Zeszyty Naukowe Politechniki Częstochowskiej
Zarządzanie Nr 32 (2018) s. 48-59
dostępne na: http://www.wz.pcz.pl/znwz

INNOVATIVENESS IN POLISH ENTERPRISES AND THE FOURTH INDUSTRIAL REVOLUTION

Kamila Charciarek

Czestochowa University of Technology
Faculty of Management

Abstract: The paper addresses issues related to the development of companies from the micro and SME sector with reference to the fourth industrial revolution. It constitutes the effect of dynamic market changes associated with permanent shortening of the product life-cycle and thus, the necessity to increase the quality of offered products. The aim of the present paper was to evaluate the implementation level of the fourth industrial revolution elements in Polish production companies operating the micro and SME sector. Additionally, the tools to use the 4.0 concept at the highest level in Polish enterprises, including the factors and persons responsible for their implementation were indicated. The study attempts to distinguish the technologies that are most widely applied in the sector of these enterprises and evaluates their impact on developing a competitive advantage on the market. For this purpose the *Smart Industry Poland. Innovativeness in the sector of small and medium-sized producing companies in Poland* report published by the Kantar Millward Brown Institute on behalf of Siemens in April 2018 was used.

Keywords: innovativeness of enterprises, industry 4.0, management processes computerization, process management

DOI: 10.17512/znpcz.2018.4.05

Introduction

A key factor of enterprise innovativeness is its entrepreneurship, particularly in the aspect of management through making use of innovative technologies. In the conditions of dynamic market changes, it conditions the possibility of implementing actions of all kinds aimed to improve their functioning (Kowalik 2016, p. 170-171; Włodarczyk 2017, p. 117). This also means the willingness of enterprises to invest financial resources in the purchase of advanced technological, informatic and analytical solutions or modern management methods (*Smart Industry Polska 2018…*, p. 5). The application of digital technologies in the manufacturing company sector allows the costs to be decreased related to producing a trial series of prototypes of products that are indispensable for tests and in the perspective of further development introducing new products to the market. This is of key importance to gain a market advantage. Moreover, the application of these technologies significantly influences the development of industry through increased competitiveness of particular business entities (Brodowska-Szewczuk 2009, p. 87). The development of digitisation in turn depends on the accessibility and possibility of using these tools at a given place and time with regard to the current needs of enterprises. This allows the omnipresence

of technologies in their successive development, among others, through adjusting their market offer to the interests of customers. In other words, digitisation is an element of the economic environment that facilitates the acquisition of additional tangible and intangible assets, such as knowledge on the potential and possibility of utilising available technologies (Michalski 2014, p. 80; Godlewska-Majkowska, Skrzypek, Płonka 2016, p. 45).

The level of implementing the tools of the fourth industrial revolution in Polish enterprises

The use of digital technologies to a large extent conditions the competitiveness of enterprises. Over decades, its level has been dependent on the application of various technologies of product manufacturing, which result from the needs of customers as well as the functioning of particular business entities (*Figure 1*).

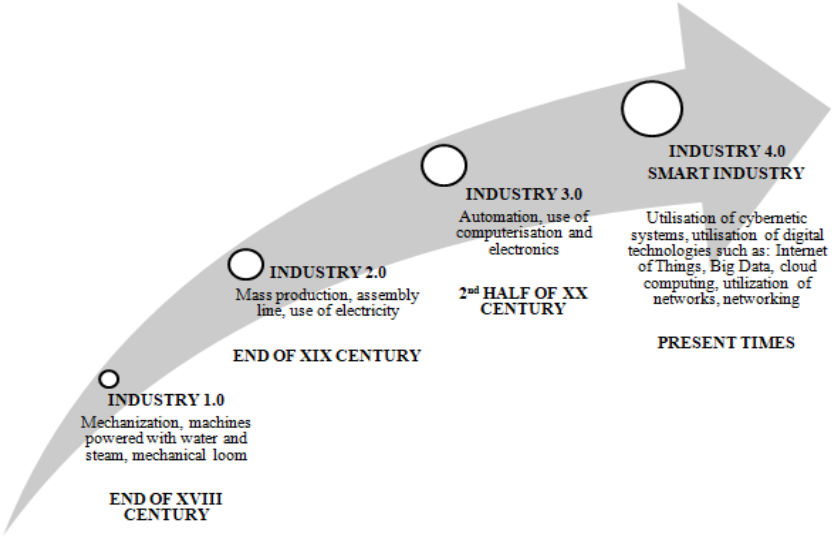

Figure 1. Development of industry over decades

Source: Author's own elaboration based on (*Smart Industry Polska 2018*…, p. 5)

