SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2022
ORGANIZATION AND MANAGEMENT SERIES NO. 165

HUMANISTIC AND SOCIAL DIMENSIONS OF COBOTIZATION IN THE CONTEXT OF IMPLEMENTATION INDUSTRY 5.0

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Purpose: The aim of the article is to describe the humanistic and social dimension of the cobotization process in the context of the implementation of Industry 5.0.
Design/methodology/approach: Over the past few years, researchers have focused on analyzing the phenomena associated with Industry 4.0, which has made it possible, among other things, to assess the negative consequences of the proposed approach, and as a result, the necessity to take corrective action has been recognized. This new way of understanding production processes has been called as Industry 5.0. The key threads of this approach include the use of advanced digital technologies in the production process but with a simultaneous focus on human. This is connected with massive use of human-machine cooperation, so called cobotization. The success of this plan requires an in-depth analysis of the human perspective, as the implementation of these solutions depends on it. In the present discussion, it is proposed to take into account the humanistic and social dimensions conditioning the possibility of effective use of cobots in the context of achieving the objectives of Industry 5.0. Conceptual analysis has been used, as it seems to be the most appropriate at this stage of research.
Findings: As a result of the conducted analyzes, key dimensions have been identified from a human perspective, which may contribute to the successful implementation of Industry 5.0. Within the humanistic dimension, attention has been paid to the importance of the very way in which man treats technology/machines (philosophical dimension) with particular emphasis on instrumentalism, substantivism and post-phenomenalism. The forms of human-machine interaction generating different types of interaction (psychological and sociological dimensions) were also pointed out and the relationships that are crucial for human-machine cooperation, conditioning the productive effectiveness of this collaboration, were finally examined.
Social implications: The article has a conceptual function; according to the applied research method it allows developing the concept of Industry 5.0, paying attention to what aspects will have to be considered in its implementation, taking into account the human-centered perspective.
Originality/value: This article is addressed to all stakeholders involved in the implementation of the concept of Industry 5.0. Key in these considerations was to draw attention to the "human" dimensions of cobotization processes, affecting the effective use of human-machine collaboration in manufacturing processes. The author's contribution to the issues at hand should be considered an attempt to use existing research in philosophy of technology, psychology and sociology to develop a holistic view of the dimensions that can influence the building of different types of relationships with robots, including artificial intelligence, from coexistence

and collaboration to cooperation. Overlooking dimensions related to the human perspective in these relationships may result in ineffectiveness of the technical innovations themselves.

Keywords: Industry 5.0, cobot, cobotization, human-machine interactions, human-robot collaboration.

Category of the paper: conceptual work.

1. Introduction

ESIR, means expert group on the economic and societal impact of research and innovation, published a policy brief earlier 2022 year in which they state: “over the past decade, Europe has gradually stepped up its commitment to industrial transformation mostly by working on the transition towards so-called industry 4.0, a paradigm that is essentially technological, centred around the emergence of cyber-physical objects, and offering a promise of enhanced efficiency through digital connectivity and artificial intelligence. However, the Industry 4.0 paradigm, as currently conceived, is not fit for purpose in a context of climate crisis and planetary emergency, nor does it address deep social tensions. On the contrary, it is structurally aligned with the optimisation of business models and economic thinking that are the root causes of the threats we now face. The current digital economy is a winner-takes-all model that creates technological monopolies and giant wealth inequalities. Industry 4.0 lacks key design and performance dimensions that will be indispensable to make systemic transformation possible and to ensure the necessary decoupling of resource and material use from negative environmental, climate and social impacts” (Dixson-Decleve et al., 2022, p. 5). One of the negative aspects of the impact of Industry 4.0 in their opinion we can consider “an inherently social dimension, demanding attention to the wellbeing of workers, the need for social inclusion, and the adoption of technologies that do not substitute, but rather complement human capabilities whenever possible” (Dixson-Decleve et al., 2022, p. 5). After more than a decade of the IT development strategy presented by the German government at the Hanover Fair in 2011, referred to as Industry 4.0, we know that it requires a number of adaptive adjustments. The main assumptions of this strategy concern the possibility of implementing digital technologies in production processes and the emergence of so-called *smart factories* (Schwab, 2016, p. 12; Morrar et al., 2017, p. 17; Piccarozzi el al., 2018; Marr, 2018, p. 2). These transformations have been identified with the fourth industrial revolution or the second machine age, in which computers and other solutions provide strong support for production processes (Brynjolfsson, Mcafee, 2014). The primary issues focusing attention around Industry 4.0, most often concerned proposed models for *smart factories* to maximize their efficiency and thus profit (Kagerman, 2013; Bunse et al., 2014; MacDougall, 2014; Wang, Wang, 2016, Schwab, 2016, Morrar, 2017; Piccarozzi et al., 2018; Stock, Seliger, 2019; Pollak, 2020a;

