




Article

# Social Expectations and Market Changes in the Context of Developing the Industry 4.0 Concept

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**Abstract:** There are more and more talks in the community of scientists and business practitioners about new challenges for industry in connection with the fourth industrial revolution. Industry 4.0 is the result of the development of cyber-physical generation systems as part of the fourth industrial revolution. Industry 4.0 sets new areas of change in the sphere of production and management but also exerts an impact on various aspects of society's life. It is a transformational challenge for enterprises of the present age. Industry 4.0 is present in economic studies at the macroeconomic level and business at the microeconomic level. Scientists discuss the essence of change, and specialized research centers and consulting companies carry out research on various aspects of this industrial revolution. The article presents the range of expectations and changes in society towards the development of the concept of Industry 4.0. The work was based on a literature study and direct research in the field of social change in the Industry 4.0 era. The aim of the article is to identify social expectations of development changes related to the implementation of the Industry 4.0 concept. The article devotes a lot of attention to customization because it is one of the keys of Industry 4.0, leading to a change of the paradigm from mass production to personalized production. This simple change will affect customers, producers, and employees. Based on the synthesis of literature and secondary research, authors identify opportunities and threats to the broadly understood society functioning in the Industry 4.0 environment. Social conditions were analyzed from the point of view of the consumer, producer, and employee. In the cited direct studies, the basic area of analysis was product personalization and pre-recognition of the opinions of potential consumers about customization in Industry 4.0. The limitation of the research area to the consumer segment resulted from the importance of product personalization in Industry 4.0 and its impact on producer behavior and effects for employees.

**Keywords:** Industry 4.0; customization; smart factory; expectations of modern consumers; customer and producer challenges

## 1. Introduction

Along with economic and social changes resulting from technical progress, new levels of civilization develop. If the extent of the change is radical, then there is talk of a revolution. In the case of industrial development, four industrial revolutions were recorded. The latter, the Fourth Industrial Revolution, results in a strong connection between two worlds: Real (physical) and virtual (IT) in Cyber Physical Systems (CPS). The new industry concept, referred to as Industry 4.0, means the integration of IT devices and solutions in production processes that are designed to increase production efficiency and increase production flexibility [1–4].

The concept of Industry 4.0 was initiated in Germany in 2011. Its essence lies in the combination of a real and virtual work organization system as well as networking and integration of people with digitally controlled intelligent machines that make extensive use of the Internet and information technology. Production is characterized by automation, computerization, and robotization. All devices in the technological line communicate with each other, creating an intelligent production system [5–8]. The production technique implemented using computers and microelectronics was already implemented in the second half of the 20th century, but Industry 4.0 is about increasing the share of industrial robots and manipulators in the manufacture of products using the Internet to control devices in integrated processes inside and outside the enterprise within the supply chain. This creates new opportunities for the development of the economy and modern society [9,10].

A paradigm Industry 4.0 will be a step forward towards more sustainable industrial value creation. In the current literature, this step is mainly characterized as a contribution to the environmental dimension of sustainability. The allocation of resources, i.e., products, materials, energy, and water, can be realized in a more efficient way on the basis of intelligent cross-linked value creation modules. Besides these environmental contributions, Industry 4.0 holds a great opportunity for realizing sustainable industrial value creation on all three sustainability dimensions: Economic, social, and environmental [11].

There are more and more economic initiatives related to Industry 4.0. The popularization of Industry 4.0 results in changes in many areas of society and economy. The scope of changes is very wide and it is impossible to list them all and even fully identify them. In light of the changes taking place, the question arises: What are the social expectations of the Fourth Industrial Revolution? Selected expectations from the perspectives of: customers and consumers of products, producers and employees in relation to the environment of Industry 4.0 constitute the content of this publication [12–16]. The article is of a review nature and undertakes considerations in the scope of characterization and assessment of the approach, which is flexible production focused on customization, as well as indicating directions of evaluation of expectations of producers, employees, and consumers. To this end, the literature on the subject was analyzed, and case studies, as well as the results of surveys carried out, were used.

## 2. Review of the Subject Literature

### 2.1. Industry 4.0 Pillars Set

Industry 4.0 means the integration of intelligent machines and systems and the introduction of changes in production processes aimed at increasing production efficiency and introducing the possibility of flexible changes in the range. Industry 4.0 is not only about technology, but also about new ways of working and the role of people in Industry [17–19].

Industry 4.0 is another technological leap, using the potential of connected machines and devices via the Internet [20–23]. Industry 4.0 is the subset of the fourth industrial revolution that concerns the industry. The term “Industry 4.0”, shortened to I4.0 or simply I4, originated in 2011 from a project in the high-tech strategy of the German government, which promotes the computerization of manufacturing [24–27]. The project of changes created in Germany was aimed at preparing the German industry for smart production. The changes are characterized by strong individualization of products in the conditions of very flexible production [28–31]. Customers and business partners are directly involved in business processes and value creation. Production is combined with high quality services. In the future, thanks to intelligent monitoring and decision making processes, companies and entire networks should be able to control and optimize their operations almost in real time [32–34].

In essence, Industry 4.0 is the trend towards automation and data exchange in manufacturing technologies and processes, which include Cyber Physical Systems (CPS), the Internet of Things (IoT), Industrial Internet of Things (IIOT), Cloud Computing, Cognitive Computing, and Artificial Intelligence Recommendations for implementing the strategic initiative Industry 4.0: Final report of

the Industry 4.0. Also known as SMART manufacturing or Manufacturing 4.0, Industry 4.0 is marked by a shift toward a physical-to-digital-to-physical connection [35–39].

