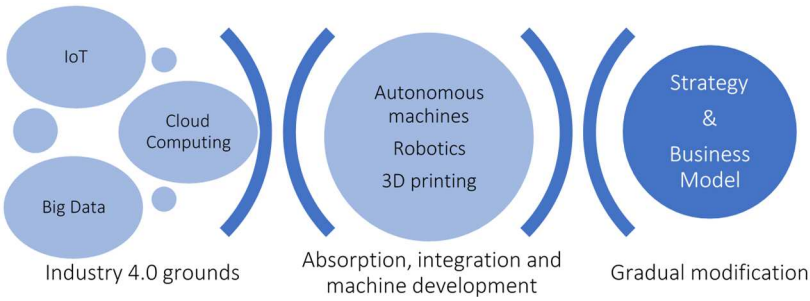

Figure 1. Key elements of digital transformation
Source: own elaboration.

Industry 4.0 is a global concept, but it can take many different forms around the world. In the United States, the emphasis is put mostly on a comprehensive digital evolution. In Europe, where this concept comes from, this phenomenon is more focused on factories. The overall concept remains basically the same and covers the same technologies and applications. Industry 4.0, however, goes beyond the production area, focusing on the

[1] Cotteleer and Sniderman (2018) point to *physical-to-digital-to-physical loop*, occurring in enterprise 4.0. It includes 3 processes: *Physical to digital* (capturing information from the physical world and creating digital records based on physical data), *Digital to digital* (information transfer and discovering valuable insights through advanced analysis, scenario analysis and artificial intelligence), and *Digital to physical* (application of algorithms to transfer decisions taken in digital reality to data that are supposed to stimulate physical activity).

entire ecosystem of partners, suppliers, customers, employees and operational conditions. Thus, it becomes necessary to look holistically at the Fourth Industrial Revolution and the ways in which it is changing business environment (Mussomeli, Gish & Laaper, 2016).

HOW INDUSTRY 4.0 RECONFIGURE PRODUCTION PATTERNS?

It is expected that the costs of hardware and software supporting the implementation of technologies 4.0 will drop, while the efficiency of the systems will improve significantly. BCG (2015) estimates that over the next decade, the cost of robots will be reduced by 20%, and their efficiency will improve by about 5% per year. Until recently, industrial robots, hitherto widely used in the manufacturing industry, were more suited to the implementation of repetitive tasks. Today, however, machines are becoming more and more flexible thanks to the progress of work on the development of artificial intelligence, self-learning and automatic correction, which means that they can perform a wider range of complex activities.

In particular, the use of so-called "cobots" (or cooperating robots) capable of performing repetitive, precise and often complicated tasks is more and more frequent. It is worth noting, however, that this technology helps employees, but it does not replace them. Fratocchi [2017] believes that in comparison with other traditional production technologies, additive manufacturing (3D printing) has clear advantages, allowing, among others, for: obtaining a cost advantage (in the production of small batches), the possibility of a stronger involvement of the recipients and an increase in the value perceived by them and a reduction in energy consumption and the amount of waste.

So far, limited empirical evidence has been obtained on the real effects of the use of robotics, and the discussion in this area is mainly focused on the implications for labor markets. In particular, in developed economies, robots are expected to have a significant impact on employment by generating "technological unemployment" (Brynjolfsson & McAfee, 2011). Frey and Osborne (2017) suggest that almost half (47%) of jobs in the United States can be threatened by computerization and automation. Similarly, Acemoglu and Restrepo (2017) point to the negative impact of robots on employment and wages. However, other studies predict that the impact of robots on the elimination of jobs will be much smaller (e.g., OECD, 2016). The most at-risk jobs include routine occupations, performed by low-skilled workforce (Graetz & Michaels, 2015; Acemoglu & Restrepo, 2017; Frey & Osborne, 2017)

Of course, the potential benefits, but also the dangers associated with the implementation of the concept of Industry 4.0 have a much wider scope. Młody (2018) indicates opportunities, challenges and threats at the level of the entire economy, sector and enterprise. However, it is worth noting that the most of individual factors indicated in Table 1 can penetrate *de facto* through all levels of the economy.