Gajdzik, Wolniak, 2021), then the social consequences of automation were highlighted (Manyika et al., 2011, 2013, 2017; Brynjolfsson, Mcafee, 2014; Schwab, 2016; Harari, 2018; Osika, 2019, 2020, 2021). However, only now, after a number of experiences, we are beginning to see that full automation of production processes raises a number of practical difficulties and is becoming a source of social instability around the world (Harari, 2018; Osika, 2021, 2022). Therefore, it currently seems that the most promising model in terms of production efficiency, but considered in a broader social context, will be the cobotization model, i.e. close cooperation between humans and cyber-physical systems (Przegalińska, Oksanowicz, 2020). Cobotization as a nonexclusive approach to production processes with the current technological advancement has a chance to counteract the flaws of the existing economic system indicated by Philip Kotler, which include the creation of large groups of unemployed and underemployed and the lack of social values in the market equation (2015). Such hopes are placed in the industrial strategy referred to as Industry 5.0. This strategy assumes the release of industrial potential combined with sustainable, regenerative and circular economic behavior, rather than a short-term model of overproduction and consumption determined by the current growth paradigm (Dixson-Decleve et al., 2022). Therefore, Industry 5.0 is, by definition, meant to be human-centric (Demir et al., 2019), "by bringing human workers back to the factory floor, the fifth industrial revolution will bring people and machines together to further harness human brain power and creativity to make processes more efficient by combining workflows with intelligent systems [...]. Industry 5.0 is to be a synergy between humans and autonomous machines" (Nahavandi 2019, p. 3). However, in order for this cooperation to bring about the expected results, we must try to predict the key dimensions that affect its effectiveness, including those that directly impact the individual themselves, i.e., how can people find their way in this unprecedented form of collaboration? There is a central research question. It is assumed that the answer to it can indicate the conditions for the realization of the concept of Industry 5.0. This paper proposes to analyze two dimensions, humanistic and social, assuming that both are key in building human-machine relationships.

2. Methods

Conceptual analysis will be used to describe the dimensions related to cobotization in terms of Industry 5.0 implementation. As one of the oldest scientific methods (Furner, 2004; Gilson, Goldberg, 2015; Stuart, 2015; Dickson et al., 2018), it allows, on the basis of existing knowledge, to "develop a theory" - that is, using deductive reasoning that requires making initial assumptions, we can formulate conclusions that provide a novel perspective on the problem. Inference carried out in this way allows us to already pose specific research hypotheses in empirical studies. Because conceptual analysis can be used to combine theories, adopt theories to new solutions, categorize and establish logical relationships between phenomena, and build theoretical models (Jakkolla, 2020), it seems to be an adequate research method given the theoretical advancements of research in the problem area described. According to the stages of conceptual analysis, it is assumed that the following steps must be taken:

1. Defining the basic concepts, describing the initial theoretical assumptions – for this research – terms such as Industry 5.0, cobot, cobotization will be defined.
2. Establishing relationships – for this research – What dimensions of cobotization processes are crucial from a human perspective?
3. Conclusions – from this research – What humanistic and social dimensions of cobotization should be considered in the context of implementing Industry 5.0?

The questions formulated above are the details of the research proposals. The research will make use of conceptual analysis because, as it seems, at this stage of work it is necessary to theoretically develop knowledge that is already well established empirically, which in turn will create assumptions that can be subjected to further empirical verification.