There are several basic pillars of Industry 4.0. Individual authors of scientific publications, consultants, advisors, employees of scientific institutes, and consulting companies specify various systems of features describing Industry 4.0 [40–43]. In order to avoid duplication of information already contained in many available publications, the basic pillars of Industry 4.0 have been compiled and presented in Table 1. The compilation was based on searching for information using a web browser (Google) with the password: “Pillars of Industry 4.0”. Also used was a list of keywords for Industry 4.0 prepared by the Hermann team, which at the beginning of 2015 analyzed 51 publications [44]. The results from this study were IoT, smart factory, IoS, smart product, M2M, Big Data, and Cloud Computing. The basic pillars of Industry 4.0 were Smart Solutions, Smart Innovations, Smart Supply Chain, and Smart Factory. Smart Solutions is constituted of Smart Products and Smart Services [45]. A further search of databases resulted in the repeatability of nine pillars of Industry 4.0 proposed by Boston CG (selected scientific publications are listed in Table 1). The basic pillars according to BCG include [46]:

1. Big Data and Big Data Analytics,
2. Augmented Reality,
3. Printing 3D,
4. Cloud Computing,
5. Cyber Security,
6. Autonomous Robots,
7. Simulation,
8. Horizontal/Vertical Software Integration,
9. IoT.

**Table 1.** Pillars of Industry 4.0.

Source	Pillars of I 4.0	Accessed
Pillars identified in scientific works		
G. Erboz	<ul style="list-style-type: none"> <li>• Cyber-Physical Systems</li> <li>• IoT</li> <li>• Cloud Computing</li> <li>• Cognitive Computing</li> </ul>	<a href="https://www.researchgate.net/publication/326557388_How_To_Define_Industry_40_Main_Pillars_Of_Industry_40">https://www.researchgate.net/publication/326557388_How_To_Define_Industry_40_Main_Pillars_Of_Industry_40</a>
D. Burrell	<ul style="list-style-type: none"> <li>• IoT</li> <li>• Big Data</li> <li>• Cloud Computing</li> <li>• Advanced Simulation</li> <li>• Autonomous Systems</li> <li>• Universal Integration</li> <li>• Augmented Reality</li> <li>• Additive Manufacture</li> <li>• Cyber Security</li> </ul>	<a href="https://www.plextek.com/insights/insights-insights/industry-4-0-and-the-9-pillars/">https://www.plextek.com/insights/insights-insights/industry-4-0-and-the-9-pillars/</a>
C. Senn	<ul style="list-style-type: none"> <li>• IoT</li> <li>• Augmented Reality (Safety Training by using AR, Streamlined Logistics, Maintenance by using AR)</li> <li>• Simulation</li> <li>• Additive Manufacture (Design 3D, Prototyping: 3D, Low-Volume Production)</li> <li>• System Integration</li> <li>• Cloud Computing</li> <li>• Autonomous System</li> <li>• Cyber Security</li> <li>• Big Data Analytics</li> </ul>	<a href="https://www.idashboards.com/blog/2019/07/31/the-pillars-of-industry-4-0/">https://www.idashboards.com/blog/2019/07/31/the-pillars-of-industry-4-0/</a>

Table 1. Cont.

H. Fatorachian and H. Kazemi	<ul style="list-style-type: none"> <li>• Industrial Internet</li> <li>• IoT</li> <li>• CPSs</li> <li>• Information Network</li> <li>• Software Systems</li> <li>• Cloud Computing and Big Data Analytics</li> </ul>	Online: Taylor and Francis (11 January 2019)
V. Pilloni	<ul style="list-style-type: none"> <li>• Internet and new industrial technology</li> <li>• Machine-to-Machine Communication</li> <li>• Big Data and Advanced Analytics</li> </ul>	<a href="http://www.mdpi.com/journal/futureinternet">www.mdpi.com/journal/futureinternet</a>
K. Santos et al.	<ul style="list-style-type: none"> <li>• Smart Solutions,</li> <li>• Smart Innovations,</li> <li>• Smart Supply Chain</li> <li>• Smart Factory</li> <li>• Smart Products</li> <li>• Smart Services</li> </ul>	Procedia Manufacturing 11 (2017) 1358–1365
<b>Pillars identified in industrial reports</b>		
BCG	<ul style="list-style-type: none"> <li>• Big data and Big Data Analytics</li> <li>• Augmented reality</li> <li>• Printing 3D</li> <li>• Cloud computing,</li> <li>• Cyber Security</li> <li>• autonomous robots</li> <li>• Simulation</li> <li>• horizontal/vertical software integration</li> <li>• IoT</li> </ul>	<a href="https://napedzamyprzyszlosc.pl/files/Zeszyt_10_PL.PDF">https://napedzamyprzyszlosc.pl/files/Zeszyt_10_PL.PDF</a>
Booth Welsh	<ul style="list-style-type: none"> <li>• IoT</li> <li>• Systems Integration</li> <li>• Simulation</li> <li>• Augmented Reality</li> <li>• Big Data</li> <li>• Additive Manufacture</li> <li>• Autonomous System</li> <li>• Cloud computing</li> <li>• Cyber Security</li> </ul>	<a href="https://boothwelsh.co.uk/defining-pillars-industry-4-0/">https://boothwelsh.co.uk/defining-pillars-industry-4-0/</a>
Deloitte	<ul style="list-style-type: none"> <li>• Industrial Internet</li> <li>• Connected Enterprise</li> <li>• Smart Manufacturing</li> <li>• Smart Factory</li> <li>• Manufacturing 4.0</li> <li>• Internet of Everything</li> <li>• Internet of Things for Manufacturing</li> </ul>	<a href="https://www2.deloitte.com/content/dam/insights/us/articles/manufacturing-ecosystems-exploring-world-connected-enterprises/DUP_2898_Industry4.0ManufacturingEcosystems.pdf">https://www2.deloitte.com/content/dam/insights/us/articles/manufacturing-ecosystems-exploring-world-connected-enterprises/DUP_2898_Industry4.0ManufacturingEcosystems.pdf</a>

The pillars of Industry 4.0 listed in Table 1 interpenetrate each other and enter into logical interactions that will be controlled by artificial intelligence in the long run. The common denominator of the above solutions is “digital”, which is the foundation for the development of Industry 4.0. The Internet itself has acquired two meanings. In a narrow sense, it is about the Internet with social networks and applications on mobile devices. In a broad sense, it is about the role of the Internet in creating new opportunities for producers, employees, and customers [47–51]. There are customers, producers, competitors, and suppliers in the network, and their cooperation creates a global space of possibilities. The changes are all-encompassing across various areas of cooperation and are unlimited in time and space [52–55].

