Chapter 6
Organisational Culture in the Industry 4.0 Era: Introduction to Research

Katarzyna Szymańska

Abstract The aim of the paper was to identify the main directions of changes in the organisational culture of enterprises associated with the process of adaptation to functioning in the face of challenges of the Industry 4.0 concept. Thus, formulated goal was accomplished by presenting the main assumptions of the development of the Industry 4.0 era, indicating the Industry 4.0 era desired directions of changes in the organisational culture based on the results and conclusions from the empirical research conducted in 2018. In order to carry out the research, quantitative methods were used, and the research tool was an original questionnaire. As evidenced, the profile of the organisational culture of the studied group of enterprises in reference to the Industry 4.0 era requires profound changes associated with more comprehensive modelling that would strictly correspond to the requirements of the described concept.

Keywords Organisational culture · Industry4.0 era · Cultural profile in the IR 4.0 era

6.1 Introduction

A dynamically changing environment as well as progressing globalisation has resulted in the creation of the Fourth Industrial Revolution (Industry 4.0, Fourth Revolution, Internet of Things or SMART, Industry Revolution 4.0 (IR 4.0)).[1] Industry 4.0 is understood as a common term, combining engineering, information technology, and management knowledge. In addition, it assumes the existence of smart systems that are networked, i.e. they are connected with other processes occurring inside the enterprise which in turn are associated with value-creating networks. Two realities intersect in the new environment in which enterprises operate: physical reality (PR) and virtual reality (VR) [2]. This process encompasses the development

[1] In the paper, the terms Industry 4.0, IR 4.0, etc., will be used interchangeably.

K. Szymańska (✉)
Department of Management, Lodz University of Technology, Lodz, Poland
e-mail: katarzyna.szymanska@p.lodz.pl

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of various types of inter-organisational cooperation networks (network cooperation, virtual network), new technologies based on, among others, computerisation, digitalisation, and robotics(cyber-physical systems—CPS),dynamic processing of large amounts of data in real time(big data Analytics—BDA), Internet connections (Internet of things—IoT; Internet of services—IoS), close, partnering interpersonal relations (cooperation, partnering, team working), inter-organisational relations (strategic partnering—SP, knowledge partnering—KP; coopetition), and inter-machine relations (machine to machine communications—M2M; artificial intelligence; neural networks) [1]. Under such conditions, management becomes a challenge for managers who are used to a hard analytical approach focused on hard competition and not on extensive cooperation. In this context, management must rely on a specific model that will be used by managers in this process. The assumptions of Industry 4.0 are currently quite often a subject of research, but the technological approach is usually taken into account. There is a lack of research conducted in relation to the other so-called soft elements important in the management process determining the success of Industry 4.0 [6, 15, 17], i.e. organisational culture, which prompts to conducting research in this area [16].

To ensure success in the new work environment created by the Industry 4.0 era, an organisational culture that must be characterised by openness to various fields of activity becomes crucial. A new type of culture requires a new, open system of values, standards, thinking patterns, and actions that will be perpetuated in the social environment of the organisation, contributing to the achievement of its goals. The organisational culture in the era of Industry 4.0 is primarily open to the environment, supports extensive cooperation with it, provides freedom of relations, uses not only the potential of employees but also external partners, and is open to new knowledge, changes, and sometimes to the resulting mistakes. In addition, it is focused on implementing unique visions and strategies, while ensuring discipline, and successfully integrates participants of described relationships around new activities [28, 30]. The question then arises: are Polish enterprises ready to adopt the assumptions of the Industry 4.0 era and does their organisational culture foster their functioning under these new conditions? The answer to this question corresponds with the purpose of the paper, which was to identify the main directions of changes in the organisational culture of enterprises associated with the process of adaptation to functioning in the face of challenges of the Industry 4.0 concept. The paper is a contribution to the literature on management in the context of changes caused by the new IR4 era analysing its impact on the organisational culture of enterprises. Therefore, the subsequent sections of the paper discuss issues related to the requirements of IR 4.0 in the context of changes in the organisational culture of enterprises. Next, the research method, research results, conclusions, and further research recommendations are described.