Social and economic development has had a serious impact on increasing the awareness of consumers and the decisions of enterprises to shorten the product life-cycle. These actions force the decision-makers in organisations to introduce significant alterations to the existing manner of their functioning, among others, by implementing the tools of the fourth industrial revolution (extremely advanced technological, informatic or managerial solutions). Thus, the development of technologies that improve the changeover of machines and production equipment allows companies to adjust the offer to the demand occurring on the market. Moreover, making use of widely understood computerisation as well as digital and analytical solutions such as the Internet of things, cloud computing or big data, make it possible to acquire and gather a larger amount of data and information, and

therefore make decisions that increase the probability of achieving overarching strategic goals (Kraszewska, Pujer 2017, p. 16; Porter 2006, p. 63; Pierścionek 2007, p. 199-200; Łobejko, Pierścionek 2011, p. 18; Adamkiewicz-Drwiłło 2006, p. 23; Koczerga 2008, p. 91-93).

The Smart Industry Poland 2018[1] survey conducted by Kantar Millward Brown on behalf of Siemens in April 2018 shows that the functioning of currently operating production companies from the micro and SME sector is not based on full implementation of the fourth industrial revolution tools (*Figure 2*).

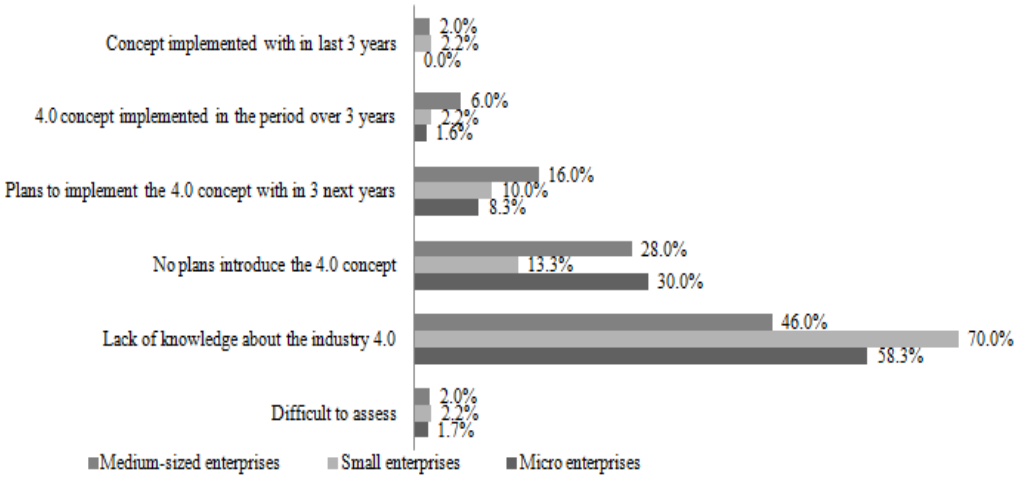

Figure 2. Implementation level of 4.0 concept in Polish production companies of micro and SME sector

Source: Author's own elaboration based on (*Smart Industry Polska 2018*…, p. 17)

The evaluation of the results of the survey included in the *Smart Industry Poland 2018 Report, Innovativeness in the sector of micro and small and medium-sized enterprises in Poland* has shown that a significant number of the analysed enterprises demonstrated a lack of knowledge related to the fourth industrial revolution. This concerns in particular small enterprises, which probably results from the lack of sufficient financial resources that could be designated for financing investment and development activities (70% of business entities). In the case of micro enterprises, it was observed that 58.3% of the businesses demonstrate a lack of knowledge related to the elements of the 4.0 concept. The survey also shows that Polish enterprises are willing to implement modern technological, informatic or managerial solutions, which concerns in particular medium-sized enterprises (48%). This is probably an outcome of the established market position

[1] The Smart Industry Polska Survey – carried out in April 2018 on behalf of Siemens by Kantar Millward Brown. Its goal was to evaluate the motivation and barriers of implementing innovative solutions in the group of Polish manfacturing and industrial companies of the micro and SME sector. The survey was conducted among 200 enterprises, where the level of employment was up to 249 persons.

compared to rival enterprises, and what follows, achieving higher profits. In this group of enterprises decision-makers demonstrate plans to implement the elements of the fourth industrial revolution within the next 3 years (16% of enterprises). Efforts made to develop the activity may also be noticed in the case of micro and small enterprises. The distribution of answers given by these enterprises was as follows:

1. micro enterprises – 10% of enterprises,
2. small enterprises – 8.3% of enterprises.