## 2.2. Industry 4.0 from the Perspective of: Customer, Producer and Employee

The Fourth Industrial Revolution refers to the production and demand; that is, of how customers and consumers enjoy the products and how they are involved in their creation. The development of Industry 4.0 technology opens new opportunities for customers who overcome time and space constraints, which may result in a decrease in internal demand in consumption and an increase in external demand. In individual product markets, technological changes take place at different rates and depend on the product life cycle. In sectors such as energy and metallurgy, where the life cycle of devices counts in decades, changes are slower than in the sector of everyday goods and services (clothing, shoes, cars, household appliances, electronics) [56–60].

Companies that are becoming digital (Boeing, General Electric, Adidas) are growing dynamically, deepening the distance of efficiency and earnings between them and companies still existing in the “analogue reality”. In turn, the companies that offered innovative solutions become benchmarks for other companies. Examples include:

- Uber-drivers providing passenger transport services do not belong to the traditional group of taxi drivers,
- Adidas-Salomon with intelligent footwear that has a built-in computer and is created for an individual customer,
- H&M network, based on information collected in the cloud about the tastes and behavior of its customers, designing entire collections for specific customer,
- BMW Individual Manufactory offering its customers a car configuration up to the third power, without any restrictions. The BMW Individual Manufactory is a factory enabling its customers to realize their own car fantasies.

The aspirations and aspirations of enterprises in shaping the field of their market activity in the environment of Industry 4.0 are manifested in the creation of highly personalized products. The results achieved in this field are to be determined by the customer’s involvement at the product manufacturing stage (the shapes and dimensions of typical product components are modified and changed to meet the specific needs of a specific customer), as well as through standardized customization, where the customer is involved at the product distribution or assembly stage [61–65]. This enhances the scope of changes in the functioning of product manufacturers, manifesting itself, among others, in the forms of design, ordering, communication, sale of products, and the way they are delivered. In the era of Industry 4.0, mass customization of products and services is to become more beneficial than mass production. The changes introduced in the production processes are to enable the implementation of activities in the design and manufacture of the product initiated by the customer [48,61–68].

However, the new reality raises many questions of strategic importance for customers, producers, and employees. To respond to new challenges, a bibliometric analysis of publications included in the Web of Science, Google Scholar, and other publicly available sources was performed. The obtained publications were selected by searching their content in terms of customization, social responsibility, sustainable development, problems or concerns of consumers, producers, and employees in view of changes in the perspective of developing the concept of industry 4.0. Industrial reports (consulting companies) PWC [15], ASTOR [69], Deloitte [70], and McKinsey [39] dominate in this category. Creating a list of opportunities and threats, scientific publications were also used: Fatorachian H., Kazemi H. [71]; Kagermann H., et al. [72]; Helo P., Hao Y. [73]; Öberg C., Graham G. [74]; Hu B., Kostamis D. [75], Chen Y. J., Deng M. [76]; Lang M., et al. [77], Shamsuzzoha A., et al. [78]; Bechtold, J., et al. [79]; Li F., et al. [80]; Brecher C., et al. [81]; Zhong R. Y., et al. [82], Brettel M., et al. [36], Brousell D. R., et al. [83], Schmidt R., et al. [84]. Based on reports and publications, the authors created their own list of key questions about Industry 4.0 from the perspective of the customer/consumer, producer, and employees (Table 2). On the other hand, Table 3, on the basis of reports and publications of other authors, lists the opportunities and threats in relation to the examined segments. The three-segment system is our own study.

An example list of questions was developed by the authors of this publication and summarized in Table 2.

**Table 2.** The list of question about Industry 4.0.

<b>Customer</b>	
How to do	How to directly communicate, trade, exchange goods and services without system, communication, logistics or language barriers on a large scale in Industry 4.0?
About cooperation	Do you want to resign from owning the resources only for personal use for paid sharing? What resources are available for personal use only to be used for paid sharing (car, room in the apartment, capital or time)? Do I have the appropriate competences and skills to share resources in accordance with the principles of sharing economy?
About model of life	What mobile devices should equip your work and life environment? How do you balance life and high technology? Will big data and artificial intelligence analytics that examine our consumption, communication, nutrition or health behaviors and habits, and guess our needs, suggest the right solutions for us? How to buy and use products to be responsible towards the world/planet?
About cyber security	How to be secure online without restrictions? Will autonomous devices, e.g., cars, take us safely to where we want to, or will they guarantee us safety and fulfillment of goals/tasks?
<b>Producer</b>	
About customer and demand	What are the new (personalized) customer expectations? What needs of an increasingly demanding customer will develop in the future? How to identify them, how to satisfy them? How will production on demand change consumer behavior? How to reach the customer when he needs it? To what extent will consumer preferences affect the demand for manufactured products? Will automated factories using artificial intelligence anticipate customers' needs well? Which elements of the offer should be personalized and which in the same offer should be customized? To what extent should the company implement personalization and should it be played at individual, segment level or between them?
About flexibility business	Does business, by offering new solutions, provide consumers with the opportunity to personalize products and services? Is the leading party in production the consumer and his behavior discovered through Big Data and data analytics? How does business tolerate digitization? By reducing production line control, will manufacturers provide what customers need at the right time? How to build an effective production system enabling cooperation of millions of consumers creating products and services in the model of direct consumer-to-consumer interaction?
About business model	How should a company from country A "digital company" cooperate with company country B "analogue company"? How do new business models - based on digital platforms and integrating with real business - affect competition?
About market and regulations	How to regulate markets so as not to interrupt development? How to accelerate the transformation of business models? What challenges does digitization pose to regulators in terms of safety and consumer protection against the unfair competition? How ethical is it to use information about you and track your online activity? How to ensure safe and socially beneficial long-term development during a period of radical changes? How to design dynamic pre-emptive regulations that allow you to scale new business models?
<b>Employee</b>	
About employment reduction	Will Industry 4.0 change the employment structure/will low-skilled employees be needed?
About new jobs	Will artificial intelligence completely eliminate a person from the workplace?
About education	What technical competencies are required in cooperation with the new technology?
About work place	Does the existing education system in your country allow you to acquire new qualifications required in Industry 4.0?