6.2 Industry4.0—What Does It Mean?

Over the years, the development of new technologies has caused the world to go through new eras of the industry which has fundamentally changed the rules of the game important for the functioning of various types of enterprises. Water and steam propulsion was used in the First Revolution, electricity in the second, and innovations in the field of microelectronics, and IT supporting automation were introduced in the third revolution.

Industry 4.0 (or German Industrie 4.0) is a collective term for technical innovation and a new concept (era) of value chain organisation that enable a revolutionary change in industrial production [3]. The term Industry 4.0 is understood as the unification of the real world of production machines with the virtual world of the Internet and information technology [14, 17]. In this process, i.e. in the course of production, there is an automatic exchange of information between people, machines, and IT systems, as well as between separate factories and various IT systems operating in different branches of industry. Thus, the diverse nature of production systems operating in various industries does not allow for the generalisation of the term Industry 4.0 [11, 13, 27]. This means that the scope of definitions should be considered individually for different areas of functioning of a given enterprise. This concept describes a decentralised production chain that extends from the design to the supply chain, production, distribution, and eventually to the final customer service [18, 19]. Therefore, Industry 4.0 refers to the entire value chain, i.e. from placing an order and delivering components for ongoing production, until sending the goods to final customers, and after-sales services. Innovative software and devices connected to the Internet are used in this process, thanks to which real-time errors can be prevented from occurring at different levels of management [22]. Due to this network, the enterprise can become faster, more flexible, effective, and competitive. As a result, managers are constantly looking for new and innovative production systems that motivate to create new business models focused on the exploitation of a high degree of economic benefits, while improving existing models. The research conducted by Arnold, Kiel, and Voigt identifies only some of the most important areas directly related and relevant to business activity conducted in accordance with the concept of Industry 4.0. According to the authors, these areas include proposals for creating data-based value, the process of switching from a product to system offer, improved personalisation, intensified customer relations, IT and software know-how as key resources, and increasing interconnectivity, as well as cooperation with key partners [4, 9, 23].

Based on these studies, it can be seen that the phenomenon of socio-economic development defined in the literature as the "Fourth Industrial Revolution" is associated with the following three phenomena [7]:

– universal digitalisation and ensuring constant communication between people, between people and machines, as well as between machines,
– implemented disruptive innovations which allow for a rapid increase in the efficiency and effectiveness of the socio-economic system,

– achieving such development of machines that they gain the ability to display autonomous behaviour through the use of "artificial intelligence" in the process of control.

Unlike the previous revolutions, Industry 4.0 creates the so-called Industry 4.0 environment which is to support the team in creating extensive value networks that allow for exchange and access to virtually any useful information, anytime, from anywhere. This enables the economic production of customised products for the needs of a specific customer and the so-called short batches (mass customisation). Thus, Industry 4.0 is not intended to create mechanised factories in which man's place is occupied by robots but factories in which an employee is the most valuable asset of an enterprise. In this system, man, machine, and process are closely integrated with one another. The basis for all this is the cooperation of separate control units that are capable of autonomous decision making, managing the assigned technological unit, and in particular of becoming an independent and full member of comprehensive production units. Therefore, this concept requires continuous innovation and education depending not only on the skills of people but also on the organisational culture of the company. For this purpose, it is necessary to understand the internal and external changes in order to adapt the strategy, structures, and processes, as well as people and technologies to the requirements of the "new wave" of the IR 4.0 concept. An appropriate managerial approach therefore plays an important role in creating such measures that will foster the development of the described concept in all types of enterprises. Existing studies, however, draw attention to the higher probability of evolution and changes occurring in small and medium-sized enterprises in particular, as they often operate in the area of high technologies and to a large extent seek innovation, create and develop new areas of manufacturing, as well as new sectors and industries based on the assumptions of the new era [8, 11, 29].

