

KEY COMPONENTS OF THE BUSINESS MODEL IN AN INDUSTRY 5.0 ENVIRONMENT

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Purpose: The aim of the article is to identify the key components of the business model of an enterprise operating in the Industry 5.0 environment

Design/methodology/approach: The achievements and results presented in the article were obtained on the basis of literature research and expert research conducted among 25 professionals with experience in strategic management, Industry 4.0 and Industry 5.0 technologies. The research technique was the Delphi method. The key components of the business model were presented in the form of Business Model Canvas.

Findings: Based on the research results obtained, components shaping the business model of a company operating in the Industry 5.0 environment were identified.

Research limitations/implications: The analysis of experts' opinions is a preliminary stage of identifying key components of the business model of a company operating in the Industry 5.0 environment. The research should be extended to the analysis of case studies of companies implementing Industry 4.0 technologies.

Originality/value: The original achievements obtained during the research include obtaining valuable research results in the field of key components of the business model affecting the formation of its architecture, competitive advantage and value creation and monetization. The research results were obtained directly from experts who have the necessary knowledge of strategic management, Industry 4.0 technologies and Industry 5.0 pillars.

Keywords: business model, Canvas, Industry 5.0, Industry 4.0, competitiveness, value creation.

Category of the paper: Research paper.

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Introduction

Rapidly changing business environment, development of new technologies, increasing intensity of competition and globalization, put companies in the face of increasingly difficult requirements. The fourth industrial revolution has been going on for several years now, affecting not only business and industry, but also other areas of life, providing opportunities previously unattainable for companies and customers (Grabowska, Saniuk, 2022). Dynamic technological development and solutions implemented in modern companies result in a change of management paradigms and a need to build new business models. This is reflected in the creation of new business models, such that allow for open innovation, rapid reorganization of processes and very flexible adjustment of business operations to new conditions, rapidly changing competitive and common environment (Müller et al., 2018).

Changes resulting from Industry 5.0 requirements force many management areas to restructure or even build business models from scratch. In future business realities, what was previously the domain of multiple market participants will be offered within a single application by a single player (Arnold et al., 2016). Trends will be shaped profoundly by customer expectations and experiences, creating the potential to transform almost every sector, within B2B and B2C. As a result, companies will be forced to define their strategies and business models very differently over the next few years – not in relation to traditional market competitors, but to the emerging consumer ecosystems (Burmeister et al., 2016).

The fourth industrial revolution is the age in which modern technological solutions shape the industrial environment and influence the economy and society, intensifying the sustainable development of the world. Concepts identified with this revolution are Industry 4.0 and Industry 5.0 created on its basis.

Industry 4.0 through digitalization brings enterprises into the world of Smart Factory, builds cyber-physical production systems, as forms of integration of information technology and operational technology in enterprises and the entire value chain (Lee et al., 2015; Liu et al., 2017). Industry 4.0 as it raised many public concerns about the elimination of man from his workplace in favor of the robot resulted in the evolution to Industry 5.0. It began to emphasize the fact that Industry 4.0 technologies cannot impose their choices on man but offer them to him. The first mentions of the role of operators in Industry 4.0 appeared in the publications of Romero et al. (2016). It was emphasized that a symbiosis between humans and new technologies is needed. The authors proposed the introduction of the human factor into cyber-physical systems. In addition to the human factor, research gaps in the areas of sustainability, resilience, security, and others were noted in Industry 4.0 (Saniuk et al., 2020).

Industry 5.0 is an industry that focuses on the consideration of the key role of humans and greater involvement of their knowledge and competencies in a cyber-physical production system. Man and machine collaborate for improved quality and efficiency in production (Broo

et al., 2021; Haleem, 2019). The interaction of human and artificial intelligence is paramount in Industry 5.0. The concept is also expected to be more beneficial to the environment as companies develop systems that use renewable energy and eliminate waste (Nahavandi, 2019).