The results of the survey presented in the *Smart Industry Poland 2018* Report show that a lack of sufficient financial resources and knowledge of industry 4.0 functioning in Polish enterprises is not a barrier to their implementation (*Table 1*).

Table 1. Percentage of Polish production companies that declare implementation of 4.0 concept

	Concept has been implemented within last 3 yearsConcept has been implemented over period of 3 years	
Micro enterprises	-	1.6%
Small enterprises	2.2%	2.2%
Medium-sized enterprises	2.0%	6.0%

Source: Author's own compilation based on (*Smart Industry Polska 2018*…, p. 17)

In the analysed period, 2% of medium-sized enterprises implemented innovative solutions and 6% of organisations used the tools of the fourth industrial revolution in the production process over 3 years. This means that Polish enterprises decide to implement solutions that foster their development. In the case of micro enterprises, a lower level of conducting investment activity was observed related to purchases of innovative technological solutions. In the period of the last 3 years the decision-makers of micro enterprises demonstrated a lack of implementation of the 4.0 concept in their enterprises. At the same time, 1.6% of the entities declared that over a 3 year period they made the decision to introduce alterations to the existing manner of functioning. The distribution of the results of the survey may be an outcome of insufficient amounts of financial resources due to the short period of market operations and insufficient number of customers. Therefore, Polish manufacturing companies should strive to strengthen their market position compared to rival companies, among others, through an increase in the level of digitisation and importance of modern technologies. The analysis of the survey results also showed that 2.2% of small enterprises in the analysed period implemented the 4.0 concept.

Moreover, one can conclude that the lack of knowledge among Polish enterprises related to the benefits of implementing the 4.0 strategy significantly influences the decisions to implement it in the future. Owners of micro enterprises who decided to participate in the survey of Kantar Millward Brown declared that they did not have plans to implement the elements of the industry 4.0 in the future

(30%). Medium-sized enterprises were classified in the second position (28%), while small business entities came third (13.3%).

The key element of the *Smart Industry Poland 2018 report Innovativeness in the sector of micro and small and medium-sized producing companies in Poland* was also evaluation of the factors that determine the implementation of all types of innovative solutions in Polish production companies of the micro and SME sector (*Figure 3*).

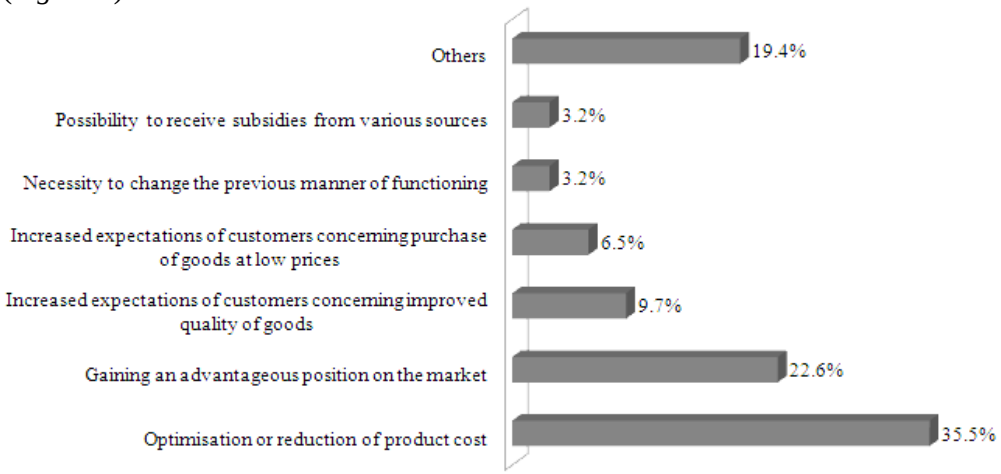

Figure 3. Factors that determine implementation of innovative solutions in Polish enterprises of micro and SME sector

Source: Author's own compilation based on (*Smart Industry Polska 2018*…, p. 19)