An appropriate managerial approach plays an important role in generating such activities that will be conducive to the development of the described concept. There is still growing interest around Industry 4.0, but there is a lack of systematic reviews of research concerning various development determinants of this concept. Most existing studies discuss only the technological approach to this concept without paying attention to the importance of other factors determining success of this process [6, 15, 17]. This is confirmed by the research conducted by Lu and Cecil, who, based on a literature review, attempted to identify the state of research on the concept of Industry 4.0. They indicate that most studies discuss technological aspects, not taking into account the importance of soft management aspects, i.e. organisational culture, which motivates researchers to conduct studies in this area [16].

6.3 Organisational Culture and IR 4.0

Attempts to proactively predict the main directions of changes related to the implementation of determinants of the Industry 4.0 era in enterprises lead to the conclusion that to implement new solutions determining their development, enterprises will have to adopt new organisational models based on new open relations with various stakeholders [12]. The effectiveness of these activities requires not only continuous innovation and education but also depends on the skills of people and is determined by the new organisational culture. This culture is a "social bond" and creates a sense of community that counteracts the processes of diversification which is an unavoidable part of the organisation's life, in particular, in the context of determinants of the development of Industry 4.0. Organisational culture, offering a common system of meanings, forms the basis for communication and mutual understanding. That is why managers who implement new principles emphasise the relationship between the success of the organisation and its organisational culture.

In the face of a large variety of interpretations defining the term organisational culture, the definition given by one of the classics and experts of culture E. H. Schein seems important. The author interpreted it as "a pattern of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those" [26].

The adopted, general definition allows for a comprehensive reference to organisational culture without valuing its individual elements, which means that the attitudes, values, and behaviour patterns of the organisation's employees can be treated equally. In addition, it can be assumed that the above-presented definition of culture to some extent combines other definitions given by researchers, as it results from the assumption that each organisation builds certain specific behaviours of people that correspond to formal organisational solutions present in it, creating an organisational culture that integrates employees around the adopted organisation's purpose and allows it to function in the environment [10, 20, 21].

In the new IR 4.0 work environment, an organisational culture which is characterised by openness becomes crucial, as thanks to this culture, employees demonstrate an entrepreneurial and innovative attitude, using a wide range of competences and skills. This understanding of culture will enable the development of technologically advanced algorithms, and then skilful reading of data from various sources to improve the quality of production, flexibility, performance, etc. [5, 15].

The culture of a new type compatible with IR 4.0 requires therefore the development of a new system of values, standards, thinking patterns, and actions that will be consolidated in the social environment of the organisation, contributing to the achievement of its goals. Organisational culture in the era of Industry 4.0 must be open to the environment, support cooperation, ensure the freedom of various relationships, using not only the potential of employees but also external partners, be wide open to new knowledge, changes, and sometimes the resulting errors. In addition, it is focused on implementing unique visions and strategies, while ensuring discipline and

successfully integrates participants of described relationships around new activities. For the purpose of the research, it has been assumed that the organisational culture of enterprises in the Industry 4.0 era is one that is open space, open to change, open innovation, and open to flexibility [30]. Openness in this case should refer not only to customers, suppliers, or competitors but in fact simply to many stakeholders who have complementary capabilities and do not hesitate to use them in cooperation with other sectors to implement the IR 4.0. Readiness for innovative changes is related to the ability of the enterprise to consider and organise activities related to the occurrence of new factors in its environment in order to reduce the risk of errors and to take advantage of emerging opportunities when introducing a new concept. A high degree of tolerance of uncertainty is related to the fact that managers and employees have adequate knowledge explaining a given phenomenon which requires undertaking an action or solution. Flexibility in operation will be an important feature/property of a modern enterprise, knowingly and successfully coping in the Industry 4.0 era. As it can be seen, the proposed definition of open culture closely corresponds to the assumptions of Industry 4.0. In this concept, the processes related to changes leading to an open organisational culture are becoming particularly important. This culture is characterised by the following traits: it supports cooperation, provides freedom, is open to the environment, exploits the potential of employees, is open to errors, is focused on visions and strategy, while ensuring discipline, and integrates business participants, owners, managers, and employees around new activities (see Fig. 6.1).

