

# CHALLENGES FOR THE BUSINESS MODEL OF A NETWORK OF SMALL AND MEDIUM-SIZED MANUFACTURING ENTERPRISES IN THE ERA OF INDUSTRY 4.0

Sebastian SANIUK<sup>1</sup>, Sandra GRABOWSKA<sup>2\*</sup>

<sup>1</sup> University of Zielona Góra, Zielona Góra; s.saniuk@wez.uz.zgora.pl, ORCID: 0000-0002-9014-036X

<sup>2</sup> Silesian University of Technology, Katowice; sandra.grabowska@polsl.pl, ORCID: 0000-0002-0478-3466

\* Correspondence author

**Abstract:** After three industrial revolutions, the fourth has come, transferring production to sophisticated networks of companies equipped with intelligent devices, machines, and means of transport, communicating with each other using modern technologies. It creates new challenges for industrial companies; it requires existing business models to be redefined. The development of the Industry 4.0 concept forces modern companies, especially small and medium-sized enterprises, to quickly and flexibly adapt to the changing demand conditions. This is reflected in the creation of new business models, ones that allow for the introduction of innovations, the rapid reorganization of processes, and very flexible adaptation of enterprises to the conditions of a changing environment.

The aim of the article is to present the concept of a business model assuming the creation of a network of small and medium-sized enterprises that are able to generate added value for their clients in the era of Industry 4.0.

**Keywords:** business model, Industry 4.0, customization, network production companies.

## 1. Introduction

Technological changes have gained strategic importance in the thinking and actions of many market players, at the same time penetrating into all links of the value chain and the ways they are connected, which changed the range of competition and the way in which the needs of buyers are met. The technical revolution has broadened the boundaries of what businesses can deliver to customers in the form of value. In a modern, highly competitive production environment, enterprises face the challenge of dealing with large amounts of data, the need to make quick decisions, and the need to make production processes flexible (in terms of offering the customer a highly personalized product). The contemporary nature of production is shaped by changes in the paradigm from mass production to production at the customer's request (Gajdzik, 2018).

Industry 4.0 marks the fourth industrial revolution, which is assumed to be a vision of intelligent factories built of cyber–physical systems composed of intelligent manufacturing and logistical resources communicating with each other through information and communication technologies (ICT). In addition, within the framework of the proposed concept of Industry 4.0, there is a close connection of physical objects functioning in geographically dispersed companies with an information network (Grabowska, 2018). Thus, sophisticated networks of companies are created, connected by intelligent resources, communicating via the Internet for the purpose of implementing joint production projects. The functioning of small and medium-sized enterprises in production networks today provides many additional development opportunities, but at the same time raises some concerns and requires many problems to be solved. In the case of SMEs, it means the possibility of offering customers a wide variety of products and services. The effectiveness and efficiency of such functioning requires businesses to create a cooperation network and to apply appropriate business models, as well as making often significant changes to them (Saniuk, 2018).

Almost all existing business systems are built as a way to archive and manage large numbers of transactions related to the company's operations — from sales through purchases and employee benefits to industrial processing. However, in the “modern world,” and especially in the concept of Industry 4.0, the task of creating unique, personalized experiences requires systems to capture the essence of interaction, not the transactions themselves.

The aim of the article is to present the concept of a business model assuming the creation of a network of small and medium-sized enterprises that are able to generate added value for the client in the era of Industry 4.0. The article attempts to present the conditions for the development of production networks of small and medium-sized enterprises capable of functioning within the framework of the Industry 4.0 concept and the concept of a business model that takes into account their individual characteristics. The article is based on in-depth literature studies and the previous research of authors in the field of business models, Industry 4.0, and virtual cooperation networks.