The factor that to the largest extent determines the implementation of innovative solutions in Polish production companies is the possibility to optimise or decrease production costs (33.5%). The aspiration of business entities to establish a competitive position on the market occupies second place in the ranking (22.6%), while increased expectations of customers in the aspect of purchasing a product characterised by high-quality parameters came third (9.7%). The factors that determine the implementation of innovative solutions also include: increased expectations of customers in relation to used products (6.5%), aspiration to introduce alterations to the existing manner of operations (3.2%), as well as attempts to finance the activity from external sources, such as subsidies (3.2%). Therefore, one can conclude that the development of enterprise innovativeness depends on satisfying the requirements of customers, who are interested in purchasing high-quality products at a relatively low price. This requires enterprises to optimise and lower production costs. To do so, decision-makers in manufacturing companies should strive to introduce alterations to the existing work organisation and purchase machines that allow a prompt changeover. These actions in the perspective of further development will allow them to maintain a competitive position on the market, and therefore increase their profit from the sales of the manufactured products.

The role of the tools of the fourth industrial revolution in increasing the level of innovativeness and competitiveness of micro and SME sector enterprises

An attempt to increase the level of innovativeness of Polish production companies results from their internal needs as well as possibilities in relation to rival enterprises. Selection of the proper instruments allows organisations to adjust themselves to changes occurring in their external environment. The portfolio of tools applied within industry 4.0 includes devices of all types whose functioning is based on robotics and production automation, software that lowers the costs of prototyping and introducing new products to the market as well as extremely advanced analytical tools, such as (*Smart Industry Polska 2018…,* p. 35):

- the Internet of things,
- Industrial Internet of Things,
- 3D printing, collaborative robots[2],
- digital twin and production digitalisation,

cloud computing, big data, artificial intelligence. The application of the tools that belong to the 4.0 concept in particular organisational structures of Polish production and industrial companies is diversified. Therefore, a significant number of business entities decides to transfer the responsibility for implementing innovative solutions to particular departments (*Figure 4*).

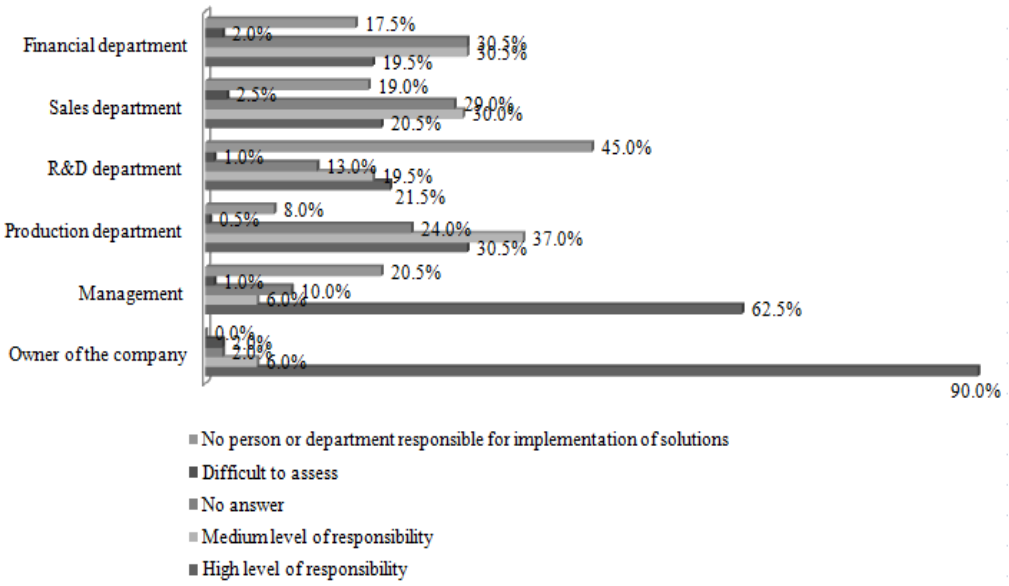

Figure 4. Level of responsibility of persons and structures in aspect of implementing industry 4.0 tools in Polish production and industrial companies of micro and SME sector

Source: Author's own compilation based on (*Smart Industry Polska 2018…*, p. 21)

[2] Industrial robots, collaborative ones.