In order to develop values related to the dimensions given in this definition, specific processes should be designed to promote openness, innovation, creativity, flexibility, and change. However, the most important is to understand that these activities must become an element of the organisation's functioning in the Industry 4.0 era. They must be part of its philosophy, as only then will they cease to be only ephemeral constructs and will begin to exert a real influence on the enterprise. Otherwise, they will remain only impressively sounding words that have no effect. In addition, it should be noted that the provided definition is "open" and can be supplemented with other new dimensions relevant to the development of the IR era.

The confirmation of significant dependencies between IR 4.0 and other elements can be found in the research conducted by Bahrin et al. who have identified various

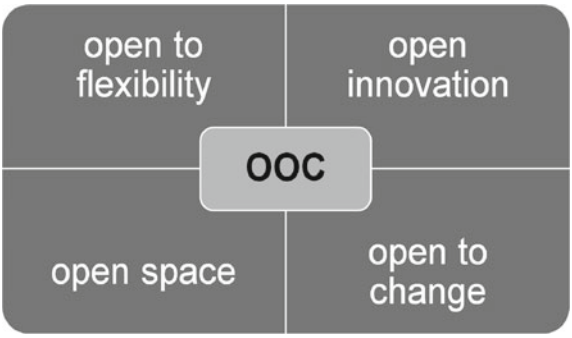

Fig. 6.1 Proposal of the dimensions of an open organisational culture. *Source* The author's own elaboration

interrelationships, including organisational culture and other organisational systems that lead to the dynamic development of components designated by the new era [5]. The authors, though not conducting in-depth research in this area, confirm that continuous learning and innovative development depend not only on the enterprise's capabilities but mainly on people who create its organisational culture. In turn, Pfeiffer, questioning the view that man can be replaced by robots, has confirmed that only different types of knowledge that employees have allow the company to carry out interactive activities in various work processes in order to ensure their high quality and efficiency. The organisational culture of enterprises is therefore one of the composites that integrate people with cyberspace which is a key for the development of the era of Industry 4.0 [31]. Therefore, researching the issue of the relationship between the organisational culture of enterprises and the assumptions consistent with the Industry 4.0 concept seems to be reasonable. This issue is particularly important when supporting enterprises by strengthening their cooperation with entities in their environment, especially cooperation with the sphere of science, public administration and business (e.g.: as part of clusters), and activities carried out in the framework of open innovation (OI). Sackey identifies the problem related to the necessity and ability to manage these relationships in order to meet the Industry 4.0 assumptions and indicates that it is possible to build an industrial ecosystem based on an organisational culture that offers practical infrastructure for teaching and learning [25]. The profile of such an organisational culture must therefore refer to the pillars set by the Industry 4.0 era. The accuracy of interpreting such assumptions will result in the ability to take action in a technologically developing market. Under such conditions, organisational culture, thanks to the related processes, will foster absorption, understanding, teaching, problem solving and communication, creating the basis for adaptation to the requirements of IR 4.0. This means that such culture will support the broadly understood ability of enterprises to operate in two realities—real and virtual, under changing environmental conditions and in cooperation with various types of partners, and thus, the company will be ready for the systematic and consciously created dynamics of changes in many business processes, including the building of its competitive advantage. This will also refer to a certain kind of transparency that is perceived in the context of access to information (e.g.: open resources of knowledge) [21, 24].

The question arises—are Polish enterprises ready to accept the concept of Industry 4.0 and does their organisational culture foster their functioning under these new conditions? As a consequence of these considerations, the following hypothesis was proposed:

H: The Industry 4.0 era affects the change of the organisational culture of enterprises due to the fact that the more open the organisational culture, the more it strengthens the possibilities of developing IR 4.0 in the enterprise.

In order to verify the formulated hypothesis, the research described in the next part of the paper was carried out.