Robots are strongly concentrated in several industry sectors – most applications of modern production machines (around 70%) focus on motor vehicles and transport, consumer electronics, chemical production as well as food and beverages (De Backer et al., 2018). The deployment of robots in industries depends on many factors. First of all, the technical requirements of the production process clearly define the possibility and limits of using robots. Some activities and tasks can be easily automated, while others still have to be carried out through human work. Although robots are becoming more and more

efficient in the assembly process, they are getting cheaper and increasingly capable of working with people, advanced production systems with a wide range of functions are associated with costly implementation, also due to the lack of qualified workforce. In addition, the manufacturing industry, in which labor costs constitute a significant (or prevailing) share in the total cost of production, more often invests in robotization, thereby reducing costs. Another important issue related to the wider use of robots is

Table 1. Benefits and challenges related to Industry 4.0 at the micro, meso and macro levels

Macro level	Opportunities	- reindustrialization / inhibition of the offshoring trend - competitiveness of the economy based on aspects other than cost advantage - reshoring of part of manufacturing processes - partial elimination of problems with labor supply
	Challenges	- elimination of institutional barriers (including bureaucracy, tax system) - elimination of competency gap - investment / incentive financing - increase in expenditure on R&D (% of GDP) - public and private - institutional support
	Threats	- technological unemployment - risk of non-return on investment (public) - problems with full technology implementation - regulation at the supranational level - lack of social acceptance
Meso level	Opportunities	- creation of clusters / improvement of competitive position - shifting free labor to labor-intensive industries - strengthened integration of the value chain - improvement of the competitive position of SMEs (subject to the availability of technology)
	Challenges	- lack of solutions at the level of industries, including institutional support - problems with the flow of knowledge, know-how and exchange of experience - infrastructure integration
	Threats	- the risk of overinvestment due to a strong competitive fight - cannibalism between industries, resulting in excessive business diversification
Micro level	Opportunities	- increase in process and production efficiency (supply chain) - reduction of production costs - improvement of flexibility and quality - deliveries for individual orders - acceleration of decision-making processes - shortening the implementation time of new employees (simulations / virtual reality) - reduction of prototyping costs (3D printing)
	Challenges	- low inclination of enterprises to invest - attitude of managers (risk) / allocation of resources - responsibility of HR departments - the need to modify the corporate culture
	Threats	- cyber-security - technology race / financial liquidity - gradual elimination of manufactories from the market (the possibility of individual orders)

Source: own elaboration based on Młody (2018).

connected with the location of production. Branches that have moved their production to emerging economies are less likely to accept robots and automation, as it is less profitable in locations with lower labor costs.

Manufacturing location and Industry 4.0

The transfer of some production processes to key target markets (including home markets) can be enabled by limiting the need for high human labor costs due to technology 4.0. If these operations turn out to be economically justified, the automated 4.0 factories can revolutionize the market (Berman 2012). Robotics and automation can affect changes in global value chains. The current organization of production in long and complex chains has resulted in companies being less responsive to changes in customer demand. Industry 4.0 is perceived as an opportunity in this context, the use of which may allow to build a competitive advantage.

Some authors indicate that robotization will have a long-term impact on existing production models and may also lead to the relocation of some production processes back to developed economies (Dachs and Zanker, 2015, De Backer et al., 2016). The reshoring process will cover economies that have so far benefited from lower labor costs (Lewis 2014). Due to the fact that production using robots becomes cheaper and offshoring is more and more unprofitable (rising labor costs in e.g. Asian countries), production in the home country is becoming an increasingly favorable alternative for companies. Intelligent robots are becoming increasingly adaptable, programmable and autonomous, which makes them important tools for personalized production. Industries in which market demand and consumer preferences change rapidly can benefit a lot from the use of robots. At the same time, suppliers in offshore locations do not always produce according to the defined specifications, which causes problems with quality and extended delivery time.