The results of the survey presented in the *Smart Industry Poland 2018* report have shown that the decision-makers responsible for implementing modern solutions and technologies in the group of Polish enterprises of the micro and SME sector are the owners of enterprises (90%). The second place was occupied by organisations where the execution of decision-making processes depends on managerial board members (62.5%). Moreover, a high level of responsibility may be observed in the case of: the production department (30.5%), R&D department (21.5%), sales department (20.5%) and financial department (19.5%). While evaluating the presented results, one may conclude that the implementation of 4.0 tools is a complex process that is conditioned by decisions of persons who are responsible for achieving strategic goals and who possess knowledge in the scope of the financial and investment capabilities of enterprises. The sales department's responsibility in turn is to evaluate the usefulness of particular groups of products from the user perspective and collaboration with the financial department, whose functioning is aimed at adjusting the scope of investment to the financial standing of the economic entity. The survey presented in the *Smart Industry Poland 2018 report* also shows that in the case of the production department, a medium level of responsibility for making decisions on implementing extremely advanced solutions and technologies occurs. This confirms the qualifications and interdisciplinarity of employees in the aspect of making adjustments in accordance to market changes (37% of enterprises). The perspective of implementing industry 4.0 solutions at a medium level can be observed in the case of persons employed in the sales department (30% of enterprises) and financial department (30.5% of enterprises). The decisions about applying modern solutions and technologies are seldom made by employees responsible for implementing R&D projects. They constituted 45% of the total number of respondents. This may mean that the adopted development strategy of Polish manufacturing companies allows the carried out tasks to be adjusted to the abilities and professional qualifications of their employees. From the perspective of their successive development, these actions may to a great extent cause a reduction in the time of performing particular operations as well as the distribution processes of ready products to customers.

An element of the survey by Kantar Millward Brown also constituted evaluation of the difficulties in implementing particular tools of industry 4.0 in Polish production companies of the micro and SME sector (*Figure 5*).