6.4 Research Methodology

In order to achieve the aim of the paper, which was to identify the main directions of changes in the organisational culture of enterprises associated with the process of adaptation to functioning in the face of challenges of the Industry 4.0 concept, empirical research was carried out. The study was conducted from March to November 2018 as part of the first stage of the author's own research on organisational culture in the Industry 4.0 era. In order to carry out the research, quantitative methods were used, including the survey method using the mix mode technique and the combination of CAPI and CATI research, and the research tool was an original questionnaire.

The sampling of enterprises was stratified randomly based on the following criteria: the enterprise size measured by the number of employees, the industry (according to the Polish Classification of Activity, enterprises from various industries were examined), the level of innovativeness (screening question, companies characterised by different levels of innovativeness were examined), the company's development phase (screening question, companies characterised by various development stages were examined). The sampling frame was the database of the REGON National Official Register of national economy entities from which the so-called gross sample was obtained, i.e. a list of entities exceeding the size of the sample several times, and the draw was made by the company called "ASM—Centrum Badań i Analiz Rynku" (ASM—Market Research and Analysis Centre) from Kutno. The size of the random sample was set with a large excess, taking into account that with the applied technique it would be possible to obtain completed surveys only from some of the randomly selected entities. Respondents were owners (38%) and/or managers (62%) of the surveyed companies. The research covered a group of 139 enterprises including 21 medium-sized enterprises (i.e. employing 50–249 people) and 118 small enterprises (i.e. employing between 10 and 49 people). The most innovative companies (i.e. with the highest level of innovativeness according to the scale adopted by the researchers) were included in the study. The surveyed enterprises represented various industries, but the majority were manufacturing enterprises (88 out of 139 surveyed enterprises). They operated in the local market (44 entities), national market (76 entities), as well as international market covering several countries (17 entities), and two enterprises had a global reach (many countries, often on different continents). The vast majority had only Polish capital (72 out of 139 surveyed entities). The dominant companies were those operating for more than 10 years (71 entities).

The results presented in the paper are only a small part of the wider analysis of the interrelations between organisational culture and the assumptions of the Industry 4.0 era.

6.5 Effects of Adapting the Organisational Culture of Enterprises to Function in the Face of Challenges of the Industry 4.0 Concept—Research Results

The definition of organisational culture adopted in the paper provided the opportunity to diagnose key activities for the desired organisational culture in the perspective of the development of the Industry 4.0 era in the analysed enterprises. First, the surveyed respondents were asked to assess their level of knowledge about the assumptions of the IR 4.0 era. For this purpose, four areas of activities related to actions specified in the adopted definition of organisational culture related to the ability to create a network of cooperation with the environment (open space), the propensity for creating innovative activities in the surveyed enterprises (open innovation), activities undertaken in the situation of dynamic changes in the environment (openness to change), and flexibility (openness to flexibility) were assessed [31]. It was assumed that the given areas would be assessed in small and medium-sized enterprises. Table 6.1 presents the assessment of the respondents possessed on the 4.0 industry.

The conducted research shows that the vast majority of respondents are familiar with the assumptions important for the era of Industry 4.0 at the low level (medium-sized enterprises—20.0% of responses, small enterprises—25.9% of responses), medium level (medium-sized enterprises—37.0% of responses, small enterprises—53.3% of responses), and high level (medium-sized enterprises—23.3% of responses, small enterprises—9.3% of responses). A total lack of knowledge of this topic in the group of respondents was confirmed by 18.2% of small and 3.3% of medium-sized enterprises. However, it should be noted that the responses referred solely to the confirmation of the knowledge and the actual functioning in accordance with the Industry 4.0 rules was confirmed by only two medium-sized enterprises and one small enterprise operating in the high-tech industry. Such a distribution of responses is most probably influenced by the fact that the concept of a new era forces the introduction of changes into traditional, and even innovative, business models. However, this change will be taking place in an evolutionary manner over the next decades, which will result in the gradual implementation of new assumptions in enterprises.