The premise of Industry 5.0 focuses on creating interaction in the human-machine system. The interaction involves connecting humans with smart devices and cyber-physical system through smart mobile devices (Demir et al., 2019; Vollmer, 2018). Nowadays, robots seem to be replacing humans due to advances in artificial intelligence development and the possibility of brain-machine interface development (Longo, 2020). This means in the future a strong combination of robots with the human brain and using them as a collaborator, executor of commands rather than a competitor (Nahavandi, 2019). The idea of Industry 5.0 will therefore focus on developing more advanced human-machine interfaces using artificial intelligence algorithms. This represents an opportunity to utilize the capabilities of human brains in the process of increasing the efficiency of automation and robotization of systems (Aslam et al., 2020). This means, breaking away from the view of losing control of the cyber physical world dominated by thinking robots what was so feared about Industry 4.0 (Haleem, Javaid, 2019). The transformation of the Industry 4.0 concept to Industry 5.0 is a combination of the advantages of the cyber-physical system of intelligent machines and common sense thinking, which can mean a focus on productivity and sustainability (Özdemir, Hekim 2018). In the process of human-machine integration, it is also important to develop competence and knowledge in new technologies and the trend of talent management.

According to the European Commission, the strength of Industry 5.0 is the social objectives beyond jobs and economic growth to become a resilient provider of well-being, thanks to the fact that production respects the limits of the planet and the welfare of the industrial worker is at the heart of the production process. A favorable factor in the development of the Industry 5.0 concept is the growing environmental awareness of society. This means an interest in green products, the sharing economy, and an interest in developing a closed loop economy (Elfar et al., 2021; Aslam et al., 2020; Di Nardo, Yu, 2021). Industry 5.0 does not deny the need to digitize societies, economies, and industries but rather extends it to include social and environmental aspects (Doyle-Kent, Kopacek, 2019). Digitalization in Industry 5.0 is a broad philosophy that organizes processes in the enterprise and value creation chains.

The fourth industrial revolution along with the key technologies of Industry 4.0 and the pillars of Industry 5.0 creates the need to create new business models, hence the purpose of this article is to identify the key components of the business model of an enterprise operating in the Industry 5.0 environment.

Materials and Methods

The research conducted consisted of two parts. The first part of the research consisted of literature analysis. The systematic review of the literature along with the critical analysis of the content of selected publications allowed to identify the research gap in the form of unidentified components of the business model of an enterprise operating in the environment of Industry 5.0. In the second part, research was conducted among experts using the Delphi method. Research questions were formulated and interviews with experts were conducted. The research with 25 experts was conducted in the period from March 01 to May 15, 2022.

The experts participating in the survey were selected by three Competent Judges (academics with knowledge in the field of Industry 4.0 and Industry 5.0). The experts were business practitioners, managers from manufacturing companies implementing Industry 4.0 technologies.

Results and Discussion

The business model of an enterprise operating in an environment determined by the pillars of Industry 5.0 can be defined as a configuration of business processes connecting and developing resources, formed in the form of social and technical architecture of the enterprise, built on flexible, digital processes, enabling the creation of cyber-physical networks capable of meeting the demand for personalized products. This model is based on a strong combination of the megatrends of the fourth industrial revolution¹, the key technologies of Industry 4.0² and the pillars of Industry 5.0³. The implementation of strategies in this model in practice takes place through the construction of a cyber-physical cooperation network, ensuring both the efficient use of resources and skills and their renewal. The technological innovations implemented enable collaboration within cyber-physical networks, which aim to produce personalized products and offer complementary services. These activities take into account the principles of sustainable production. Based on the Business Model Canvas template created by A. Osterwalder (2004), a Canvas was created for the business model of a company operating in an Industry 5.0 environment. It takes into account the potential for radical change that Industry 5.0 brings to the entire value chain in the manufacturing sector. By filling in the nine main

¹ The megatrends of the fourth industrial revolution are: Economy 4.0, Smart Factories, Society 5.0, Sustainable Consumption and Sustainable Production.

² Key technologies of Industry 4.0 include Autonomous Robots, Big Data, Cloud Computing, Systems Integration, Additive Manufacturing, Industrial Internet of Things, Augmented Reality, Simulation, and Technologies that Support Cybersecurity.

³ The pillars of Industry 5.0 are: Human-Centric, Sustainability, Resilience.

elements of the model, the value position of the company, its infrastructure, its customers and its finances were described (Figure 1).