The results of De Backer and Flaig (2017), which have been trying to determine the future of global value chains (GVC) based on a series of scenarios, also indicate the impact of automation and robotization on offshoring of enterprises from developed economies. On the basis of one of them, they stated that rapid advances in information technology would increase the attractiveness of OECD economies for production activities. It should be taken into account that while statistics on the number of robots in individual economies are available[2], the knowledge about the quality and performance of robots that are installed in factories is hardly present. Thus, there are some difficulties in estimating the future effects of industry digitization. In addition, the statistics for individual sectors are presented in a very detailed manner. Astor's research (2017), conducted among over 60 Polish manufacturing companies, indicates that the number of companies

[2] When assessing the state of automation and robotization of the Polish industry, one can get the impression that the changes are very dynamic. However, the global view shows that compared to other countries, the Polish manufacturing sector still has a lot to catch up to. The International Federation of Robotics (IFR, 2017) classifies the robotization density in Poland (32 robots per 10,000 employees in 2016) far below the global average, behind some Central and Eastern European countries (Hungary, Slovakia, the Czech Republic). Despite this, Poland and the Czech Republic are currently recording the highest growth in the number of implementations in Europe. In the world ranking of robotics, South Korea (631 robots) has been leading the world for many years, while the USA, Germany and Japan have the result half as good at the most. It is also worth paying attention to the strong increase recorded by China.

that are not automated at all is decreasing - in 2013 it was 13%, and in 2016 only 3%. Comprehensive automation is declared by as many as 26% of companies. At the same time, the study indicates that the Industry 3.0 stage is already largely managed by enterprises. The above-mentioned results can be perceived as optimistic, but nevertheless they cover a group of enterprises that are far too narrow.

The phenomenon of manufacturing reshoring from a demand-side perspective has been explored to a small extent so far. Grappi, Romani and Bagozzi (2018) developed a Consumer Reshoring Sentiment (CRS) scale and distinguish four segments of consumers: *ethnocentric reshoring advocates* (consumers who express strong and positive sentiments towards reshoring decisions; supported by strong ethnocentric orientations); *reshoring advocates* (characterized by low levels of consumer ethnocentrism while showing strong reshoring sentiments), *ethnocentric reshoring neutrals* (who evaluate the reshoring decisions of a company through ethnocentric lenses), and *reshoring neutrals* (these consumers express a low level of consumer ethnocentrism and relatively weak reshoring sentiments). According to the authors, „the identification and subsequent targeting of consumers with strong reshoring sentiments (i.e., ethnocentric reshoring advocates and reshoring advocates segments) can be effective strategies for reshoring companies". In the light of the above, a key question arises to which segment of consumers the clients of the enterprise involved in reshoring belong to.

The conducted analysis may suggest that robotization may inhibit the offshoring process and allow maintaining production activity in developed economies. Another issue is whether investment in technology 4.0 will lead to intensification of the reshoring trend and increase in the number of jobs in the home countries. De Backer et al. (2016) indicate that investments in robotics are very capital-intensive, but they allow to reduce the demand for labor. This may be one of the reasons why the impact of reshoring on employment in developed economies may be rather limited. It seems, however, that at the current, relatively early stage of implementing the 4.0 concept, there may be difficulties in the actual assessment of the impact of robotization and automation on the location of production. It can be expected that potential effects of investments in technology 4.0 will materialize in the near future.

How Industry 4.0 changes business models?

Despite the wide scope of research on business models, no commonly accepted definition has been established so far (Zott, Amit and Massa, 2011; Johnson, 2010). This is due to the difficulty of creating a universal business model. From the perspective of strategic management, a business model is considered as a set of activities that companies use to create and capture value in an enterprise. Osterwalder (2010) indicates that the business model is perceived as a "link" between the company's strategy and its activities, which makes it a peculiar, simplified plan for the operationalization of the strategy. The business model is based on the logic of value creation for all stakeholders and consideration of key value-creating activities that are also carried out by external entities in relation to the enterprise.

Although many attempts have been made to conceptualize the business model, the following values are most often formulated to distinguish business model elements: the value proposition, value creation activities and value capturing (Zott et al., 2011). Most

of the current definitions are in line with Teece's (2010) approach, which interprets the business model as "the design or architecture of the value creation, delivery, and capture mechanisms it employs" (Teece 2010). According to Osterwalder and Pigneur (2010, p. 14), "business model describes the rationale of how an organization creates, delivers, and captures value". The combination of these two definitions can be adopted to create a general overview of changes in business models due to Industry 4.0.

Industry 4.0's technological capabilities allow companies to change the way they create and capture value. The products and services offered can be innovative, and new forms of cooperation and sharing of knowledge change the way in which the company competes on the market. The literature on innovation in the 4.0 business model is limited and it usually includes the impact of individual technologies of Industry 4.0 (Internet of Things, cloud computing, additive manufacturing, Big Data etc.). The characteristics of changes in individual areas of the business model in the context of Industry 4.0 implementation are presented in Table 2.