Table 6.1 Assessment of the level of knowledge possessed on the Industry 4.0 era (%)

Knowledge of the assumptions of the IR 4.0 era	Total	Small	Medium
Lack of knowledge	15.2	18.5	3.3
Low level of knowledge	24.6	25.9	20.0
Medium level of knowledge	40.6	37.0	53.3
High level of knowledge	12.3	9.3	23.3
Key level of knowledge	2.2	2.8	3.0
I don't know/hard to say	5.1	6.5	1.0

Source The author's elaboration based on the research conducted
Note Respondents could provide more than one answer

Subsequently, the activity of the surveyed enterprises in the area of networking with various entities (open space) was assessed.

As the research indicates, in the areas of designing new products, conducting joint research and development activity, taking active participation in conferences/meetings/seminars, establishing business contacts, designing new products, purchasing licences/patents and new technologies, they rarely cooperate with customers, competitors, suppliers, and strategic allies (small enterprises at the level of 10.2% of responses and medium-sized enterprises 15.0% of responses). The worst was the assessment of the cooperation with R&D research units and intermediate institutions (small enterprises—0.0% of responses and medium-sized enterprises—3.0% of responses).

The propensity of enterprises in the field of innovative development (open innovation) was assessed in terms of conducting activities related to creating new ideas, changes in production processes, product development, changes in marketing processes, as well as knowledge and technology management (Table 6.2).

As the conducted research has shown, all initiatives in the field of innovative development are undertaken more often in small companies. These activities are related to creating new ideas (86.0% of small enterprises and 13.5% of medium-sized enterprises), changes introduced in production processes (52.5% of small enterprises and 47.2% of medium-sized enterprises), activities connected with product development (70.6% of small enterprises and 47.6% of medium-sized enterprises), changes introduced in marketing processes (87.9% of small enterprises and 12.1% of medium-sized enterprises), as well as initiatives in the field of knowledge and technology management (81.2% of small enterprises and 18.2% of medium-sized enterprises).

This may be a result of the specificity of the functioning and management of this group of enterprises (the scale of operations, industry, innovations, etc.) as well as the managing person (the number of managers, their professional experience, profile of education, etc.). In the course of the interviews, the surveyed respondents also indicated that to increase their competitive position in the market, enterprises introduced product and process innovations (29.6% of small enterprises and 40.0% of medium-sized enterprises). Next, the actions taken by the surveyed enterprises in the situation of dynamic changes in the environment were assessed (openness to change) (Table 6.3).

Table 6.2 Initiatives in the field of innovative development undertaken in the surveyed enterprises over the last 5 years (%)

Type of activity	Small enterprises	Medium-sized enterprises
Creating new ideas	86.0	13.5
Changes in production processes	52.5	47.2
Product development	70.6	47.6
Changes in marketing processes	87.9	12.1
Knowledge and technology management	81.2	18.2

Source The author's own elaboration based on the research conducted

Table 6.3 Actions taken by the management in the situation of changes in the environment

Actions taken by the management team in the situation of changes in the environment	Total	Small companies	Medium-sized companies
Financial restructuring (debt restructuring)	8.6	6.5	25.0
Reduction of employment in the group of administration employees	8.6	9.7	0.0
Reduction of employment in the group of production employees	8.6	9.7	0.0
Withdrawal from some markets	11.4	9.7	25.0
Cessation of new investments	11.4	12.9	0.0
Reduction of operating costs	11.4	3.2	7.5
No such actions taken as no need seen	45.7	51.6	0.0

Source The author's own elaboration based on the research conducted

As indicated by the surveyed respondents, the analysed enterprises undertake various activities that are a result of dynamic changes taking place in the environment in which they operate. Among the actions listed, limitations were indicated rather than activities related to implementing IR 4.0. Entrepreneurs most often reduce the costs of their operations (small enterprises 3.2% of responses and medium-sized enterprises 75.0% of responses). Actions related to withdrawal from some markets, cessation of new investments, reduction of employment in the group of administration and production employees, or debt restructuring were assessed to at a similar level in the examined group, which confirms not very high frequency of these activities. Respondents from small enterprises indicate that they have not introduced any changes in the indicated areas, as they claim they have had no such need (small enterprises 51.6% of responses). The distribution of the answers obtained also refers to the flexibility of the surveyed enterprises in different situations (openness to flexibility).As the conducted research has shown, restrictive measures which are a direct response to changes occurring in the environment are the ones taken more often in the surveyed enterprises.

