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Managerial Perceptions of the Implementation of Industry 4.0 in Hungary

Summary

The purpose of the study is the presentation and examination of the views and perceptions on the implementation of Industry 4.0 processes and mechanisms in Hungary. The qualitative research attempts to explore 1) how managers deal with information regarding Industry 4.0, and how the information assists them in the introduction of the elements of the Industry 4.0. 2) what are the implementation and hindering factors of Industry 4.0 tools within the framework of SMEs. 3) how managerial motivations and attitudes related to Industry 4.0 influence the introduction of the topic within the company. In order to answer the research questions, we conducted a total of 8 semi-structured interviews in the spring of 2022. Due to the small number of items, our research results cannot be generalized, they are only valid for the test sample. The following answers can be given to our research questions: a, domestic companies primarily acquire information about Industry 4.0 at Hungarian professional events, workshops, and internet portals; the implementation of industry 4.0 is mostly hindered by the lack of financial resources; the leader must be fundamentally open-minded to both professional innovations and technological changes.

Keywords: Industry 4.0, production sector, semi-structured interview, Hungarian company managers, obtaining information

Introduction

Looking at the composition of the Hungarian economy, we see that industry plays a significant role. Therefore, the successful adaptation of Industry 4.0 would give domestic organizations an economic competitive advantage. In its interaction with the environment, the enterprise can choose between tolerant, adaptive, or proactive forms of behavior (Spector, 2013). Proactive behavior is characterized by the prognostication and prevention of events, the use of favorable trends and the assessment of expected consequences, and the moderation of adverse effects for the company with the help of preventive measures.

The main driving force behind market changes stems from the effects and consequences of rapid technological development and globalization. In the face of such coercive market forces, the main task and even the obligation of the company manager is to react appropriately and effectively to the changes (Spector, 2013). Leadership can foster a creative and innovative spirit and enable change by effectively allocating appropriate resources (Titu et al., 2015). The key to compliance in a competitive market situation is the leader's vision of the future and his ability to flexibly adapt to changes.

Companies are forced to continuously innovate in the ever-increasing competitive situation, and business management also has to cope with the challenges in front of them on a daily basis. That is why it is particularly important for managers to find specific and novel solutions for preparing strategic decisions (Nagy, 2019). The innovative approach and attitude includes the fact that the manager constantly monitors market trends and analyzes all possibilities and contingencies. We can no longer draw conclusions from the events that happened in the past, since they happen with such speed and quantity, it is much more necessary to „feel" the future, this is the future of innovative company management and at the same time it requires a completely new manager profile (David et al., 2020).

Literature Review

Industrial revolutions based on changes in production systems had a wide-ranging impact on the economy and society. Industry 4.0, which forms the framework of the thesis, grew out of the meeting of different networks (such as cloud solutions) within the framework of the fourth industrial revolution. The roots of the concept go back to the 1990s, and in contrast to the industrial revolution, industry 4.0 is a narrower phenomenon that focuses on the corporate sphere (Schwab, 2016).

The phenomenon is not new, it is merely the result of the joint work of three influential and experienced professionals, each from the fields of politics, economics and science. The transformation process is possible with an even stronger automation of the industry. The goal is the near real-time management and optimization of various companies and their value-creating network. Another goal is the development of intelligent monitoring and autonomous decision-making processes (Industrie 4.0).

In the case of a product being made, the paradigm shift means that the product itself becomes active: not by central control, but by the raw workpiece of a product "telling" how to work during the various production steps. The finished product controls the production process, keeps an eye on the most important environmental parameters through the embedded sensors and takes appropriate countermeasures in case of disturbances, so it becomes an observer and an actor at the same time. The vertical network of embedded systems offers new business models in the field of logistics and production, in addition to the existing software used in the enterprise economy, where there is also a significant potential for optimization.

The business potential of the fourth industrial revolution is not only about the optimization of the operating process, but also about services that appear in different areas of use. These

new generation products can communicate with each other via the Internet, initiate actions or mutually control each other (M2M) (Bundesministerium 2021; Industrie 4.0, 2011).