3. Results

3.1. Theoretical framework

3.1.1. Industry 5.0 – definition

According to the assumptions, Industry 4.0 was intended to be the realization of the concept of a smart factory in which the production organization would be based on cyber-designed systems that enable the control of physical processes (Kagerman et al., 2013; Bunse et al., 2014; MacDougall, 2014; Schwab, 2016; Morrar et al., 2017; Piccarozzi et al., 2018; Miśkiewicz, Wolniak, 2020). The entire production process was to be based on automated operations, allowing to minimize to a large extent the participation of humans. Automation was supposed to ensure the reduction of production time and costs (Yin, Kaynak, 2015; Gandomi, Haider, 2015; Alcacer, Cruz-Machado, 2019; Gajdzik, Wolniak, 2021). Therefore, the idea of Industry 4.0 emphasizes the optimal use of existing digital solutions such as: the Internet of People (social and business networks); the Internet of Things (intelligent mobility and sensor data); the Internet of Services (intelligent networks and logistics), all kinds of robot that enable automation of production processes, as well as autonomous manufacturing and processing systems on production lines with full process control and 3D printing that enables the so-called additive manufacturing. An important complement to the cyber-physical system under construction are cloud computing; analytical and computational systems, so-called Big Data (BD) (Mayer-Schönberger, Cukier, 2013; Yin, Kaynak, 2015; Wang, Wang, 2016; Lee, Kao, 2014; Manyika, et al., 2011; Henke, 2016; Alcacer, Cruz-Machado, 2019), and artificial intelligence and deep machine learning (Kleppman, 2017). However, Industry 5.0, goes a step further, technological innovation and the resource and cost optimization behind it are meant to serve specific social goals, such as increasing the quality of life, developing production while respecting the limits of our planet, and in this sense technology becomes a tool for sustainable development. Thus, we can say that Industry 5.0 complements the existing Industry 4.0 paradigm, directing it towards the realization of values precious from the social point of view (Breque, 2021; Demir et al., 2019; Nahavandi, 2019; Xu et al., 2021). Below, Table 1, we capture the main differences between Industry 4.0 and Industry 5.0.

Table 1.
Difference between Industry 4.0 and Industry 5.0

Industry 4.0	Industry 5.0
• Centered around enhanced efficiency through digital connectivity and AI. • Technology – centred around the emergence of cyber-physical objectives. • Aligned with the optimization of business models within existing capital market dynamics and economic models – i.e., ultimately directed at minimization of costs and maximization of profit for shareholders. • No focus on design and performance dimensions is essential for systematic transformation and decoupling of recourse and materials use for negative environmental, climate, and social impact.	• Ensures a framework for industry that combines competitiveness and sustainability, allowing the industry to realize its potential as one of the pillars of transformation. • Emphasizes the impact of alternative models of (technology) governance for sustainability and resilience. • Empowers workers through the use of digital devices, endorsing a human-centric approach to technology. • Builds transition pathways towards environmentally sustainable use of technology. • Expands the remit of the corporation's responsibility to their whole value chains. • Introduce indicators that show, for each industrial ecosystem, the progress achieved on the path to well-being, resilience, and overall sustainability.

Source: Dixson-Decleve S. et al. (2022). Industry 5.0: A transformative Vision for Europe. Governing Systemic Transformations towards a Sustainable Industry, Luxembourg: Publications Office of the European Union, p. 6.

The emergence of the Industry 5.0 concept is the result of an overlap of several factors: the experience of implementing Industry 4.0 (Krauss, 2015; Christian, Griffiths, 2016; O'Neil, 2016; Zysman, Kenney, 2018; Osika, 2019, 2020, 2021, 2022), the difficulties arising from the Covid-19 pandemic, and future environmental challenges, have highlighted the need to rethink existing ways of farming to be able to make them more resilient to change, more sustainable, and more human-centered. Therefore, human-centricity, sustainability, and resilience are considered the core values of this concept (Xu et al., 2021). “The human-centric approach puts core human needs and interests at the heart of the production process, shifting from technology-driven progress to a thoroughly human-centric and society-centric approach. As a result, industry workers will develop new roles as a shift of value from considering workers as ‘cost’ to ‘investment’” (Xu et al., 2021). Sustainability refers to the development of production processes that allow the long-term use of products and the recycling of natural resources to reduce waste and environmental impact, ultimately leading to a circular economy with greater efficiency and resource productivity (Breque, 2021; Huang, 2021; Xu et al., 2021; Lu et al., 2021). Resilience is about building the capacity for industrial flexibility to hedge against increasingly frequent geopolitical or climatic disruptions that generate social instability (Xu et al., 2021; Breque, 2021).