On the basis of the conducted deliberations as well as the research results obtained, many generalisations and conclusions can be formulated at this point. In response to the question posed in the Introduction whether Polish enterprises are ready to adopt the assumptions of the Industry 4.0 era and whether their organisational culture fosters the functioning under the new conditions, it can be concluded that the surveyed enterprises (although the respondents confirmed the basic knowledge of the IR 4.0 framework) are characterised by a certain degree of cultural closure which blocks the development of this concept. According to the surveyed respondents, it can be said that this stems from a lack of activities in the area of creating a network of cooperation with the environment (open space), low frequency of carrying

out even basic innovation-related activities in the surveyed enterprises (open innovation), rare/limited actions undertaken in the situation of dynamic changes in the environment (openness to change), and a lack of flexibility (openness to flexibility). This approach results from the underestimation and failure of the owners and managers to see key cultural determinants supporting the IR 4.0 era. Due to the limited research sample, one can only formulate the following hypothesis: "*The Industry 4.0 era affects the change of the organisational culture of enterprises due to the fact that the more open the organisational culture, the more it strengthens the possibilities of developing IR 4.0 in the enterprise*". The conducted deliberations indicate that the Industry 4.0 implementation in enterprises causes many changes, including changes in the methods of communication, implementation of tasks, methods of solving problems, personal practices, the organisational structure, etc. Cultural changes are therefore necessary, as the system of beliefs, values and opinions of employees influences their attitudes and behaviours. Cultural openness is enforced not only by internal changes resulting from the implementation of new IR 4.0 assumptions but also changes taking place in the environment, e.g.: the fast development of technology and the need for its absorption, the multi-directional knowledge development, changing customer requirements, competition intensity, sociocultural determinants (education of society, values, and attitudes conducive to building the knowledge-based economy), and increasing cooperation, especially within inter-organisational networks, etc.

Therefore, entrepreneurs should strive to initiate all activities that stimulate the creation of the desired organisational culture which can become a strategic factor of success in the IR 4.0 era.

6.6 Conclusions

As it has been shown, the general profile of the studied group of enterprises in reference to the Industry 4.0 era requires profound changes associated with more comprehensive modelling that would strictly correspond to the requirements of the described concept.

The author of the paper is aware of the limitations of the presented research, which result, among others, from the selection of the sample, the research methods, and the research tool. These limitations also influence the level of caution in regard to the interpretation of the research results obtained and the possibilities of generalising the findings. One of the additional objectives of the paper, however, is the initiating of the discussion on the importance of soft aspects, i.e. organisational culture, in the IR 4.0 era.

If activities related to the implementation of IR 4.0 are a strategic and economic part of enterprises' operations, then in general organisational culture should support them in all the indicated areas. Improper management can become a burden and a source of strategic weakness of the enterprise.

The obtained results inspire to conduct further research in this area. First of all, due to the lack of representativeness of the sample, as all formulated applications concern only the examined group of enterprises. An interesting challenge would be to identify and assess the analysed relationships on a representative sample of enterprises from various industries and sectors that have implemented and operate in accordance with the IR 4.0 assumptions.

Secondly, most enterprises in Poland are only at the initial stage of the implementation of the Industry 4.0 concept (for many this is only the early period), therefore it is inspiring to develop an organisational culture model that will indicate general determinants of success and support for the exploitation of the 4.0 strategy. The key is therefore to build an organisational culture model that supports: cooperation, management (planning, organising, motivating, and controlling), and optimisation of processes taking place in the entire enterprise through close human interaction with real and virtual reality.

A need for a more accurate understanding of the mechanisms and processes occurring in the dyad—the development of the IR 4.0 era—organisational culture motivates to conduct in-depth research in this field. The considerations presented in the paper should therefore be treated as a contribution to further research.

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