Based on the definition of the German Economic and Energy Association, industry 4.0 is: "the direct connection of people, machines and products, with the intelligent connection of machines and industrial processes, using information and communication technology tools" (Bundesministerium für Wirtschaft und Energie, 2021). The following options are available for different companies to use smart connectivity:

1. Flexible production: thanks to digitization, production steps can be better coordinated, and the utilization of machines can be better planned.
2. Changeable factory: in the future, production lines will have a modular structure, they will be able to be adapted more quickly for a certain task, thus increasing economy and productivity, thanks to which unique products will be available at a lower production price.
3. Customer-centric solutions: the consumer and the manufacturer become closer to each other: customers can customize the product according to their own wishes. At the same time, smart products can provide information to the manufacturer even after delivery and during use. With these data obtained during use, the manufacturer can improve the quality of its product, so that it can better adapt it to the customer's use, and the need for the introduction of new services may be revealed.
4. Use of data: the data generated during the production process and the data obtained on the product's condition can be compared and analyzed, with the help of which process data analysis can move production in a more efficient direction. What may be even more important: it can form the basis for completely new business models and services.

Industry 4.0 in Hungarian Context

Varga's (2015) research examining Hungarian SMEs and their managers' strategic decision-making showed that company managers are very aware of the increasing market and technological turbulence, the most significant effect of which is that businesses must be constantly on the lookout to meet changing market demands. be ready. For this reason, they are forced to implement significant improvements, and those companies that are not able or ready to do so, or are unable to make changes due to the scarcity of their financial resources, will surely fall short in the competition. In this critical situation, companies are characterized by consumer and competitor orientation.

At the same time, Luksander et al., (2012) in their paper investigating the values of entrepreneurs and managers pointed out that the characteristic feature of the values of both company managers and self-employed persons is the principle of performance as a positive attribute, but a big difference is that managers desire much more the security, and less independence and stimulation.

Processing information from government sources proves to be difficult for SMEs, because although they are useful, few managers can use them and, above all, utilize them (Varga, 2015). There is not much demand for information and consulting services dealing with the collection and analysis of information, or for personalized services, especially among small and medium-sized enterprises. Here, in the "market research, market survey" category under the umbrella of the purchased service (which would also include obtaining up-to-date information on Industry 4.0 trends), only 1.9% of all businesses, or Its share is 6.9%. On the other hand, there is a jump in the scale for medium-sized companies over 50, as around 31% of the managers mention that they regularly use the service.

According to Varga (2015), it is in the fundamental interest of the manager to have up-to-date information, because this is the only way to maintain the supply of information that is necessary to keep the business alive, to take appropriate measures, and in general for daily operations. The majority of enterprises acquire information from several and various channels, which includes continuous contact with market players and obtaining information. In this way, they are informed about the main sector trends, development directions and ideas.

Many other factors hinder the development of businesses, including "Lack of business knowledge and information", which occurs in 29.7% of the mentions. It is also characteristic that the managers of SMEs have not attended any training or further training in the last three years, and only managers under the age of 40 monitor the news portals appearing on web channels on a daily basis, and are informed about the technological and sectoral changes and trends occurring in the world and in Hungary.

On the other hand, Varga (2015) found another interesting fact, namely that managers are too confident in their abilities and up-to-date knowledge, even though half of the managers in the sample did not attend training or a professional forum, and do not consider these to be important. The question arises, are we not facing a problem based on a lack of self-knowledge?

In his study, Nagy (2019) points out that, according to the opinion of the interviewed SMEs, "the key to Industry 4.0 is information and the data that can be extracted from it, which can be shared with the appropriate departments through the network and used in decision-making processes to gain a competitive advantage". The steps taken towards Industry 4.0 presuppose the collection of data, which is properly planned and carried out with technological means, and then the conversion of the data into decision-supporting information. However, few companies have the competence of data analysis, although this is a source of competitive advantage.

Research Questions

Due to the exploratory nature of our research, we do not formulate hypotheses in advance, only research questions. In our study, we seek answers to the following research questions:

1. what are the platforms and methods of obtaining managerial information related to Industry 4.0.
2. what are the implementation and hindering factors of Industry 4.0 tools within the framework of SMEs.
3. how managerial motivations and attitudes related to Industry 4.0 influence the introduction of the topic within the company.

Methods

The exploratory analysis of the topic required a deeper level of exploration, which can only be solved with the interview technique. This is how we made semi-structured signs. During the interviews, the respondents have the opportunity to explain in more detail and to delve into the topic, as opposed to e.g. with a

structured questionnaire method, the structure of which is much more rigid. At the same time, interview subjects get closer to formulating and consolidating their own opinions when preparing and answering the questions. The interviewer can also ask questions that make the respondent think further, thereby having a beneficial effect on the leader's attitude, or his opinion or experiences and observations on the subject, in this case Industry 4.0.