Like any change, changes in the pursuit of societies and economies up to level 4.0 favor the emergence of opportunities and threats. Based on the publications: Fatorachian H., Kazemi H [71]; Helo P., Hao Y. [73]; Wamba S. F., et al. [7] and other the industrial reports: BCG [46], PWC [85], ASTOR [69], Deloitte [70], McKinsey [49].

The opportunities and threats were compared in a three-segment system: customer-producer-employee and presented in Table 3.

Tables 2 and 3 summarize the many opportunities, threats, questions, and concerns that are the voice of business representatives and customers. Emerging opportunities, however, are to lead to the creation of modern factories (Smart Factory), in which it is possible to flexibly produce increasingly shorter product series, implemented under a specific personalized customer order in a one-piece-flow arrangement [86–89]; where customers get broad access to the Internet of Things (IoT) and activities related to information processing and creating a virtual version of the product ordered at his request. The recipient of the product can view and check it in the virtual world before making the final purchase, avoiding (or minimizing the risk) the same purchase of the unnecessary product, which becomes a dangerous waste for the environment [90–93].

**Table 3.** Opportunities and threats for customer/consumer–producer–employee in Industry 4.0.

	Opportunities	Threats
<b>Customer</b>	<ul style="list-style-type: none"> <li>- Personalized satisfaction of consumption needs individualization manufacturing processes (generation of high-quality and highly customized products),</li> <li>- Including individual customer-specific criteria in the process of production,</li> <li>- Rapid transferring of customer requirements into production processes,</li> <li>- Individual, customer-specific criteria will be included in the design, configuration, ordering, planning, manufacturing and operation phases, also incorporating last-minute changes, indeed enabling mass customization to be implemented,</li> <li>- A sense of uniqueness from the process of purchasing a co-designed product,</li> <li>- Enabling high level of flexibility,</li> <li>- Higher usability of personalized products (best-suited product) Enabling last-minute changes into the production process,</li> <li>- Enabling last-minute changes into the production process,</li> <li>- The possibility of additional earnings by renting free resources, e.g., cars, designer clothing,</li> <li>- Being a socially responsible consumer.</li> </ul>	<ul style="list-style-type: none"> <li>- Increase in external demand by increasing the competitive advantage of foreign solution providers I 4.0,</li> <li>- Uncontrolled disclosure of preferences by the customer may threaten his anonymity,</li> <li>- Crossing the border between sales persuasion and surveillance,</li> <li>- Customization may make it difficult for the customer to make a purchase decision (because companies compete with each other in the scope of the offer, hence the selection of a specific product may be difficult),</li> <li>- The customer may not see his needs, which will not generate demand,</li> <li>- The need to overcome hardware and language barriers in new communication systems and ordering products,</li> <li>- The customer may feel cornered by receiving continuous information about products as part of marketing one to one.</li> </ul>



Table 3. Cont.

	Opportunities	Threats
<b>Producer</b>	- Creating new products with high added value,	- High costs of new investments and an increase in production costs (at Adidas costs increased by up to 30% compared to standard production),
	- Dynamic and flexible configuration of various elements of business processes,	- Loss of existing outlets (companies do not gain by adaptation of mass customization because it reduces product differentiation in a competitive context),
	- Accurate responding to the needs of consumers due to product design for individual orders and shortening of production series,	- Loss of control over autonomous factories and loss of control over business information in Cyber Space,
	- Creation of agile engineering and manufacturing processes,	- The need to identify products, e.g., in block chain,
	- On time verification of design decisions and quick incorporation of decisions into engineering and production processes,	- The need to search for new cooperation opportunities in cyber networks—entering into new strategic alliances, agreements, and other forms of cooperation,
	- Easy access to real-time information and effective cooperation between different machinery and manufacturing systems	- The increased level of integration and data exchange will lead to an increase in the complexity of business processes,
	- Monitoring operations in real time and improved information sharing and collaboration,	- Difficulties in maintaining a balance between business and life, between high technology and life,
	- Increase in productivity by shortening the production time of products, a decrease in equipment failure rate, limitation of product storage, etc. (improved resource productivity—the lowest amount of resources will be used to produce the highest volume of products, while minimizing emissions),	- Customer expectations are constantly rising (the customer’s own designed product model may not be implemented due to the high level of unreality of its features in relation to the possibilities of producers),
	- Continuous optimization of manufacturing processes and production systems, creating cost effective measurement systems and performance management tools, automation of environmental control tools,	- The need to reduce employs along with full automation and robotization of production lines (additional social costs may appear on companies dismissing employees),
	- Improved responsiveness and decision-making (enabling proactive approach towards problem solving), improved performance and production quality, improved product development,	- A significant increase in remuneration for employees with unique competencies.
	- Improved integration and collaboration,	- A large gap in knowledge of sustainable development models in Industry 4.0.
	- A decrease in labor costs with a significant reduction in employment.	

Table 3. Cont.