## **2. The Concept of Industry 4.0**

Industry 4.0 is currently one of the most interesting and current areas of research for many research centers and businesses, which makes it one of the most frequently discussed topics among practitioners and scientists dealing with production management issues. The growing expectations of customers in the modern market mean that modern enterprises, along with the increased efficiency and production quality, must also meet the high requirements of expected product customization, i.e., manufacturing products where the customer has a decisive influence on the final product. Customization can take various forms depending on the degree

of customer influence on the new product. The highest degree of customer interference, at the same time the most expensive and the most difficult to organize, occurs in the case of “pure customization,” where the customer participates in the design phase of the product and thus, having an impact on the manufacturing process, receives a unique product. Certainly, these are the expectations of both the customer and the target creators of the concept of Industry 4.0. A slightly easier way to customize the product, one that is easier to organize and can be used currently in Industry 4.0 networks, would be either “tailored customization” or “customized standardization.” In the first case, the customer has an impact on the production phase of standard parts, assemblies, or components, especially in terms of their sizes or shapes. In the second case, the customer influences the final assembly by selecting elements of the product configuration. In all cases, it is important that the price of the product is similar to the price of mass-produced products. The possibility of highly resolved production is guaranteed by the concept of Industry 4.0, which assumes the creation of a fully integrated system of suppliers, producers, and clients operating within cyber-physical systems (CPS), which are open sociotechnical systems capable of mutual communication and exchange of data for the implementation of activities imposed by manufacturing, logistics, or management. The implementation of this idea should allow for the development of intelligent production systems that, in addition to this autonomy, will have the characteristics of self-configuration, self-control, or repair (Wittbrodt, 2018).

The Industry 4.0 concept includes numerous technologies and associated paradigms. The main elements which are closely related to the idea of Industry 4.0, include the Industrial Internet of Things (IIoT) (cloud-based production, intelligent factories, cyber-physical systems, or social product development (Herman, 2015; Lee, 2013, Lasi, et al., 2014).

In this concept, the production process will continue to be an orderly series of actions thanks to which the consumer (user) has the opportunity to obtain the required product or service. It must be designed and organized for specific purposes that can be quickly and flexibly adapted to changing conditions, such as the volatility of quantitative and qualitative characteristics, material, energy, and information. It should be used to maximize corporate profit and customer satisfaction (Kagermann, 2014). Industry 4.0 is the use of mechatronic CPS products such as machines, devices, robots, manipulators, and means of transport throughout the production process, starting from creating a new product concept, designing, creating a product in a virtual environment, conducting necessary tests in a computer environment, and creating a product in a real environment, together with the development of software and computer-aided documentation of production and assembly, organization of logistics, service, and development of the recycling principles of the product offered. This provides the ability to meet customer expectations while maintaining high profitability of the production process, thanks to the dynamic adjustment of autonomous modules of the entire process of preparation, production, and delivery of the product to the customer using the IoT and information stored in Big Data and Cloud Computing (Chui, et al., 2010).

In the age of Industry 4.0 concept, the Industry 4.0 concept, each company is perceived as offering an intelligent module for use in the entire logistics chain, so the size of the enterprise ceases to matter. Meanwhile, the business model of a particular company takes on the significance of the technology used, the level of highly qualified staff employed, and openness to unlimited communication using increasingly common technologies, including Cloud Computing, Big Data, the Internet of Things, and blockchain (Saniuk, 2018).

### **3. Determinants of the business cooperation model of companies in the era of Industry 4.0**

In a turbulent and changing environment, businesses are forced to look for the most effective methods of monitoring and detecting changes in the environment to undertake effective adaptation activities resulting from the Industry 4.0 concept.

The constantly increasing complexity of modern technologies, the progress of information and communication technologies, networking, globalization, social innovations, and the increase in the requirements of customers who increasingly expect a highly personalized product, pose new challenges for managers (Grabowska, 2018). As Z. Malara aptly put it, “all this means that new organizational rules, rules and modalities emerge from the organizational reality, which forces him to think of the future” (Malara, 2006). This means that today’s enterprise needs to change its *modus operandi* — which has worked well in the past — and develop network cooperation. Companies should increase their ability to participate in global networks that use shared resources of partners in order to meet the high requirements of a modern client. This fundamental transformation of business is just taking place. Industry 4.0 will absolutely force enterprises to change their models of operation. One of the most important models of business management which enables flexible, effective, and competitive functioning of the company on the market is a process-based model.