From the perspective of this discussion, the human-centered focus of Industry 5.0 and the resulting relationships in human-machine interaction, that is, the cooperation of "humans working alongside robots and IoT devices in the automated industrial environments of the future" (Berg 2022), is crucial. And while the process of automating manufacturing processes itself seems irreversible, how human-machine relationships will evolve requires in-depth analysis.

3.1.2. Cobots and Cobotization: Definition

As indicated earlier, the concept of Industry 5.0 assumes a "social-centric" approach, puts human needs at the center of the production process, and proposes the adaptation of industrial technology to humans, the creation of a safe working environment in which human health and well-being is a priority (Berg, 2022), and automation processes are oriented towards the cooperation of humans and machines. The idea is to achieve high production goals while humanizing the work environment (Przegalińśka, Oksanowicz, 2020), using the synergistic action of humans and collaborating machines, what are referred to as co-bots (from *collaboration* and *robots*). 'Collaborative robots (cobots) have emerged as a technological solution for enhanced manipulation of objects while allowing safe interaction with a human counterpart' (Parra et al., 2020). Cobots are defined as robots developed with intuitive interfaces that support human operators in performing mainly physical manufacturing tasks such as handling hazardous materials or performing repetitive tasks with high reliability (Segura et al., 2021; Parra et al., 2020). The realization of the concept of Industry 5.0 is associated with the widespread use of such solutions, i.e. with the cobotization (Przegalińska et al., 2019) of production processes. According to what was said earlier, we can call the cobotization of industry the mass implementation of such a production model, in which the use of technological solutions typical of Industry 4.0 is complemented, or rather enriched by the "human factor", i.e. the manufacturing process is largely based on the interaction of people and machines. We can distinguish several forms of such interaction, co-existence, cooperation, and collaboration (Wierzbowski, 2019; Lu et al., 2022; Simões et al., 2022). “In the case of co-existence, the work areas of the human and the machine are completely separated. Moreover, the machine carries put, a completely different phase of the production processes, so the goals of human’s and machine’s activities are also different. Cooperation […] is a situation where the work areas of the machine and overlap. Thus, each of them performs certain activities, the combination of which is supposed to achieve a common goal. The most integrated form of cooperation is the situation […] where the total integration of activity stands not only a common goal or area of activity, but also jointly performed activities which are complementary” (Wierzbowski, 2019, p. 179). Each of the mentioned forms of cooperation puts completely different requirements on people, but also on machines, or rather the way they should be designed, because according to the Industry 5.0 assumption, the production process is human-centered. Therefore, the issues related to mutual cooperation should be analyzed, but from the human point of view, this issue will be devoted to the next section.

3.2. Humanistic and Social Dimension of Cobotization

The processes involved in cobotization are unprecedented in the history of mankind; never before have we considered a situation in which it is possible to speak about collaboration with man-made tools. It was only the second machine revolution (Brynjolfsson, Mcafee 2014; Le, Kai-Fu, 2019) concerning instruments that extend human intellectual potential that changed the type of these relationships from *using* to *interacting* with them. If we want to build these relationships according to the assumptions adopted in the Industry 5.0 concept, we must understand the dimensions of influence that are important from a human point of view. The key ones in this respect seem to be, firstly, those that determine how we perceive these tools as "beings", i.e. the philosophical dimension, which influences the type of attitude we adopt towards these tools. Second, what dimensions of our psyche do we engage in our relations with these tools, and third, how are we inclined to include them in the scope of human interactions; thus we are talking about the social dimension. We can therefore speak of two basic dimensions: the humanistic, which includes the philosophical level, and the social, which encompasses the psychological and sociological aspects of the relationship between man and machine. Figure 1 shows these relationships.