With the help of qualitative research, all points of view can be included in the final conclusions, thus a more accurate and nuanced picture can be obtained during the processing of the given problem. This becomes a particularly prominent factor during exploratory research, where there is not enough experience yet (Horváth, Mitev, 2015).

The data collection took place in the spring of 2022 in a personal, offline way. The interviews lasted an average of 50 minutes. We included 8 people in the research, all of whom worked in senior positions in production companies with locations in Hungary. Their average age (m=42.375; SD= 11.044) years. The oldest person is 65, the youngest is 32. The activities of the organizations are illustrated in 1. Table Sampling was done using the snowball method.

The participants were given the following interview questions:

1. How do you explain/interpret the concept of Industry 4.0, and where do you get information about this?
2. How can you use the results of Industry 4.0 within your own organization, and what are the related complicating factors?
3. How could Industry 4.0 be implemented in your organization's industry?
4. In your opinion, during the introduction of Industry 4.0, which leadership roles are particularly important?

1. Table: scope of activities of organizations

Serial number of organizations	Scope of activities
1	Repair of industrial machinery and equipment
2	Production of plastic sheets, plates, foils, pipes, profiles
3	Tool production
4	Manufacture of other electronic, electrical wires and cables
5	Tool production
6	Manufacture of other plastic products
7	Medical device manufacturing
8	Manufacture of other plastic products

Source: own source

Results

The results are presented based on the interview questions. In the case of the first question, we summarize the answers. In the case of the second, third and fourth questions, the answers of the interviewees are presented separately. For reasons of content, we do not present the answers of all interviewees to these questions.

1. How do you explain/interpret the concept of Industry 4.0, and where do you get information about this?

How managers learned about the concept also predicts how they will use it within their own organization. If they learned about it abroad, they certainly knew the methods of use in that country and can adapt them to Hungarian conditions. Of course, this depends on the company's micro- and macro-environment and the regulators, as well as on the company's knowledge and culture. If you first learned about the concept and the procedures and solutions associated with it from a Hungarian source. It is then likely that he will introduce the familiar, but "squeezed" usage options in the Hungarian environment, if he has such plans. The disadvantage of this is that it will be limited in its possibilities, because the Hungarian user environment, including knowledge and regulators, is at a different level of development than the Western environment (Nagy, 2019).

Respondents typically encountered the concept in both locations, both abroad and in Hungary, but mostly abroad, at trade fairs or exhibitions. In Hungary, they were introduced to the concept during Industry Day or Mach-Tech. These are all professional events and forums, that is, they did not get to know the concept of Industry 4.0 from the professional press or media or from a government information portal, but through personal experience.

The respondents explained the concept in a variety of ways, taking into account the diverse professional backgrounds and personal experiences, or to the uniquely different nature of information processing. Typically, the concept is associated with increased and outstanding efficiency and production optimization.

There is therefore a correlation between the frequency and depth of information acquisition and the relationship to Industry 4.0, its acceptance and introduction. The respondents' examples reveal that the further along a company is in the introduction of processes, the more the managers require obtaining information from diverse sources. The reason for this is that the supply of information must be constantly maintained in order to be informed about trends and opportunities at home and abroad "just in time". This is especially important in the case of companies that work almost exclusively for export, because Industry 4.0 processes and trends there change and develop faster, given that they were introduced earlier than in Hungary. While the presence of the latest technological innovation may not be so important for a company with mostly Hungarian customers, the lack of it for an export customer can lead to a loss of market.

2. Table illustrates the media from which the respondents obtain information. X means that the respondent obtains information from the given source. Based on the table, it can be concluded that the majority of the respondents find information on domestic professional forums, exhibitions and internet portals. Less than half of the respondents consult foreign Internet portals. 6 of the 8 respondents indicated that they also get information at foreign professional forums and exhibitions. In other words, the majority of respondents prefer the method of obtaining information in Hungarian.

2. How can you use the results of Industry 4.0 within your own organization, and what are the related complicating factors?