Table 2. Potential changes and benefits in the business models due to the implementation of technology 4.0

Value proposition ***Unique offerings/ drivers of customer value***	- Product-service hybrids - Modular and configurable products - New services based on acquired data and information - Combining existing services with services of other enterprises - Highly personalized products - Comprehensive service / concentration on the end customer
Value creation ***Resources, capabilities and processes / value natworks***	- Horizontal and vertical integration - more efficient production, logistics, quality control, inventory management - Real-time information - Connection of machine to machine (internal processes) - Data-driven decision making / big data collection - Close relationships with clients - Short time to enter the market - Development of new additional services - Business infrastructure combined with the infrastructure of partners - High efficiency, high availability
Value delivery ***Target market segments / distribution channels***	- A more flexible offer based on the individualization of production; - Co-creation of products; smart products - Access to new customer segments - Wider knowledge about the real needs of clients acquired on the basis of personalized marketing - More direct contact with the client - Diversification of sales channels (digital sales)
Value capture ***Underlying cost structure / revenue model / profit allocation***	- Cost optimization (efficient processes) - Diversification of costs and risks thanks to innovative revenue structures - New revenue streams (pay-per-use, dynamic pricing etc.)

Source: own elaboration based on Arnold et al. (2017), Burmeister et al. (2015), Ibarra et al. (2018), Piller et al. (2015), Pisching et al. (2015), Wiesner et al. (2015).

Estimation of the actual impact of Industry 4.0 on the production sector is a complex process. As indicated in Table 1, the implementation of modern technologies is

conditioned not only by development, accessibility and price, but also by social acceptance for all negative consequences of implementing the 4.0 concept. At the same time, there is no doubt that business models of enterprises using technologies 4.0 will undergo deep modifications. The scope of changes will depend, however, not only on the technology used, but also on the pace of their implementation and the acceptance of changes by the internal environment and customers. Value creation requires the coordination of a huge number of factors, and Industry 4.0 seems to be a platform that is designed to simplify and accelerate the process.

METHOD

The research results presented below are a part of empirical research on the conditions for the development of Industry 4.0 in the Polish manufacturing sector. The research was conducted on a group of 707 respondents in the period January-February 2018. The selection of the research sample was carried out using the snowball method, which is a non-probabilistic selection technique. Online questionnaire consisting of closed questions was the research tool. In the case of most questions, the respondents had the opportunity to answer according to the 5-point Likert scale[3], which was assigned the appropriate score for the analysis. The respondents' task was to respond to these statements by determining the degree of their acceptance.

The research sample was diversified in terms of gender, age, financial situation and education of the respondents. The vast majority of respondents consisted of young people, between 18 and 24 (33%) and 25 and 34 (58%)[4], assessing their situation as average (30.8%), good (57.8%) or very good (9.8%). The majority consisted of people with higher education (84.9%) and secondary education (13%). Most of the respondents (51%) live in cities over 100,000. inhabitants, while every fourth respondent declared a place of residence below 10,000. residents. Spearman's rank correlation coefficient was used to analyse the strength of the relationship between variables. The analysis of interdependencies included the level of acceptance of statements and factors such as: age, education and assessment of the material situation. In addition, average and standard deviation were calculated using IBM SPSS software.

RESULTS

The aim of the first part of the study was to diagnose the consumers' attitude to the diffusion of industry technology 4.0 in the manufacturing sector. In the case of five analyzed statements (1a-1e), a slight correlation was found or no correlation was observed with the characteristics of the respondents. The existing correlations can be considered weak / blurred ($0{,}1<|r|\leq 0{,}3$). Nevertheless, based on the obtained results, one can point to a certain significance of the respondent's age for perceiving the diffusion of technology 4.0 - greater acceptance of the implementation of modern solutions occurs among young consumers.

[3] (1 – strongly disagree, 2 – disagree, 3 – neither agree or disagree, 4 – agree, 5 – strongly agre / 1 – not at all important, 2 – low importance, 3 – neutral, 4 – moderately important, 5 – very important)

[4] The structure of respondents largely reflects the proportions of Internet users in Poland, spending the most time online (CBOS, 2017).