	Opportunities	Threats
<b>Employee</b>	<ul style="list-style-type: none"> <li>- Possibility to improve work and life balance through remote work,</li> <li>- The new flexibility will enable more flexible work organization models, which will gradually meet the growing need of employees to strike a better balance between their work and private lives,</li> <li>- New opportunities to train and acquire new skills and new knowledge,</li> <li>- New jobs with high added value focused around automation, IT and human-machine interfaces,</li> <li>- Improvement of work safety (resignation from work in conditions harmful to employees' health, dangerous work will be done by devices/machines/robots),</li> <li>- Overcoming barriers to the physical accessibility of an employee simultaneously in many places through the possibility of providing work at a distance (virtual work).</li> </ul>	<ul style="list-style-type: none"> <li>- Risk of losing a job (especially in the case of performing physical work or not requiring many operations—simple operation of devices),</li> <li>- Risk of inadequate adjustment of employees' qualifications to new jobs due to lack of access to new forms and directions of education,</li> <li>- Temporary employment forms for the duration of projects, intensification of employment in the systems: virtual work, teleworking, etc. Which, in turn, can lead to loosening of the bonds in the employer-employee system, strong polarization of workplaces, manifesting itself in an almost complete elimination of positions requiring a medium level of competence (machine operators, maintenance).</li> </ul>

Some threats, such as consumer safety in cyberspace, are still under investigation [94]. The progress of computer technology and the development of the Internet, as well as the vitalization of life, are conducive to the emergence of many threats related to data loss and privacy. Industry 4.0 is characterized by the ease of obtaining information. Each consumer wants to receive information quickly but also does not want all information about him to be publicly available (without his informed consent) [95]. In the new cyber reality created, technological and spatial barriers in circulation, processing, documenting (archiving) and access to information have been broken. IoT and IoS with a blockchain system is not only access to information, but it is also more than just entering information into everyday life for 24 h [96]. In relation to the market, wide access to information gives customers the opportunity to quickly choose a product, and even participate in its creation (customization); on the other, it creates new opportunities to manipulate the expectations of the customer and other market participants [97].

Industry 4.0 with flexible production systems is expected to change the operating conditions of societies that are better at dealing with cyber technology and are very aware of their needs and expectations. Implemented cyber technological solutions (remote robots) for production change the employment structure [98,99]. Low-skilled occupations disappear on the labor market, and new ones with special skills of cooperation with robots appear, e.g., robot coacher. In the coming years (2–3 years), the group of candidates for whom there is demand mainly includes people with experience in implementing and/or managing systems based on Industry 4.0 pillars [14,24,47,61,85].

### 3. Research Methods

The main goal of the research was to identify opportunities and threats to the wider society in the Industry 4.0—with particular emphasis on customization, which initiates many changes in the functioning of the market (including changes for producers and employees). The three-segment system adopted in the literature part was limited to the consumer segment in the study. To achieve this goal, the literature synthesis and survey methods 'Industry 4.0—perception and expectations' were used. Selected research results carried out by the authors in 2019 are presented.

The study was conducted using the CAWI method (standardized computer-based internet interview). The research tool was a questionnaire consisting of 25 questions (closed, complex, filtering, conditional, and tabular). The survey questionnaire consisted of 3 parts and specifications. The first part contained questions in the field of customization, the second part regarded concerns about the implementation of the concept of Industry 4.0 in Poland, while the third part—the benefits of Industry 4.0. The questionnaire was validated, and a pilot study was conducted among 15 experts with knowledge of Industry 4.0. The questionnaire was corrected for their comments. The respondents were potential customers representing the Silesian, Lower Silesia, Greater Poland, and Lubuskie voivodships, so it can be assumed that it was an infinite population.

Assuming a confidence level of 0.99 and an error of 10%, it was determined that the minimum size of the general population should be 166 customers. Therefore, the information contained in the surveys received can be treated as representative—504 opinions were obtained.

Most customers came from large and medium-sized cities (59%). It is worth noting that the majority of respondents assessed their financial situation as good (64.1%) and sufficient (23.24%). About 13.9% of respondents declared a very good financial (material) situation. Only 1.8% of respondents declared poor financial situation. Selected results of the selection of customer are presented in Table 4.

**Table 4.** Gender, age, place of residence, and subjective assessment of the material situation of the customer.

Age	Sex		Place of Residence				Material Situation			
	W	M	Village	Small Town	Medium City	Big City	Very Good	Good	Not Bad	Bad
below 18	16	34	3	3	26	18	13	26	10	1
19–25	122	118	56	50	66	68	23	164	49	4
26–35	30	34	10	11	22	21	10	37	14	3
36–45	34	30	14	15	21	14	12	43	9	0
46–55	19	28	11	9	14	13	4	33	9	1
56–67	15	16	12	5	5	9	6	18	7	0
over 67	4	4	4	2	1	1	2	2	4	0
/sum	240	264	110	95	155	144	70	323	102	9

The main objective of the survey was to determine the actual needs of customers associated with the products offered on the market, as well as the assessment of the level required by the customer customization. The study looked for answers to the following questions:

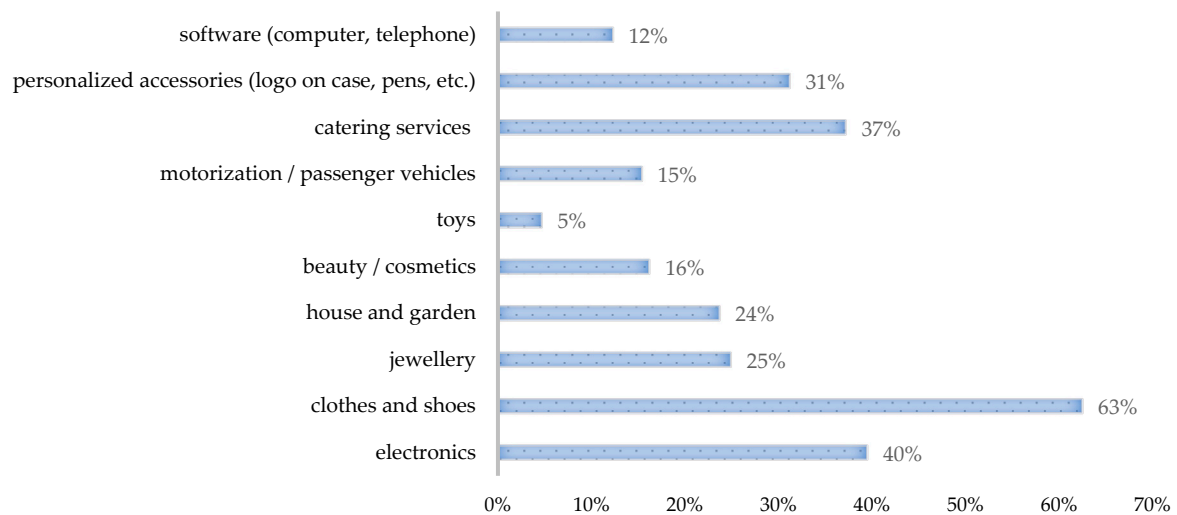
1. What are the expectations and preferences of consumers in the area of personalized production in the context of the development of the Industry 4.0 concept?
2. How do they perceive their commitment to the process of creating personalized products?
3. What threats and benefits respondents identify in the perspective of implementing the concept of Industry 4.0?

The following hypothesis was adopted in the research—customization is a key element in changing the mass production paradigm to individual production, as a result of which there are changes in the relations between consumer-producer-employee.

#### 4. Results of Direct Research

Surveys on a selected group of potential consumers showed expectations of modern customers. Over half of the respondents from the total number of respondents declared interest in personalized products. The largest group of respondents was interested in personalizing clothes and footwear (62.5% of respondents), electronic devices in (39.5%), ordering personalized dishes in restaurants (37.2%), personalized various types of accessories (31.2% of respondents), jewellery (24.9%), and home and

garden equipment including furniture (23.7% of respondents). Detailed data of customer's preferences are presented in Figure 1.



**Figure 1.** Consumer preferences regarding the type of personalized products.

Only 21% of respondents were willing to pay more for personalized products, while 47% of respondents made decisions dependent on the level of price difference between the standard and personalized product and the type of product (Figure 2).



**Figure 2.** Acceptance of a high price level for personalized products.

Studies show a great interest in personalized products created in various customization strategies. Respondents most often indicated the uniqueness of the product as a reason for purchasing personalized products, and emphasized the impact on its final shape/appearance, greater satisfaction, and comfort of use. As many as 55.5% of respondents believed that personalized products are unique (Figure 3).

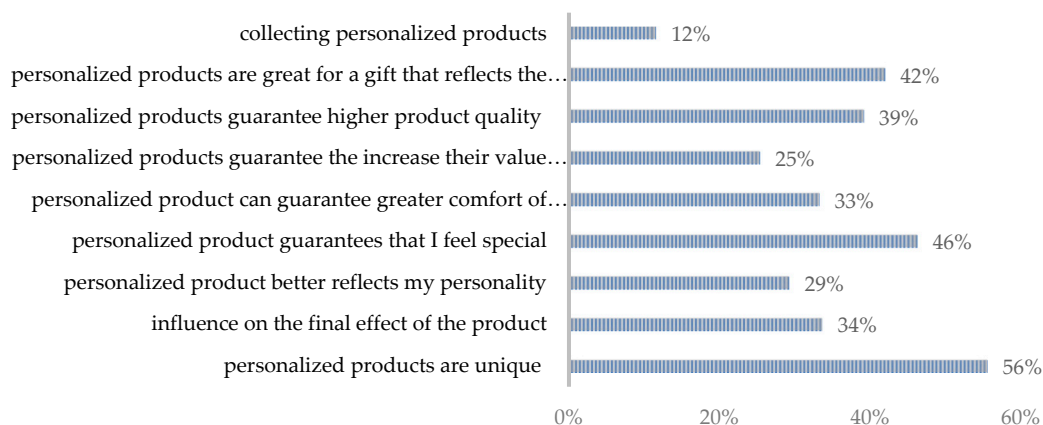


Figure 3. Reasons to buy personalized products.

Direct contact with the manufacturer’s representative (81.8% of respondents) was most often indicated as the preferred channel of contact with the producer, the use of e-commerce channels (89.15% of respondents), and more than 79% of respondents expected specialized design programs for personalized integrated products with the manufacturer’s system. The less preferred channels were questionnaire, telephone, or live broadcast, and various types of messengers (Figure 4).

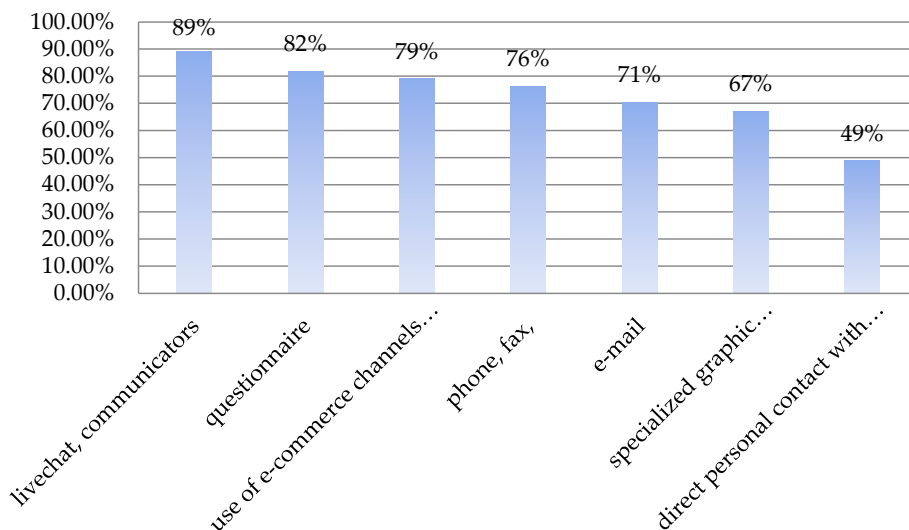
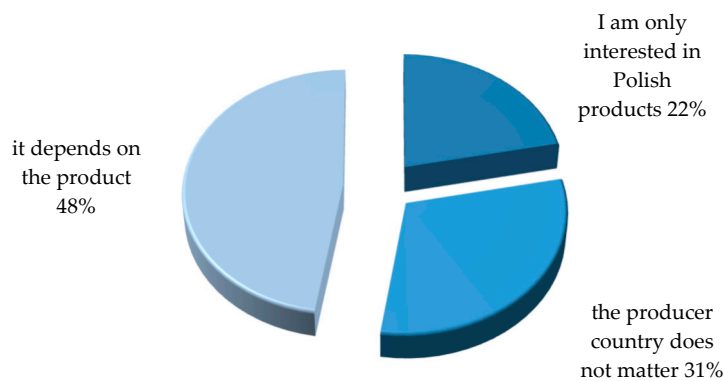