According to respondent 2, optimization in assembly lines can also bring about a kind of healthy competition between shifts to see who can do more, which can be even more effec-

3. Table : source of information about industry 4.0

Source of information	Serial number of interviewees							
	1	2	3	4	5	6	7	8
Foreign professional forum, exhibition	x	x		x	x	x		x
Hungarian professional forum, exhibition	x	x	x	x	x	x	x	x
Hungarian internet portal	x	x	x	x	x	x	x	x
Foreign internet portal	x					x		x
Hungarian newsletter	x	x		x		x	x	x
Suppliers	x	x	x	x		x	x	x

Source: own source

tive if it is supported by a premium. It also makes it clear to the production line worker what the goal is and where the processes are. By the introduction, respondent 7 means what has already been implemented, that they monitor the various phases of production, both during injection molding and during ultrasonic welding. Also, an RFID chip is placed on the product itself, which is a data carrier, and the data is already written in the machine. The data is then immediately entered into the system. They realized that this is necessary to maintain efficiency, it is not demanded by the customers, it is their own interest, and now the market also demands that the systems be made electronic at a high level and have an accessible database.

Respondent 6 mentions that we already have a company management system, for which they use another software, which retrieves the information from the database and evaluates it, which means that they already have an overview of the production as a whole, but according to his experience, the problem is that the data entry is not real in many cases, and the reason for this is unfortunately the human factor.

Respondent 8 as a difficulty, or as a hindering factor, he mentioned that there is a lack of communication within the company group, even though the sister company is 25 km away, and the parent company is no further than 300 km from the company's premises. Despite this, the amount of communication converges to zero. Much more should be shared with each other, colleagues keep secrets, so they can't even get to know each other, let alone support each other in the processes. Team building would be a great advantage, because then they can ask each other verbally, discuss problem solutions, exchange information and experience, and thereby develop mutual trust. When the next problem arises, there will be someone to turn to, and the company's knowledge capital will also be built.

3. How could Industry 4.0 be implemented in your organization's industry?

Respondent 4 criticizes the government for not dealing with the operational problems of SMEs enough. Respondent 5 also complains that more advertisements containing incentive alternatives should be broadcast to the actors of the sector, instead of massive FMCG advertisements. According to him, those domestic companies that have achieved significant market success should be supported. According to him, the introduction of industry 4-0 was hindered by two factors the most, these: the lack of capital for businesses and the lack of state subsidies. According to him, government subsidies should be continuous and permanent in the SME sector.

Respondent A6 states that "big data", which he finds to be in its rudimentary phase, practically means that during production, data is collected from the machines connected to it and the data is then stored in a central location, which can be accessed by several people, with different aspects and for the purpose of creating targeted analyses. In this way, they can create actions aimed at a more efficient cooperation of the machines, and at the same time, in addition to the connection of the machines, the cooperation of the human factor, remote operators and designers, technical specialists responsible for production, without their personal presence being necessary. With this, you can save a lot of energy, time and, above all, costs, which also serves efficiency. He would mainly present this kind of efficiency advantage to the other players in the sector, as if making them use Industry 4.0.

Respondent 7 underlined in his answer that the pandemic greatly hindered and prevented the holding of professional forums, seminars and other events, but it seems that there would be a demand for this. Programs organized online do not return the possibility of exchanging information created by personal meetings. The "networking" during the events is what actually changes hands with industry news and confidential information. In addition to these, he mentions that the change, e.g. even the introduction of Industry 4.0 solutions can encounter a lot of resistance from employees.

Respondent 8 mentions in his answer that companies are generally aware of what Industry 4.0 is about, as they hear about it from several places, and what's more, many companies visit manufacturing companies and offer their ready-made Industry 4.0 solutions. , which could be incorporated into production. However, he blames that there are not enough professional forums and advertisements, or exhibitions, and he cites his visit to the exhibition in Stuttgart 4-5 years ago as an example. Neither the quality nor the magnitude of this can be compared to the exhibitions organized in Hungary, since for 3 days he only went around the halls and talked to the professional participants.

4. In your opinion, during the implementation of Industry 4.0, which leadership roles are particularly important?

According to respondent 3, among the qualities of managers with a positive attitude who use Industry 4.0, the most important is an innovative approach, they are open to new things and are willing to accept that industry and computer technology are progressing and developing.