However, analyzing the responses of the entire surveyed population (average), it can be concluded that the awareness of the need to use automation and robotics is high (1d), although the majority of respondents think that human work is of higher quality (1c). At the same time, it is worth noting that the inclination to spend higher amounts for the product made by human labor (1b), as well as the importance of the way of producing the goods (1a) are at a moderate level. It is also important to note that consumers present quite strong belief in the possibility of mass personalization of production through the use of modern production technologies (1e), which may indicate the awareness of the opportunities arising from the implementation of technology 4.0.

Table 3. The general attitude of consumers to the trend of automation / robotization of production

	Average	Standard deviation	Age	Education	Average monthly income
1a. It does not matter to me how the product was manufactured	3,64	1,13	-,168**	,023	-,022
1b. I would prefer to pay more for a product made with a greater amount of human work than machines / robots	3,00	1,10	,174**	-,037	,009
1c. I believe that the machine is able to do the work better than a human	2,73	0,91	-,162**	-,064	,042
1d. Robotization and automation of production is inevitable in some industries	4,21	0,81	-,117**	,091*	,045
1e. Robotization and automation allow large scale personalization of products	3,44	1,01	-,105**	-,015	,038

Significance **p ≤0.01 *p ≤0.05 (bilateral), N - 707
Source: own study.

The second part of the study concerned the perception of selected effects of automation and robotization for the production sector. Interpretation of the answers is not unambiguous. On the one hand, consumers declare that they would accept the implementation of modern technologies 4.0 on a massive scale, if the prices of products dropped with quality remaining at least at the same level (2a). At the same time, however, the same respondents would agree to a small extent on liquidating of jobs (2b). It is worth noting that the understanding of the need for changes in the labor market is lower among older consumers. There was no correlation between statements and other respondents' characteristics (Table 4).

The last part of the study was aimed at assessing the consumers' attitude to the relocation of Polish brand production to the home country in the context of the gradual implementation of automation and robotics. Although the existing correlations can be considered weak, it can be said with some precaution that the older the consumer, the stronger the desire to relocate production to Poland (3a), although from the point of view of the entire research sample (average: 3.56) it is not at a high level.

A similar picture of the situation can be seen in the case of statement 3b - the consumers' tendency to pay more for goods produced mainly with the use of human labor (i.e. small automation, craft production) is relatively low. The above may be confirmed by the interest of consumers in the premises of relocation (3c). The younger the consumer, the fact of using technology 4.0 in the reshoring process is of lesser importance.

Table 4. The level of acceptance of the effects of automation / robotization of production

	Average	Standard deviation	Age	Education	Average monthly income
2a. I would accept automation / robotization of production if prices dropped significantly and the quality remained the same	3,99	0,84	-,041	-,023	-,044
2b. I would accept automation / robotization of production even if it involved the possibility of liquidating jobs	2,55	1,09	-,148**	,055	,016

Significance **p ≤0.01 *p ≤0.05 (bilateral), N - 707
Source: own study.

Table 5. Consumers' attitude to production relocation in the context of the development of automation and robotics

	Average	Standard deviation	Age	Education	Average monthly income
3a. If Polish brands transferred production from Asia to Poland, I would buy them more willingly	3,56	1,01	,205**	,010	,200**
3b. I am willing to pay more for a product made in Poland, but using mainly human labor	3,40	1,09	,212**	-,072	,049
3c. It does not matter to me that the transfer of production to Poland can be based on automation / robotization of production	3,17	0,99	-,148**	-,026	-,007

Source: own study.

DISCUSSION AND CONCLUSIONS

Our study adds to the existing firm-side arguments for the Industry 4.0 implemntation a new perspective and it is one of the first papers that adopts the demand-side perspective in examining (even partially) the consequences of the Fourth Industrial Revolution. Industry 4.0 can transform the operations of companies in many ways. The digitally integrated and intelligent value chain offers almost unlimited possibilities. Industry 4.0 technologies improve operational efficiency, productivity, product quality, entry time onto market, resources use, inventory management, workplace safety and sustainable environmental development. In practice, each of the links in the value chain can be based - at least partially - on the components of concept 4.0, starting from planning (e.g. forecasting methods), through development (e.g. simulation process, 3D product models), sales and marketing (e.g. customer intelligence, digital marketing, ecommerce solutions),

internal and external logistics (e.g. track and trace, JIT logistics, supplier, inventory, transport management), production (e.g. operational intelligence, smart machines, robots, smart packaging), and ending on maintenance and service (CGI Global, 2017). With the above in mind, deep modifications of business models seem to be unavoidable.