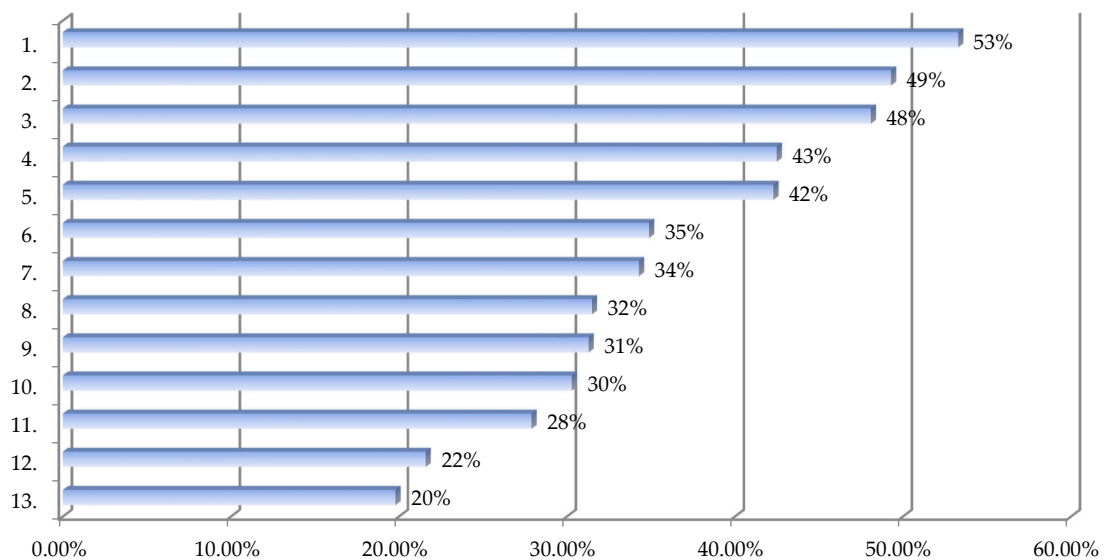
Figure 4. Preferred communication channels producer/seller-customer/consumer.

It is worth noting that as much as 21.8% of people always pay attention to the country in which the product was made, and 47.5% depended on the type of product (Figure 5). These results positively testify to the modern consumer, his social responsibility, and the expectations of social responsibility towards the producer (as an employer, user of natural resources, an entity having an influence on the market, competition, socio-economic environment).



**Figure 5.** Answers to the question: Does it matter to you whether the personalized product will be made in Poland?

As shown in the study, the Fourth Industrial Revolution was also of great concern (Figure 6). Respondents could choose from a list of five answers that they believed best described their subjective concerns. The most frequently indicated (53.3%) risk was related to a decrease in competitiveness, especially of small and medium-sized production enterprises, which could not afford investment in new technologies and fear of changing the employment structure, including higher requirements (required qualifications) in relation to employees employed in industry (59.3%). The risk of technological unemployment emerging was also strongly emphasized, resulting in a decline in consumer demand (48.1%); the possibility of a change in the social structure, especially due to the exclusion of people with low professional qualifications (42.5%); as well as increased interest in foreign products manufactured by companies that will quickly implement the Industry 4.0 concept and offer highly personalized products (42.3%). However, addiction to the purchase of personalized products was perceived as a threat only by 19.8% of respondents.



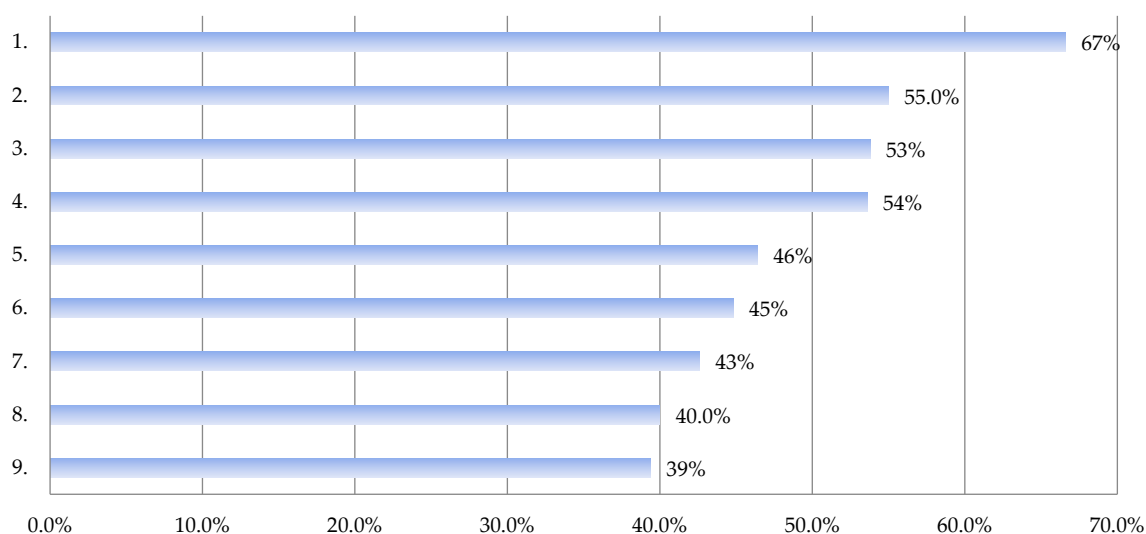
**Figure 6.** Threats related to the implementation of the Industry 4.0 concept.