In order to create a business model of a network of manufacturing enterprises operating in the era of Industry 4.0, it is necessary to start with some assumptions:

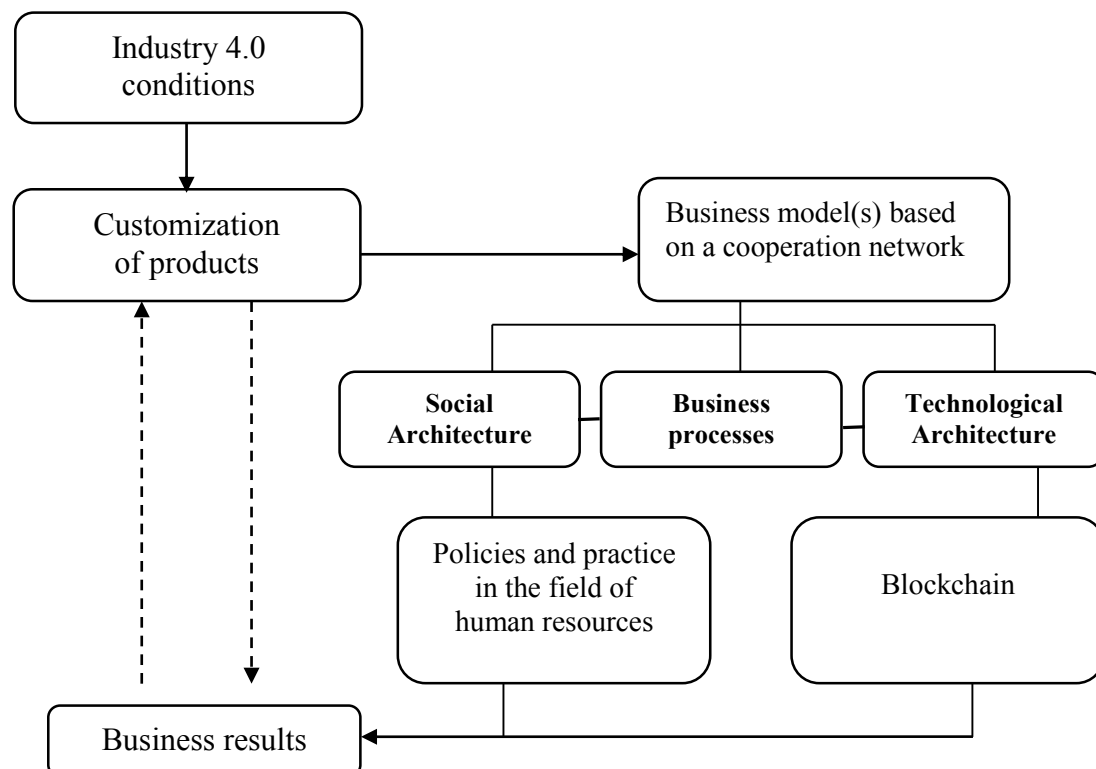
- The value is determined by experience created at a given time in cooperation with a single consumer (this phenomenon will be called  $N = 1$ ).
- The company is not vertically integrated.
- The company is not able to satisfy the consumer’s expectations at a given time due to size and activities.
- Attention is focused on access to resources, not on ownership of resources.
- Resources are derived from various suppliers, and access to them is global (this trend will be marked as  $R = G$ ).
- It is crucial that the supply of products, services, and competences is multi-institutional.

The observed increase in competitiveness and globalization processes, as well as ongoing mergers and acquisitions, affect the search for new methods, techniques, and management instruments. The ongoing development of a knowledge-based economy expressed in the intensive transfer and diffusion of innovation has a significant impact on changes in business models and business processes. New forms of competitiveness and cooperation emerge. New models applying a wide range of different types of innovations are used, business models based on the principles of a “new era of innovation” (Prahalad, Krishnan, 2010).