Technologies 4.0 can improve business operations and thus generate revenue growth, increase customer satisfaction and change the ways products are designed and developed. Data collected through intelligent products and services enable a deeper understanding of customer needs, strengthen customer experience, improve direct sales and marketing strategies and allow companies to improve after-sales service. In the era of Industry 4.0, customer experience is built not only through a physical product but through optimally adapted service and customer involvement.

Digitization makes it easier for companies to collaborate in the supply chain - cloud-based solutions allow companies to exchange data between clients, suppliers and other partners. Regardless of whether the chain consists of physical materials or data, information and expertise, enterprises are dependent on external entities. Industry 4.0 can enable a smart factory to integrate supply networks with logistics capabilities, as well as streamline planning and inventory management processes.

Enterprises from developed countries have long perceived digital production as a potential source of competitive advantage. In the face of new economic challenges, the governments of developing economies have also identified technologies 4.0 as a key factor in their future economic success. In these circumstances, the countries of Central and Eastern Europe, as locations that still have a relative cost advantage, in the long run will be under increasing pressure.

The biggest challenge for enterprises will not involve the implementation of individual solutions of Industry 4.0, but their proper integration. Autonomous robots are only part of the wider digital revolution that is currently taking place. Enterprises will have to invest in complementary assets to fully enjoy the benefits of investing in robotization. To create business value and meet customer expectations in terms of innovation, personalization and rapid market introduction, it is necessary to combine all components and continuously collect and process data across the entire supply chain.

Investments in technologies 4.0 are continuous and not incidental. Significant capital expenditures are required to create a robust and secure network infrastructure, as well as to modernize / replace older systems. At the same time, it is necessary to intensify cooperation with various technology providers, because currently none of them is able to provide complex infrastructure in a comprehensive way.

The introduction of new business models will change the way in which employees perform their daily tasks. Therefore, the implementation of solutions 4.0 requires the involvement of people with completely new competences and skills (flexibility, IT competences, analytical skills). In addition to the shortage of necessary capital, the main barrier is related to the resistance to change, so that the management and employees will have to be properly trained and prepared. It is also important that consumers themselves are prepared for the changes to come.

The main contribution of this paper is to bring consumers into the discussion about the Industry 4.0, who are largely ignored group of subjects in this area. In the light of the presented research results, it can be concluded that although consumers

understand the need to introduce technology 4.0 in the Polish manufacturing sector, at present they are not mentally prepared for this process. Consumers still believe that human labor production has a higher value, but at the same time they believe that Industry 4.0 will enable personalization of production on a wider scale. However, it is optimistic that younger consumers are more open to new solutions. Despite benefits of using new technologies, the recipients are not able to accept the potential loss of jobs, although the study also showed that if the prices of products fell (with their quality not deteriorated), the approval for the implementation of solutions 4.0 would be higher. The potential benefits for the business models presented in this article indicate that properly implemented technologies 4.0 could probably build the value the clients expect. In the context of the relocation processes of production from low-cost countries to Poland, the study showed that reshoring is of relatively minor importance to consumers. The relocation of production would be more justified for the respondents if it involved the creation of new, attractive jobs.

It seems that the cautious approach of consumers to automation and robotics as well as other technologies 4.0 is because they are hardly recognized. The fear of a possible loss of jobs, the probable need to acquire new skills and competences and a simultaneous low public awareness of the benefits offered by Industry 4.0 may lead to the fact that manufacturing companies not only will face internal resistance but also lack of understanding of technological transformation among customers. In this context, the key to success may involve designing, implementing and, subsequently, proper communication of a business model that builds real value for clients.

LIMITATIONS AND FURTHER DIRECTIONS OF RESEARCH

Our study provides new insights addressing the demand-side perspective in exploring the potential consequences of Industry 4.0 implementation. That research area deserves deeper attention by researchers and managers responsible for corporate strategies. The conducted research can be only a limited source of knowledge about the attitude towards solutions matching the Fourth Industrial Revolution. The sample structure of the surveyed respondents included only a few mature consumers, therefore their attitude regarding the implementation of technology 4.0 and relocation of production to Poland was examined to a limited extent. Moreover, our study is basically consumer-oriented and shows some findings for companies operating in the B2C context, but it ignores B2B area which could be considered in further research. The study also did not allow for a detailed diagnosis of consumer approaches in the cross-section of selected product categories.