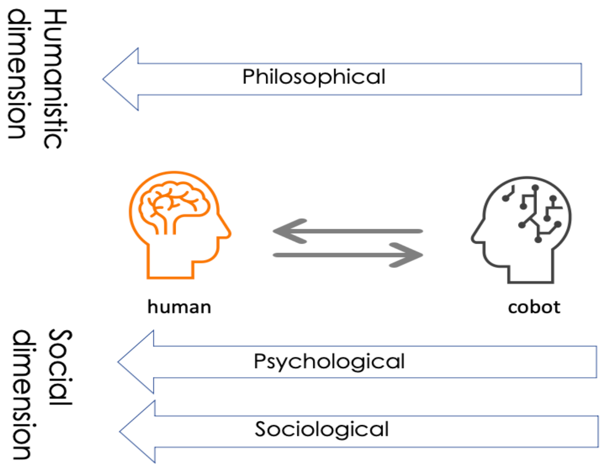

Figure 1. Dimension of Cobotization.

Source: Own elaboration.

3.3. Humanistic and Social Dimensions of Cobotization and Implementation of Industry 5.0

To be able to analyze each dimension in more detail, it must first be defined, and the necessity of including it in the analysis must be justified. Second, the area of a given dimension that will be described should be specified. These tasks should be treated as an attempt to organize knowledge, which is the result of conceptual work (philosophy) and empirical research (psychology and sociology). In the case of the first dimension, the philosophical one, it is important to define what technology is for people, because this elementary, often unconscious assumption determines our entire attitude towards machines. It seems that this dimension is crucial from the point of view of building relations; understanding the nature of relations requires becoming aware of "with whom" this relation is built. The types of approach to technology that are well established in the philosophy of technology, such as instrumentalism, substantivism, and post-phenomenalism (Borgmann, 1984; Freenberg, 2002, 2005; Barney, 2008; Osika, 2017; Vallor, 2022), will be used to describe this dimension. Instrumentalism manifests itself in the superior position of the user over the 'tool', in this approach, we treat machines/technology as being under human control (*humanly controlled*), devoid of autonomy, machines are neutral tools, 'without content', the results of their use depend entirely on the way they are intentionally assigned by man ((Borgmann, 1984; Freenberg, 2002, 2005; Barney, 2008; Osika, 2017). Substantivism takes the opposite stance to instrumentalism; machines/technology are not under man's control but are autonomous in relation to him, for in their mode of construction is "sewn" the way in which human behavior will be shaped and man must adapt to it (Borgmann, 1984; Freenberg, 2002, 2005; Barney, 2008; Osika, 2017). Post-phenomenalism, on the other hand, balances both positions, since it assumes mediation of relations; it is true that each tool influences a particular form of use of that tool, but ultimately it is the man who determines during his work how he will use a given tool, hence the category of mediation (Przegalińska, 2016; Vallor, 2022). The philosophical dimension is important in that the "worldview" about the nature of the relationship between humans and machines also affects the other dimensions, so it is crucial.

From the empirical studies conducted, the need for safety (Złotowski, 2017; Kindal et al., 2018; Janssen et al., 2019; Demir, 2019; Kożusznik, 2020; Berg, 2022; Hjorth, Chrysostomou, 2022) and the directly related degree of stress experienced (Pollak et al., 2020b) and the sense of autonomy (Kożusznik, 2020; Paliga, Pollak, 2021), concerning both the human and the robot, proved to be the most significant in the psychological dimension. Therefore, psychological aspects relate to what is most fundamental in the interaction in terms of how the relationship is experienced, that is, whether they feel unsafe and how their ability to influence each other is assessed. In the case of the sociological dimension, it turned out to be important to what extent working with the cobot gives a sense of teamwork (Kożusznik, 2020; Lu et al., 2021) and the related sense of "social" trust and empowerment, i.e. how individuals evaluated their participation in creating the situation in which they worked (Janssen et al., 2019; Kożusznik, 2020); Przegalińska, Jemielniak, 2020; Przegalińska, Oksanowicz, 2020; Kożusznik, 2020; Paliga, Pollak, 2021). As can be seen, the psychological dimension and the sociological dimension are strongly interrelated because how individuals "experience" a situation determines what kind of social relationships they generate. Table 2 juxtaposes these dimensions with the various forms of co-working mentioned above (coexistence, cooperation, collaboration). This allowed us to trace the existing relationships and develop an opinion on how different aspects must be taken into account when building a work environment in accordance with the assumptions of Industry 5.0.