Using the concept of the “new era of innovation” for the research needs of the work, it was assumed that the business model is a configuration of business processes that combine and develop resources, shaped in the form of the social and technical architecture of the enterprise.

The need to conduct research in the field of business models of enterprise networks can also be proven by the numerous benefits of business cooperation indicated in the literature. Entering enterprises into various cooperative arrangements, including the organization of permanent or temporary networks, is particularly attractive for small and medium-sized enterprises, which in this way can overcome the main competitive advantage of large companies, especially in terms of access to all types of resources (capital, competencies, know-how, etc.).

From the point of view of creating and using the so-called The "new era of innovation" should be treated as one of the most important elements of the company's competitive and innovative potential structure, serving its transformation as shown in Figure 1 (Prahalad, Krishnan, 2010).



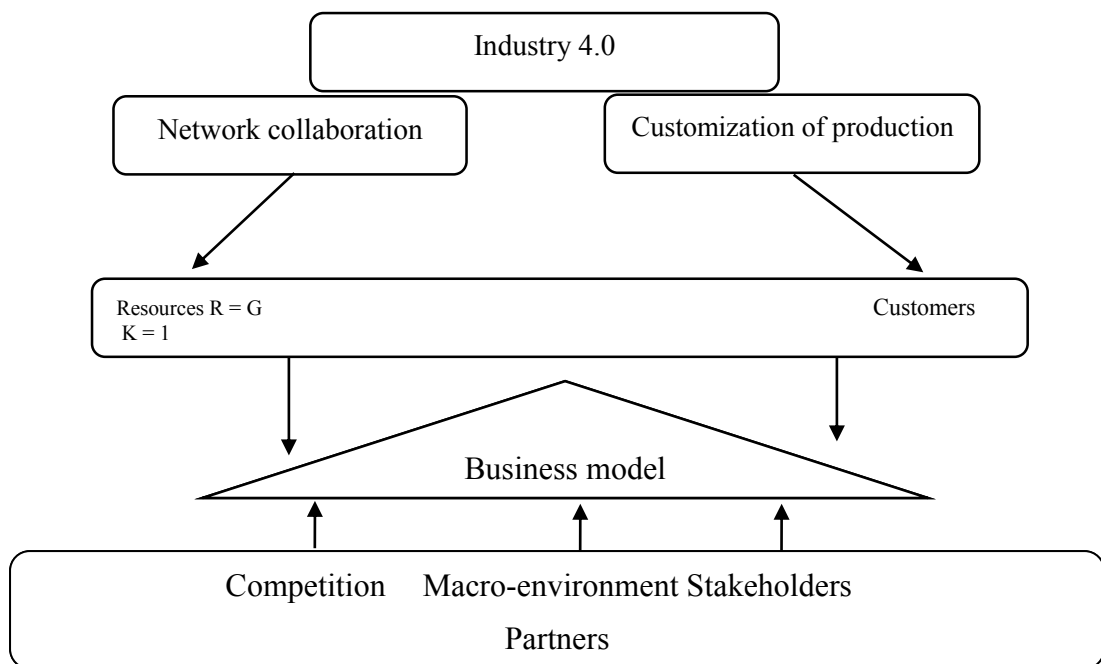
**Figure 1.** Structure of building the business transformation potential by principles of the new era of innovation ( $N = 1$  and  $R = G$ ) in Industry 4.0.

The business model, according to the new era of innovation, is based on the configuration of social architecture and technological architecture of interconnected business processes and perfectly meets the requirements of Industry 4.0 (such as product customization, the need to build cooperation networks, digitization, robotization, logistics 4.0, etc.).

In this model, the role of business processes is clearly emphasized. In practice, the elements of such a business model are as follows:

- social architecture (knowledge resources, management systems, competencies, employee development, and motivation),
- technological architecture (IT and telecommunications devices, computers, ICT systems, robots, etc.),
- business processes that combine these databases (essentially infrastructural) and at the same time derive from them the resources necessary for the implementation of appropriate products that create value for the client.