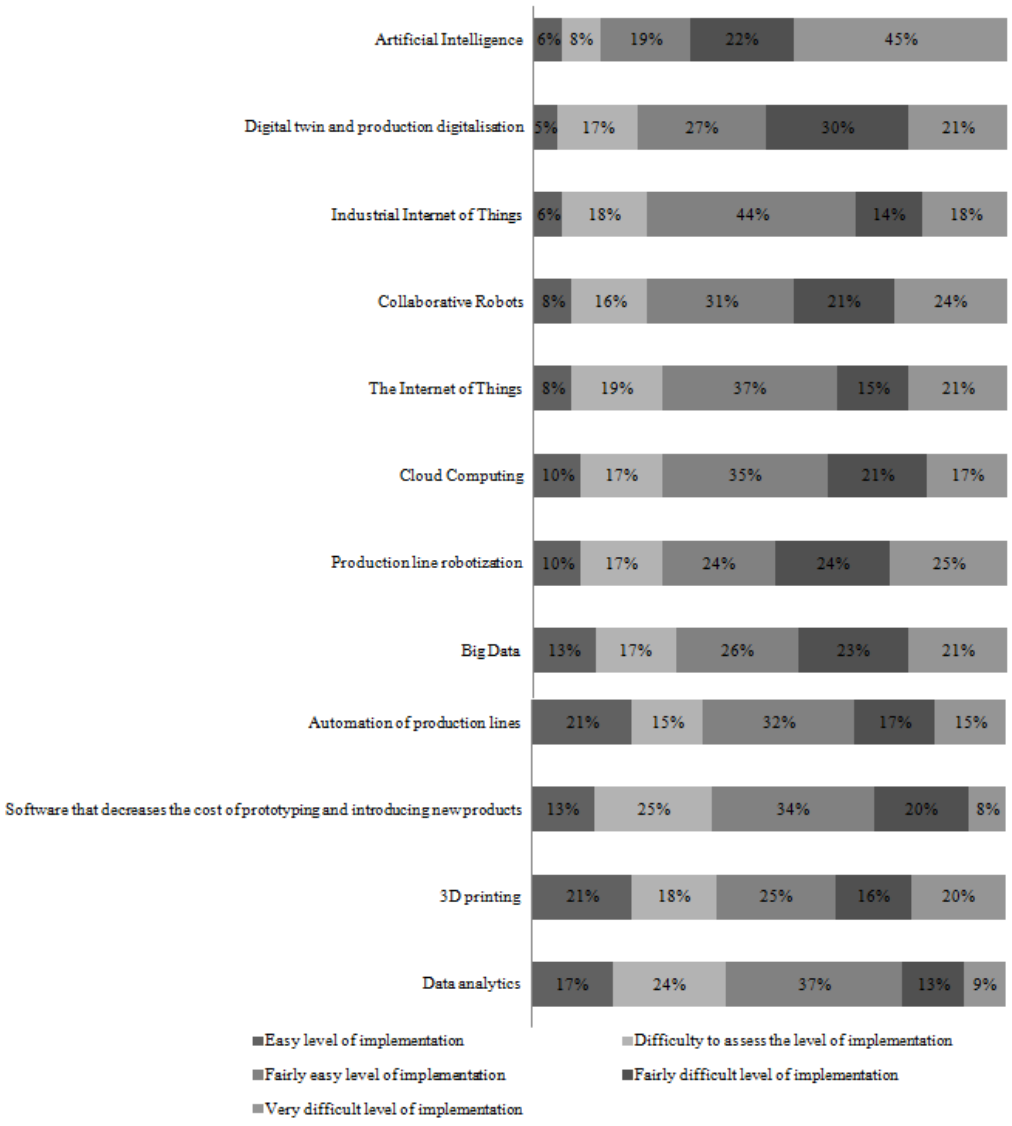

Figure 5. Evaluation of difficulties in implementing particular tools of industry 4.0 in Polish production and industrial companies of micro and SME sector

Source: Author's own compilation based on (*Smart Industry Polska 2018…*, p. 36)

Difficulties in actions of this type have been observed in the case of: artificial intelligence tools (45%), production line robotization (25%), collaborative robots (24%), digital twin and production digitalisation (21%) and 3D printing (20%). This probably results from the necessity to gather large resources of knowledge in the scope of computerisation of management processes as well as improving the course of production processes, which requires hiring qualified employees.

Additionally, the survey results presented in the *Smart Industry Poland 2018 report* demonstrated the difficulty in implementing the tools used to acquire and process the collected data and information:

1. Internet of things – 21%,
2. big data – 21%,
3. cloud computing – 17%,

The complexity of implementing analytical tools may also result from the necessity to process large information resources and use extremely advanced IT systems in order to analyse them. In the case of developing enterprises, this is a barrier to using these solutions in everyday work due to limited financial resources. This also influences the inability to conduct training for employees that improve their level of professional qualifications in the scope of using innovative informatic solutions, as well as creating new work positions for persons equipped with knowledge in this area. A similar distribution of results can be observed while evaluating the implementation of 4.0 concept tools described as *fairly difficult*:

- production line robotization (24%),
- big data (23%),
- digital twin and production digitalisation (30%).

Applying tools that improve the functioning of manufactur companies in the micro and SME sector is supposed to increase their level of competitiveness. Therefore, an element of the Kantar Millward Brown Institute survey was to evaluate the influence of extremely advanced technological, informatic and analytical solutions on building the market position of enterprises in relation to their competitors (*Figure 6*).

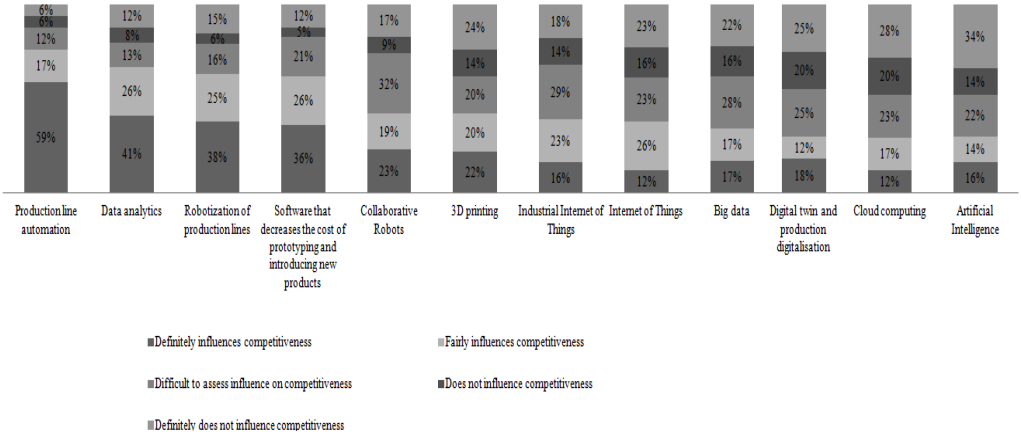

Figure 6. Evaluation of enterprises in aspect of influence of particular 4.0 industry tools on building a competitive advantage