If the Fourth Industrial Revolution is to take effect, further, intensified research is needed in the coming years at the level of enterprises, industries and entire economies. However, we cannot ignore consumers' perspectives for dynamic technological changes. Future research should focus, inter alia, on the assessment of consumers' approach to digitalization across industries - some differences in this context can be expected. It would also be worth to verify in detail the actual knowledge of opportunities and threats, as well as expectations of consumers with regard to Industry 4.0. Such research will not only have an undeniable cognitive value, but also an application value, enabling the construction of business models more adapted to the expectations of consumers.

REFERENCES

Acemoglu, D., & Restrepo, P. 2017. Robots and Jobs: Evidence from US Labor Markets. *NBER Working Paper,* No. 23285.

Arnold, C., Kiel D., & Voigt, K-I. 2016. *How Industry 4.0 changes business models in different manufacturing industries, How Industry 4.0 changes business models in different manufacturing industries*. The XXVII ISPIM Innovation Conference – Blending Tomorrow's Innovation Vintage, Porto, Portugal on 19-22 June 2016.

Astor. 2017. W jakie technologie inwestują firmy produkcyjne w Polsce?. Raport Astor. https://polskiprzemysl.com.pl. Accessed 4 June 2018.

Baldwin, R. 2016. *The Great Convergence: Information Technology and the New Globalisation*, Harvard University Press.

Berman, B. 2012. 3-D printing: the new industrial revolution. *Business Horizons*, 55: 155–162.

Brynjolfsson, B. & McAfee, A. 2014. *The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies*. W.W. Norton and Company

Burmeister, C., Luettgens, D., & Piller, F.T. 2015. *Business Model Innovation for Industrie 4.0: Why the "Industrial Internet Mandates a New Perspective on Innovation* (SSRN Scholarly Paper No. ID 2571033). Rochester, NY: Social Science Research Network.

CBOS. 2017. Korzystanie z internetu. Centrm Badań Opinii Społecznej, Komunikat z badań nr 49/2017.

CGI Global. 2017. Industry 4.0 Making your business more competitive. *https://cgiglobal.net/.* Accessed 9 June 2018.

Cotteleer, M., & Sniderman, B. 2018. Forces of change: Industry 4.0, *Deloitte Insights*.

Dachs, B., & Zanker, C. 2015. Backshoring of Production Activities in European Manufacturing, *MPRA Paper,* No. 63868.

Dachs, B., Kinkel S., & Jäger A. 2017. *Bringing it all back home? Backshoring of manufacturing activities and the adoption of Industry 4.0 technologies,* MPRA Paper, University Library of Munich, Germany.

De Backer, K., & Flaig, D. 2017. The Future of Global Value Chains: Business as usual or "a new normal?, *OECD Science, Technology and Industry Policy Papers*, No. 41, OECD Publishing, Paris.

De Backer, K., DeStefano, T., Menon, C., & Suh*.*, J. R. 2018. Industrial robotics and the global organisation of production, *OECD Science, Technology and Industry Working Papers.* OECD Publishing, Paris.

De Backer, K., Menon, C., Desnoyers-James, I., & Moussiegt, L. 2016. Reshoring: Myth or Reality?, *OECD Science, Technology and Industry Policy Papers*, OECD Publishing, Paris.

Fratocchi, L. 2017. Is 3D Printing an Enabling Technology for Manufacturing Reshoring?. In A. Vecchi (Ed.), *Reshoring of Manufacturing: Drivers, Opportunities, and Challenges*: 99-124. Springer International Publishing,

Frey, C., & Osborne, M. 2017. The Future of Employment: How Susceptible are Jobs to Computerisation?, *Technological Forecasting and Social Change,* 114: 254-280.

Graetz, G., & Michaels, G. 2015. Robots at Work, *CEP Discussion Paper* No. 1335.

Grappi, S., Romani, S., & Bagozzi, R.P. 2018. Reshoring from a demand-side perspective: Consumer reshoring sentyment and its market effects. *Journal of World Business.* 53(2):194-208.