Table 2.
Humanistic and Social Dimensions of Cobotization – Type of Interactions

		Humanistic dimension	Social Dimension	
		Philosophical	**Psychological**	**Sociological**
Type of interaction	**Coexistence**	This type of interaction fosters an **instrumentalist** approach to co-work, it is even difficult to speak of a real interaction, and therefore there may be a contextless perception of work by humans, i.e. that a machine is also involved in the whole performance of work, this may generate various forms of instability.	This type of interaction provides a high sense of **safety**, also carries a low **stress** load, and there is low awareness of dependency and therefore low restrictions on a**utonomy** - for a person, this is a relatively favorable relational situation. On the other hand, it has the disadvantage of being too strong in separation for a co-working situation. This can result in an unwillingness to familiarize oneself with the way the machine works.	This type of interaction does not synthesize into **teamwork** behavior; the category of trust is not social, it is rather **trust** in the reliability of the tool. The sense of **agency** is recognized according to the functionality of the machine, and it is the human being who decides whether this functionality is useful for doing the work.
	Cooperation	This type of interaction fosters a **substantivist** approach to co-work, since the interaction is almost physical, related to working in the same physical space, in this case, the difficulties may be related to a too deterministic perception of this relationship, resulting in the triggering of a "technological proof of equity" (Osika 2021).	This type of interaction provides a relatively low sense of **safety** and is therefore more **stressful** for the individual, there is also a reduced sense of **autonomy** due to the existence of physical and task dependencies.	This type of interaction triggers a **quasi-teamwork**, co-working is the effect of complementing each other's potential for action, i.e., on the part of the human, the competence and skills, on the part of the cobot available functionality, **trust** is the result of a sense of reliability of the tool, in relation to the **agency**, it will depend on the specificity of the task and the proportion of actions taken by the human and the cobot.

Cont. table 2.

	Collaboration	This type of interaction is conducive to a post-phenomenalist approach to co-work, it seems to be the most constructive and effective creates the potential for mutual shaping until full synergy is achieved; however, it requires from a human an attitude of openness to this type of interaction (education is important), but also from a machine the ability to personalize its functionality for the specific person with whom it works; therefore, a relatively flexible interface is necessary.	In this type of interaction, both feelings of safety and stress levels can take on different values, and the key in this regard will be a sense of autonomy. Contrary to initial intuitions, research shows that humans view a high level of cobot autonomy positively and if there is an interface possibility, they themselves are willing to increase it (Kożusznik 2020). However, there is also research indicating a sense of danger from the increased autonomy of cobots (Złotowski 2017; Pollak et al., 2020b). There is no problem with including machines in the joint execution of work if the collaborative situation can be flexibly shaped by humans.	This type of interaction allows, to the greatest extent, to treat machines as part of a team and to consider the man-machine system as a working team. The level of trust is the result of two factors, the awareness of reliability of the tool, but also the adaptive potential of the interface, which gives the possibility of flexible human binding to the task performed. Similarly, the synergy in the work of human and cobot is possible thanks to the autonomous decision of human, which range of agency wants to cede to cobot, of course within its functionality.

Source: Own elaboration.

The analysis allows us to draw several conclusions regarding the conditions that must be met by the cobotization process to think about the implementation of the Industry 5.0 concept, i.e. human-centered industry. First, a general social re-evaluation of the way we interpret technology, including machines, is important. It seems that in this respect the post-phenomenological approach (Przegalińska, 2016; Vallor, 2022) is the most promising because of its open and very flexible attitude towards technology, allowing us to put the human being at the center and at the same time taking into account the influence we are subject to when using any technical invention. This condition applies to the education of the whole society, but mainly to designers, who should take this aspect into account in their work. Second, cobots should not be treated as simple tools only with a view to their usefulness, but also consider their impact in psychological and sociological dimensions; in this regard, it is necessary to educate the workers who work with the machines and the people who make decisions about this collaboration.