 <p>Key partners</p> <p>Partners working in a cyber-physical network, forming agile teams to deliver a specific project</p> <p>The customer as a partner, a participant in the product design process</p>	 <p>Key activities</p> <p>Automated Manufacturing according to customer expectations</p> <p>Production as a service</p> <p>Production as a product (servitization)</p> <p>Digitized, resilient processes</p>	 <p>Value provided</p> <p>Product made with sustainable development in mind</p> <p>Product personalized according to individual customer order at the price of a mass-produced product (supporting sustainable consumption)</p> <p>PRODUCT ↓ servitization ↓ SERVICE</p> <p>Industrial Internet of Things (IoT) platforms</p>	 <p>Customer relationship</p> <p>Personal relationship with the customer</p> <p>A relationship using the latest technology</p> <p>Digital platforms</p> <p>Partnership throughout the product lifecycle</p>	 <p>Customers</p> <p>Mass customization</p> <p>Segmented market</p> <p>Diversified market</p>
<p>Key resources</p> <p>Humans working with robots</p> <p>Knowledge of customer preferences</p> <p>Resilient, sustainable</p>		 <p>Channel</p> <p>Wholesale or retail network</p> <p>Digital news channel</p>		
<p>Cost</p> <p>Management Manufacturing Servitization</p> 		<p>Revenue</p> <p>Sale of products/services Servitization Fee charged for use of product Licensing Monetization of value</p> 		

Figure 1. Key components of the business model of a company operating in the Industry 5.0 environment – Canvas

The most important and fundamental element of the business model of the Industry 5.0 era – Canvas – is market segmentation. It defines different groups of customers to whom the added value produced in the company is delivered. The basis for distinguishing customer segments are the following characteristics: satisfying the needs of a customer segment that requires a legitimate business differentiating offer; customers in a given segment are reachable by using specific distribution channels; a specific segment generates particular ways of behaving and building relationships with customers; each customer segment has a distinct profitability; customers in different segments are able to pay a different price for different products and/or services of the enterprise.

The next element is the added value that the enterprise offers, or more precisely, the products and/or services that the enterprise provides to distinguished customer segments, creating what is called a value-added or value proposition. Once again, it should be emphasized that the task of the enterprise is to provide a value proposition that not only responds to the customer's reported demand, but also comes up with future complementary values. What stands out here are products and services personalized according to the customer's individual order at the price of a mass-produced product and Industrial Internet of Things platforms.

The key activities that a company must perform in order to deliver value, establish customer relationships, and generate a revenue structure are automated production in line with customer expectations, production as a service, production as a product, and digitized processes.

The element called "customer relationships" describes the type of interaction a company has with identified customer segments. These relationships can be personal, but also completely automated, using digital platforms. Certainly, it should be a type of interaction that assumes partnership throughout the product lifecycle.

Another element is the distribution channels described as the wholesale and retail network. Through these, the company communicates and reaches out to a segment of customers in order to provide them with added value in the form of a product and/or service.

The revenue structure indicates product/service sales, servitization, fees charged for product use, and licensing are described as the company's ways of generating revenue from specific customer segments.

Key resources is an element describing the resources needed to generate added value and reach customer segments through distribution channels. Among the key resources identified: elimination of underutilized production capacity (obtained through collaboration in cyber-physical enterprise networks) and knowledge of customer preferences gained through support such as data analytics.

The term key partners describes the network of suppliers and contractors that make a company function. These include partners working in a cyber-physical network, forming agile teams to deliver a specific project, and customers as partners, participants in product design.

The cost structure represents all the costs that the Industry 5.0 business model generates. Creating and delivering added value, maintaining customer relationships and generating revenue generate costs. They can be easily calculated after defining key resources, key activities and key partners. Simplifying, they are defined as management, production, and servitization costs.

Conclusion

The conducted research indicates that the concept of business models in the conditions of the fourth industrial revolution is gradually being built using the key technologies of Industry 4.0 and the pillars of Industry 5.0, in order to achieve a modern form of management able to meet the challenges of turbulent, competitive and technologically advanced environment. Among all the mentioned elements in the business model template of an enterprise operating in the Industry 5.0 environment – Canvas, the following deserve special attention:

- the new role of customers as partners, participants in the product design process,
- partners working together in a cyber-physical network, forming agile teams to deliver a specific project,
- automated production in line with personalized customer expectations,
- manufacturing as a service,
- eliminating unused production capacity by making spare capacity available to cyber-physical network partners,
- offering personalized products, maximally tailored to customer preferences, at the price of a mass-produced product,
- partnering with the customer throughout the product lifecycle, having a positive impact on sustainable consumption,
- servitization.

Consideration of the concepts of business models in the era of the fourth industrial revolution certainly does not exhaust such an important and broad issue of business management. The changeability of the environment and rapid development of technology may cause both the lengthening of the list of concepts forming the Fourth Industrial Revolution, as well as changes in the structure of those already identified. An interesting direction of further research may be the analysis of competitiveness and flexibility of enterprises building their business models on the basis of cyber-physical cooperation networks. Enterprises that will include in their offer, in addition to highly individualized products, personalized services as a complementary addition to them.