Source: Author's own compilation based on (*Smart Industry Polska 2018*…, p. 38)

The respondents who decided to participate in the survey demonstrated that the level of enterprise innovativeness is to the largest extent conditioned by production line automation (59%). Enterprises whose decision-makers indicated that the

application of analytical tools determines their competitiveness came in second place (41%). Additionally, the respondents indicated that successive development and building a competitive advantage depend on production line robotization tools (38%) and software that decreases the costs of prototyping and introducing new products (36%). Financial expenditures aimed at improving the functioning of enterprises may mean an aspiration of decision-makers to introduce alterations to the existing manner of functioning so as to satisfy the needs of customers and to manufacture high quality goods. All of the actions require a thorough analysis, assessment of the prototype needs, manufacturing a pilot series of prototypes of goods and evaluating their usefulness by customers. Therefore, the decision-makers of Polish production companies indicated that the following tools of data analysis may have a serious impact on building a competitive advantage:

- Data analytics – 26%,
- Internet of things – 26%,
- Industrial Internet of Things – 23%.

The results of the survey presented in the *Smart Industry Poland 2018* report demonstrated the willingness of enterprises to increase the scope of conducted investments, among others, through purchases of tools that optimise the costs of prototyping and introducing new products to the market. The production of a pilot series of goods allows enterprises to decrease the costs that may occur when production processes are carried out in a manner not compliant with the adopted procedures and standards. This makes it impossible to satisfy the expectations of customers and therefore results in the discontinuation of investment projects. Simultaneously, it is possible to identify business entities in the Polish sector of manufacturing companies that negatively evaluate the positive influence of applying analytical tools in their successive development. This concerns in particular the following tools:

- cloud computing – 20%,
- digital twin and production digitalisation – 20%,
- Internet of things – 16%,
- big data 16%.

Conclusions

Attempts of decision-makers in enterprises to increase the level of market competition requires the introduction of significant alterations to the existing manner of their functioning. These alterations include carrying out investment projects that are also based on applying extremely advanced solutions of goods manufacturing, creating new distribution channels, as well as introducing alterations to the existing manner of organisation management. These actions have an influence on increasing the level of digitisation and computerization of enterprises, resulting from acquiring new resources of useful knowledge.

Over the decades one can observe an evolution of enterprise development and a tendency to accumulate resources of all types. Moreover, a key factor of their development and competitiveness is to evaluate the opportunities and threats that

occur in the market environment as well as the organisation's internal potential in the aspect of the capability of achieving strategic goals. Therefore, persons responsible for carrying out production tasks strive for successive development and all possible solutions that are elements of the so-called fourth industrial revolution. Their implementation has a significant impact on improvement in the functioning of enterprises, among others through the integration of particular organisational structures.

While evaluating the implementation of the tools of the fourth industrial revolution in Polish production companies of the micro and SME sector, it can be observed that business entities aspire to increase their range of conducted investment projects. The actions that have been implemented are aimed at optimising or decreasing the costs of manufacturing goods, while simultaneously increasing their quality. Moreover, the functioning of enterprises based on modern technological and informatic solutions may significantly influence the changeover of production devices and therefore supply products to the market that are in high demand. The review of the survey results in the aspect of enterprise functioning which is based on use of the 4.0 concept has shown that a lack of knowledge among decision-makers concerning extremely advanced technological and informatic solutions is not a barrier to their implementation. A significant number of enterprises of the micro and SME sector, despite limited financial expenditures designated for investment activity while striving for development, decide to implement all types of solutions that increase knowledge transfer among particular organisational units (tools of cloud computing, Internet of things and big data). These actions enable enterprises to evaluate the pace of market changes and adjust their functioning with respect to their abilities and accumulating indispensable financial resources.

In the perspective of further development, decision-makers of enterprises from the micro and SME sector should strive to implement all kinds of solutions to streamline the existing processes (highly advanced IT and analytical systems). In addition, a key element in maintaining a competitive position in this group of economic entities is market analysis in the aspect of adjusting the manufactured products to customer expectations and market demand. Therefore, an important element of the functioning of small and medium-sized enterprises is also the use of analytical solutions, enabling the acquisition of data and information, their processing into useful knowledge and its transfer between individual organizational structures. The whole range of activities can significantly affect an increase in profits from the sale of offered products, and thus maintain the profitability of enterprises over a longer period of time.