4. Discussion

Since the beginning of the 21st century, there have been extensive discussions on the use of advanced digital solutions in manufacturing processes. It is assumed that one of the first strategies was developed by the German government's Foresight presented in 2011 at the

Hannover Fair, called "Industry 4.0". The main idea of this strategy included an attempt to combine the latest digital technologies with real production, thus creating a kind of *smart factory* (Kagerman, 2013; Bunse et al., 2014; MacDougall, 2014; Wang, Wang, 2016, Schwab, 2016, Morrar, 2017; Piccarozzi et al., 2018; Stock, Seliger, 2019; Pollak, 2020a; Gajdzik, Wolniak, 2021; Morrar et al., 2017; Piccarozzi, Aquilani, Gatti, 2018). The main goal of this concept was to minimize the participation of people in production processes, allowing to reduce manufacturing time and cost. The systematic introduction of the assemblages of Industry 4.0 made it possible to reveal the social and environmental consequences of these transformations (Manyika et al., 2011, 2013, 2017; Brynjolfsson, Mcafee, 2014; Schwab, 2016; Harari, 2018; Osika, 2019, 2020, 2021). An additional factor that modified the assumed plans was the COVID 19 pandemic and the predicted climate crisis, which decided on the need to formulate a new strategy called Industry 5.0 (Dixson-Decleve et al., 2022; Breque et al., 2021; Berg, 2022; Huang, 2021; Xu et al., 2021; Lu et al., 2021; Nahavandi, 2019; Hjorth, Chrysostomou, 2022). The key to this strategy is human-centered, sustainability and resilience, but with the use of advanced technology. It is not so much the minimization of employment that is assumed, but its new form, the so-called cobotization, that is, using the cooperation of man and machine (Wierzbowski, 2019; Przegalińska et al., 2019; Przegalińśka, Oksanowicz 2020; Przegalińska, Jemielniak, 2020; Segura et al., 2021; Parra et al., 2020; Hjorth, Chrysostomou, 2022). Implementing this new vision requires studying many aspects of this cooperation. This article proposes to analyze the humanistic and social dimensions of the cobotization process (Złotowski, 2017; Kindal et al., 2018; Janssen et al., 2019; Demir, 2019; Kożusznik, 2020; Berg, 2022; Pollak et al., 2020b; Paliga, Pollak, 2021). Attention was drawn to the different types of this cooperation (Wierzbowski, 2019; Lu et al., 2022; Simões et al., 2022) and the parameters that should be taken into account in the implementation of Industry 5.0. Due to the conceptual nature of the research conducted, it seems necessary to subject the formulated assumptions to empirical verification, and this should be the focus of further research. This will allow a variety of factors to be considered when implementing Industry 5.0 to ensure proper adoption.

Conclusion

As indicated in the Introduction, the strategy referred to as Industry 4.0 is currently undergoing necessary modifications, taking the form of the concept of Industry 5.0. It takes into account the necessary corrective actions which make it possible to eliminate the negative social effects of the changes on the labour market that were caused by Industry 4.0. The key features of the new approach are: focusing on human in production processes, combined with maintaining production efficiency thanks to the use of advanced technologies; production sustainability and its resilience. The realization of these assumptions is connected with cobotization processes, i.e. basing production on close cooperation between people and machines. The full utilization of the effectiveness of such a strategy of action requires the consideration of many factors, in the present considerations a view from a humanistic and social point of view is proposed. Conceptual analysis was applied in the research. The following research steps were performed:

- Basic concepts were defined and described, such as: the concept of Industry 5.0, “cobot”, “cobotization” - this allowed to understand the changes taking place.
- Key dimensions of cobotization processes were identified from the human point of view, including philosophical, psychological, and sociological dimensions, which allowed us to concretize the areas of further research (Scheme1). This area of research work is the author's contribution to the issues at hand; on the one hand, it provides an understanding of what cobots can be to humans and, consequently, how humans are inclined to treat them. But also what specific aspects of interaction can influence the building of relationships with non-human agents of interaction.
- In the final part, the relationships that occur between various forms of human and machine cooperation and the philosophical, psychological, and sociological dimensions were established in tabular form (Table 2). This section develops the author's proposal for understanding how particular philosophical approaches can affect relationship building psychologically and sociologically. This section is crucial from the point of view of the assumptions entered in the introduction.

As a result of the analytical work, findings have been obtained on the possible ways of interpreting technology/machines affecting the type of cooperation, in the psychological dimension, attention has been paid to the sense of security, stress level, and sense of autonomy as the most crucial. Regarding the sociological dimension, the tendency to treat cobots as team members, trust, and agency. The developed areas can be considered as a valuable indication for further empirical research, allowing to determine the conditions for the implementation of Industry 5.0 taking into account human-centered assumptions.

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