References

1. Arnold, C., Kiel, D., Voigt, K.I. (2016). *How industry 4.0 changes business models in different manufacturing industries*. Proceedings of the International Society for Professional Innovation Management (ISPIM), Boston, MA, USA, 13-16 March, p. 1.
2. Aslam, F., Aimin, W., Li, M., Rehman, K. (2020). Innovation in the era of IoT and industry 5.0: absolute innovation management (AIM) framework. *Information*, 11(2), 124.
3. Broo, D.G., Kaynak, O., Sait, S.M. (2021). Rethinking Engineering Education at the Age of Industry 5.0. *Journal of Industrial Information Integration*, 100311. <https://doi.org/10.1016/j.jii.2021.100311>.
4. Burmeister, C., Luettgens, D., Piller, F.T. (2016). Business Model Innovation for Industrie 4.0: Why the Industrial Internet Mandates a New Perspective on Innovation. *Die Unternehm. Swiss J. Bus. Res. Practice*, 70.
5. Demir, K.A., Döven, G., Sezen, B. (2019). Industry 5.0 and human-robot co-working. *Procedia computer science*, 158, 688-695.
6. Di Nardo, M., Yu, H. (2021). Special issue "Industry 5.0: The prelude to the sixth industrial revolution". *Applied System Innovation*, 4(3), 45.
7. Doyle-Kent, M., Kopacek, P. (2019). *Industry 5.0: Is the manufacturing industry on the cusp of a new revolution?* Proceedings of the International Symposium for Production Research. Cham: Springer.
8. ElFar, O.A., Chang, C.K., Leong, H.Y., Peter, A.P., Chew, K.W., & Show, P.L. (2021). Prospects of Industry 5.0 in algae: Customization of production and new advance technology for clean bioenergy generation. *Energy Conversion and Management*, X, 10, 100048.
9. Grabowska, S., Saniuk, S. (2022). Assessment of the Competitiveness and Effectiveness of an Open Business Model in the Industry 4.0 Environment. *J. Open Innov. Technol. Mark. Complex.*, 8, 57. <https://doi.org/10.3390/joitmc8010057>.
10. Haleem, A., Javaid, M. (2019). Industry 5.0 and its expected applications in medical field. *Curr. Med. Res. Pr.*, 9, 167-169.
11. Lee, J., Bagheri, B., Kao, H. (2015). Research Letters: A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manuf. Lett.*, 3, 18-23.
12. Liu, Y., Peng, Y., Wang, B., Yao, S., Liu, Z. (2017). Review on cyber-physical systems. *IEEE/CAA J. Autom. Sin.*, 4, 27-40, doi:10.1109/jas.2017.7510349.
13. Longo, F., Padovano, A., Umbrello, S. (2020). Value-oriented and ethical technology engineering in industry 5.0: A human-centric perspective for the design of the factory of the future. *Appl. Sci.*, 10, 4182.

14. Müller, J.M.; Buliga, O.; Voigt, K.I. (2018). Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technol. Forecast. Soc. Change*, 132, 2-17.
15. Nahavandi, S. (2019). Industry 5.0 — A human-centric solution. *Sustainability*, 11, 4371.
16. Osterwalder, A., Pigneur, Y. (2012). *Tworzenie modeli biznesowych, podręcznik wizjonera*. Gliwice: Wydawnictwo Helion.
17. Özdemir, V., Hekim, N. (2018). Birth of industry 5.0: Making sense of big data with artificial intelligence. The Internet of things and next-generation technology policy. *OMICS A J. Integr. Biol.*, 22, 65-76.
18. Romero, D., Bernus, P., Noran, O., Stahre, J., Berglund, Å.F. (2016). The operator 4.0: Human cyber-physical systems & adaptive automation towards human-automation symbiosis work systems. *IFIP Advances in Information and Communication Technology*, Vol. 488. Springer: New York, NY, USA, pp. 677-686.
19. Saniuk, S., Grabowska, S., Gajdzik, B. (2020). Social Expectations and Market Changes in the Context of Developing the Industry 4.0 Concept. *Sustainability*, 12, 1362; doi:10.3390/su12041362.
20. Vollmer, M. (2018). *What is Industry 5.0?* Retrieved from <https://medium.com/@marcellvollmer/what-is-industry-5-0-a363041a6f0a>, 29.05.2022.