Legend (Figure 6):

1. The decline in the competitiveness, especially small and medium-sized manufacturing enterprises, which cannot afford to invest in new technologies;
2. Change in the employment structure including higher requirements (required qualifications) in relation to employees employed in industry;

3. Technological unemployment, which will affect the decline in consumer demand;
4. Changes in the social structure, especially due to the exclusion of people with low professional qualifications;
5. Interest in foreign products produced by companies that will implement the Industry 4.0 concept faster and will offer highly personalized products;
6. Problems with returning personalized products to the point of sale (return logistics);
7. Excessive increase in the level of consumption for personalized products and thus the risk of increased demand for energy and environmental pollution;
8. Ecological problems, e.g., the need to withdraw products from the market more often;
9. The decrease in the number of stationary sales points and an increase in electronic sales (e-commerce);
10. Difficulties with the service of personalized products (e.g., lack of availability of spare parts);
11. An increase in the level of stress caused by the desire to have new, personalized products;
12. The danger of theft of “intellectual capital” in the case of own designs of personalized products;
13. Addiction to the purchase of personalized products.

The study also attempted to identify the benefits of Industry 4.0 (Figure 7). The respondents could choose five answers. According to the respondents, the greatest benefit was the increase in the level of adaptation of the product offer to the current needs of the customer (66.6%); reducing the number of intermediaries in the supply chain (55%); increasing the availability of a wide range of products (53.8%); production of highly personalized products at a low purchase price (53.6%); and the possibility of active participation in the design of new products (46.4%).



**Figure 7.** Benefits of implementing the Industry 4.0 concept.

Legend (Figure 7):

1. A higher level of adjustment of the product offer to the current client's needs;
2. Reducing the number of elements of the supply chain;
3. Increasing the availability of a wide range of products;
4. Production of highly personalized products at a low purchase price;
5. The possibility of active involvement in the design of new products;
6. A higher level of on-time delivery of orders (products);
7. Industry 4.0 can solve the problem of the lack of employees with basic qualifications;
8. Increase in the quality of life through the opportunity to purchase personalized products;

9. The possibility of developing new business models based on the products of own design produced by enterprises of Industry 4.0.

## 5. Discussion and Conclusions

Industry 4.0 is a change in the production paradigm from mass production to personalized production—it is a key element of Industry 4.0, which is why so much attention was paid to customization in research. On the other hand, the pillars of Industry 4.0 described in the literature are fundamentals enabling substantive transformation of the production system. The research focused on the consumer, because it generates demand for personalized products, and as a consequence, the manufacturer introduces a number of changes to ensure the gift. Changing the way of working, technology implemented innovative production impact on employees.

The research confirmed the importance of customization for the modern consumer, thus confirming the correctness of the hypothesis. Modern consumers are interested in personalizing products, expecting much more than just the best-quality product at the lowest price. Consumers expect the possibility of personalizing products, and this phenomenon is already clearly visible in many industries, especially in the clothing and footwear, consumer electronics, and automotive industries. Consumers increasingly expect products that will reflect their tastes, needs, adapt to their lifestyle, will be unique, and at the price of a mass-produced product. The supply of personalized products can guarantee benefits for both parties to the consumer–producer transaction. Active customer participation in the design and production of products reduces the risk of producing unsuccessful products and contributes to improving the adaptation of the market offer to the current needs of consumers. A higher level of satisfaction with purchased, personalized products can contribute to an increase in the quality of life, which is emphasized by respondents in their responses. Increased satisfaction with having unique products may directly reduce the overall consumption, which will have a positive impact on sustainable development (e.g., zero waste). Nowadays, excessive consumption can be observed for products that are purchased only because of the desire to have a new model or only to a small extent improving the functionality of the product used so far—which results in problems related to, for example, an excess of generated waste by consumers. The possibility of active customer involvement in product design (full customization) eliminates the problem of the need for frequent product changes and thus reduces excessive consumption, waste of resources, or the need to dispose of discontinued standard products. In addition, the satisfied customer will be more loyal, which in turn can translate into the stability of the manufacturer’s revenues.

Manufacturers should recognize that customers are increasingly assessing them in many ways, noting whether they are a socially responsible company.

Based on the research and literature studies, it can be determined that a modern consumer wants to buy personalized products. This results in threats to companies. Many entrepreneurs will not be able to afford investments in new technologies that are able to cope with the automated production remaining at the price level of mass production. There will also be threats related to technological unemployment and a change in the employment structure and required qualifications, because manufacturing companies most often employ people with basic qualifications. This raises concerns about changes in the social structure caused by the exclusion of people with low qualifications when the concept of Industry 4.0 is introduced. This means the emergence of a series of problems of a social and economic nature resulting from technological unemployment.

Also noteworthy is the danger of consumers becoming addicted to personalized production, which is manifested in an increase in stress levels caused by the desire to have unique products (especially observed among young people).

Summing up the social expectations and market changes in the era of Industry 4.0, it should be noted that it is difficult to predict now how the concept of Industry 4.0 will evolve and the industrial revolution that is under way. With the development of Industry 4.0, new opportunities and threats to enterprises appear, as well as social opportunities and threats. Building a new industry is not easy



because it requires building new resources of enterprises. Formulating and adapting to changes is a long-term activity that requires a lot of material and financial expenses. This increases the need for future research into the problems of developing new business models, especially focused on network forms of cooperation between customer-oriented enterprises operating in the era of the Industry 4.0 concept.

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