Ibarra D, Ganzarain J, & Igartua H.I. 2018. Business model innovation through Industry 4.0: A review. *Procedia Manufacturing*, 22: 4-10.

IFR. 2017. World Robotics 2017. International Federation of Robotics, Frankfurt am Main.

Johnson, M.W. 2010. The Time Has Come for Business Model Innovation. *Leader to Leader,*57: 6-10.

Lewis, C. 2014. Robots Are Starting to Make Offshoring Less Attractive, *Harvard Business Review*. https://hbr.org. Accessed 6 June 2018.

Młody, M. 2017. Dylemat make or buy – przesłanki wyboru międzynarodowej strategii produkcyjnej. *Handel Wewnętrzny*, 3(368): 288-299.

Młody, M. 2018. Przemysł 4.0 – potencjalne korzyści i wyzwania na poziomie mikro, mezo oraz makro. In A. Lipińska, P. Klimas (Ed.), *Kierunki badań innowacyjności*:173-186, Wydawnictwo Uniwersytetu Jagiellońskiego, Kraków,.

Moradlou H., & Backhouse C.J. 2016. *An Investigation into Re-shoring Decision: Case Study Approach*, Conference: 14th International Conference on Manufacturing Research.

OECD. 2016. The Risk of Automation for Jobs in OECD Countries, A Comparative Analysis, *OECD Social, Employment and Migration Working Papers*, No. 189, OECD Publishing, Paris

OECD. 2017. *Going Digital: Making the Transformation Work for Growth and Well-Being*. Document prepared for the MCM 2017 Meeting, OECD publishing, Paris

Osterwalder, A., & Pigneur, Y. 2010. *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Hoboken, NJ: Wiley.

Piller, F. T., Weller, C., & Kleer, R. 2015. Business Models with Additive Manufacturing—Opportunities and Challenges from the Perspective of Economics and Management. In C. Brecher (Ed.), *Advances in Production Technology*: 39-48. Springer International Publishing.

Pisching, M. A., Junqueira, F., Filho, D. J. S., & Miyagi, P. E. 2015. Service Composition in the Cloud-Based Manufacturing Focused on the Industry 4.0. In L.M. Camarinha-Matos, T.A. Baldissera, G.D. Orio, & F. Marques (Ed.), *Technological Innovation for Cloud-Based Engineering Systems*: 65–72. Springer International Publishing.

Rodak, A., & Gracel J. 2017. *Transformacja do przemysłu 4.0*, Harvard Business Review Polska. In *How to do IT. Technologie dla Biznesu – wydanie specjalne*, August 2017.

Teece, D. J. 2010. Business Models, Business Strategy and Innovation. *Long range planning,* 43(2): 172-194.

The Boston Consulting Group. 2015. The Robotics Revolution, the Next Great Leap. In Manufacturing, *Manufacturing, Innovation and Growth,* Mussomeli, Adam Gish, Doug and Laaper, Stephen *The rise of the digital supply network: Industry 4.0 enables the digital transformation of supply chains*, Deloitte University Press.

Wang Y., Ma H-S, Yang J-H, Wang K-S, 2017. Industry 4.0: a way from mass customization to mass personalization production. *Advances in Manufacturing*, 5: 311-320.

Wiesner, S., Padrock, P., & Thoben, K.-D. 2014. Product Services Systems and Value Creation. Proceedings of the 6th CIRP Conference on Industrial Product-Service SystemsExtended Product Business Model Development in Four Manufacturing Case Studies. *Procedia CIRP*, *16*, 110–115.

Zott, C., Amit, R., & Massa, L. 2011. The Business Model: Recent Developments and Future Research. *Journal of Management,* 37(4): 1019-1042.

Suggested citation:

Młody, M. (2018). *New production patterns and the future of manufac-turing relocation trend in the 4.0 era: The perspective of consumers.* In: **K. Wach & M. Maciejewski** (Eds.), *International Entrepreneurship as the Bridge between International Economics and International Business: Conference Proceedings of the 9th ENTRE Conference – 5th AIB-CEE Chapter Annual Conference.* Kraków: Cracow University of Economics (ISBN: 978-83-65262-19-6). Published within the series "Przedsiębiorczość Międzynarodowa | International Entrepreneurship", vol. 4, no. 3 (ISSN 2543-537X).