References

1. Adamkiewicz-Drwiłło H.G. (2006), *Determinanty konkurencyjności przedsiębiorstwa działającego na rynku globalnym*, [in:] Juchniewicz M. (red.), *Zarządzanie przedsiębiorstwem w warunkach konkurencyjności. Determinanty konkurencyjności przedsiębiorstw*, cz. I, Wydawnictwo UWM, Olsztyn.
2. Brodowska-Szewczuk J. (2009), *Konkurencyjność przedsiębiorstw i źródła przewagi konkurencyjnej*, "Zeszyty Naukowe Akademii Podlaskiej. Administracja i Zarządzanie", nr 80(7).

3. Godlewska-Majkowska H., Skrzypek E., Płonka M. (2016), *Przewaga konkurencyjna w przedsiębiorstwie. Sektor. Wiedza. Przestrzeń*, Texter, Warszawa.
4. Koczerga M. (2008), *Sposób budowania przewagi konkurencyjnej przedsiębiorstwa*, [in:] Mruk H. (red.), *Nowoczesne sposoby konkurowania w biznesie*, Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań.
5. Kowalik J. (2016), *Ekonomiczne uwarunkowania innowacyjności przedsiębiorstw w UE. Analiza przestrzenno-czasowa*, "Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie", z. 97.
6. Kraszewska M., Pujer K. (2017), *Konkurencyjność przedsiębiorstw. Sposoby budowania przewagi konkurencyjnej*, Exante, Wrocław.
7. Łobejko S., Pierścionek Z. (2011), *Zarządzanie strategiczne w praktyce polskich przedsiębiorstw*, Wydawnictwo Naukowe PWN, Warszawa.
8. Michalski E. (2014), *Czynniki determinujące innowacyjność przedsiębiorstwa*, "Handel Wewnętrzny", nr 6(353).
9. Pierścionek Z. (2007), *Strategie konkurencji i rozwój przedsiębiorstwa*, Wydawnictwo Naukowe PWN, Warszawa.
10. Porter M.E. (2006), *Strategia konkurencji. Metody analizy sektorów i konkurentów*, MT Biznes, Warszawa.
11. *Smart Industry Polska 2018. Innowacyjność w sektorze mikro oraz małych i średnich przedsiębiorstw produkcyjnych w Polsce. Raport z badań*, Ministerstwo Przedsiębiorczości i Technologii / Siemens, Warszawa, kwiecień 2018.
12. Włodarczyk R. (2017), *Działalność innowacyjna polskich przedsiębiorstw*, "Zeszyty Naukowe Politechniki Częstochowskiej. Zarządzanie", nr 25, t. 2. DOI: 10.17512/znpcz. 2017.1.2.10.

INNOWACYJNOŚĆ W POLSKICH PRZEDSIĘBIORSTWACH A CZWARTA REWOLUCJA PRZEMYSŁOWA

Streszczenie: W niniejszym opracowaniu poruszono tematykę związaną z rozwojem przedsiębiorstw sektora mikro i MŚP w odniesieniu do czwartej rewolucji przemysłowej. Stanowi ona efekt dynamicznych zmian rynkowych związanych z permanentnym skróceniem cyklu życia produktu, a tym samym koniecznością zwiększenia poziomu jakości oferowanych wyrobów. Celem niniejszego opracowania jest ocena poziomu implementacji elementów czwartej rewolucji przemysłowej w polskich przedsiębiorstwach produkcyjnych, prowadzących działalność w sektorze mikro i MŚP. Ponadto wskazano narzędzia wykorzystania koncepcji 4.0 na najwyższym poziomie w polskich przedsiębiorstwach z uwzględnieniem czynników i osób odpowiedzialnych za ich implementację. W opracowaniu podjęto próbę wyodrębnienia technologii, które w największym stopniu są stosowane w sektorze wspomnianych przedsiębiorstw, oraz dokonano oceny ich wpływu na budowanie przewagi konkurencyjnej na rynku. W tym celu wykorzystano raport *Smart Industry Polska 2018. Innowacyjność w sektorze mikro oraz małych i średnich przedsiębiorstw produkcyjnych w Polsce* opublikowany przez Instytut Kantar Millward Brown na zlecenie firmy Siemens w kwietniu 2018 roku.

Słowa kluczowe: innowacyjność przedsiębiorstw, przemysł 4.0, informatyzacja procesów zarządzania, zarządzanie procesowe