Schematically, such a model is shown in Figure 2.



**Figure 2.** Business model of network enterprises in Industry 4.0.

When analyzing Figure 2, it is worth noting that the transformation potential is highly dependent on human resources and the ability to apply modern ICT systems. In particular, this concerns the competencies and opportunities for employee development, as well as the advancement of digitization processes and efficient communication systems. It is worth noting that in this approach the results of business operations are conditioned by the transparency of the developed strategy and the configuration of business model elements. Only in such conditions will enterprises cooperate effectively within the network.

1. Value is based on exceptional personalized customer experience. Businesses must focus on one customer. Regardless of the number of clients, the focus is on the central position of the unit. This pillar is known as  $N = 1$  (the experience of a single client at one time). By focusing on the needs of an individual customer, it is possible to get his/her feedback or directly materialized product. Such an approach to the customer means treating him/her as an active recipient and a modifier of the product, and thus a prosumer, which is the main assumption of the concept of Industry 4.0. Meeting this assumption requires interaction with SMEs. The level of technology used, the level of highly qualified staff employed, and openness to unlimited communication are becoming increasingly important today. By combining the potential of partners as a network organization, you can offer more complex, innovative products and services tailored to customer needs (Walters, Buchanan, 2001). The company's participation in the network provides new opportunities and enables the use of modern organizational solutions which have a significant impact on the increase in operational efficiency manifested by the process orientation, decentralization of management, professional development of employees, etc. (Perechuda, 2002). In addition, the possibility of being part of many alliances allows one to better use one's resources and increase their use with the benefit of increasing the productivity of the entire company. It is also worth mentioning the positive impact on the learning process of organizations (enterprises operating within the network) of gaining new experiences and know-how from mutual relationships between cooperating enterprises (Urbaniak, 2001).
2. All enterprises have access to a global ecosystem, including resources. Businesses focus their attention on access to resources and not only on possessing them. This pillar is described as  $R = G$  (resources are global from many suppliers, often from anywhere around the world).

As can be seen in Figure 2, in the business model business processes must be associated with the relevant qualifications, attitudes, and orientations of managers. Social architecture — organizational structure, measurement methods, training, qualifications, and organizational values — must reflect the new competitive imperatives resulting from the concept of Industry 4.0. The same must be required from the technological architecture of the company — the backbone of its information technology, automation, and robotization of production processes. All of these areas represent the potential that can be offered to partners within the cooperation network.

It can therefore be said that an important advantage of this concept is the treatment of the model as overriding values — innovation and efficiency — which are achieved through appropriately selected and combined elements of the model. The use of innovations that radically change the company's strategy enables the creation of a new market space — a formula of success that allows one to “work around” the existing competition system.

## 4. Conclusions

With the development of Industry 4.0, there are new opportunities as well as threats to companies and their business models. Building a new industry is not easy because it requires new business resources. Formulating and adapting to change is a long-term activity. The assumptions of the business models of enterprises presented herein should be treated as an overview because the concept of Industry 4.0 is such a new concept that there are many possible scenarios for its development. It is difficult to predict today how enterprises should behave because we do not know exactly what expectations the client will have. On the other hand, to paraphrase Pitcher Drucker, the companies shape the client — his tastes, expectations, and requirements.

However, it can be stated that changes in business models and business processes will play an important role in the area of management systems. The new business concepts will translate into a concrete model constituting a strategic and operational basis for changing the configuration of products and processes in the company, enabling competition on the market determined by the concept of Industry 4.0.

The emerging transformation of business from the ideas of Industry 4.0 is based on trends that cannot be reversed. Consumer activism, ubiquitous communication, the convergence of technologies and industries, globalization of markets, and the global search for and access to resources are trends that are not controlled by any single company — hence, the creation of cooperation networks, especially for SMEs. These changes will inevitably lead to the business world that follows the development of Industry 4.0.

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