According to respondent 5, the manager must perform outstandingly in terms of technical training and experience, and the business practically operates on the basis that he can meet

this expectation. He has to understand every work process and not just because, as he says, his company runs because he can design, fit, mill, wire, and grind tools, that's what makes their company run. The head of the company must first of all meet the challenges professionally, thereby setting an example and a model for the employees to follow.

Respondent 8 explains that, in his opinion, you should be open to new things, take in information and, last but not least, search for it. Effective managers are always looking for new things and solutions to existing problems, be it design, production, or sales. However, during his own professional career, he experienced that not everyone likes and appreciates leaders with an innovative approach, because e.g. when he wanted to install the latest developed products, precisely so that the production machine would be efficient, he encountered a lot of resistance. He is convinced that once a decision has been made to install new machines, then the latest and most advanced technology of the time should be installed. He believes that if companies refrain from innovation and do not invest in it, or if they make meaningless investments, then the company will become obsolete compared to the others, and when new customers come to see what level of technological development it has produced, what kind of product they could sell them , then they realize that it is not worth buying anything there, since they are lagging behind other companies. They make sure what the scrap rate is, compare it with a competing company (using more modern technology), then it is certain that they are orders of magnitude better because they use modern developments. They then move on to the other manufacturing company where they produce with more up-to-date technology.

Conclusions and Proposals

We provide the following answers to the research questions. The answer to the first research question is that Hungarian companies primarily acquire information about Industry 4.0 at Hungarian professional events, workshops, and internet portals. Respondents also consider suppliers and domestic newsletters to be important sources. Obtaining information from foreign internet portals can be said to be rare, on the contrary, visiting foreign professional forums was mentioned by six out of eight persons. This result of ours is partly related to the fact that, according to Nagy (2019), Hungarian organizations are primarily informed about Industry 4.0 from domestic sources, which has the disadvantage: the organization is limited in terms of the possibilities of obtaining information, since the Hungarian user environment, including knowledge and regulators, at a different level of development than the Western environment.

The answer to our second research question is that the implementation of Industry 4.0 is mostly hindered by the lack of financial resources, since companies operating in the SME sector rarely have the resources for this, and the government does not constantly support these developments, and the workers are afraid of any changes, also from changes related to industry 4.0, since they have to acquire many new competences and elements of knowledge, the lack of which can mean a competitive disadvantage for them (Spector, 2013).

The answer to the third research question can be given that the leader must be fundamentally open-minded to both professional innovations and technological changes. This result of ours agrees with Obermayer et al. (2021), according to whom managers with a positive attitude prefer Industry 4.0 solutions and see long-term opportunities in them, as contrasted to managers with a negative or critical attitude. In addition, it is important for the candidate not only to be highly qualified in terms of management, but also to understand and see through the operation of individual processes from a professional point of view. The absence of these drastically reduces the company's effectiveness, profit, and the ability to retain employees. This is related to the fact that Certo et al. (2019), management skills also have an impact on the dynamic skills within the company, i.e. the extent to which the company is able to renew and restructure or renew its strategic capabilities in the changing environment. The training of managers can also be considered a critical point because, according to Csehné (2020), managers have to react suddenly and within a short time to unknown situations in accordance with their lniuk, knowing that a bad decision can even put the company at a competitive disadvantage.

Our proposals are listed below:

1. The government unit responsible for industrial development and the development of SMEs or the chamber should look for businesses interested in Industry 4.0 and provide them with research, development and support opportunities in a personalized offer package.
2. A more intensive participation in professional forums, with industry players sharing up-to-date information with each other, is recommended.
3. European Union information sources are hardly used by managers, and they were not even mentioned in their answers. We see a possible shift in this as follows: to use the information services of European Union market research companies, or to become a member of a European Union professional organization or association that provides up-to-date information and possibly even introduces companies to each other in a networking manner, according to needs.
4. The leadership attitudes presented by the research should be included in leadership trainings or in the program of professional forums, and leaders should be persuaded to develop their own leadership skills

Overall, it can be concluded that, according to the participants in the interview, it would be necessary to adapt the elements of Industry 4.0, since its absence results in a competitive disadvantage. Despite this, organizations are not able to use the elements of Industry 4.0, the main reason being that they do not have sufficient resources for this. In order to ensure that small and large companies operating in the Hungarian production sector are not put at a competitive disadvantage with other companies in the region, we consider it necessary for the government to financially support these organizations (e.g. through tenders) so that they can introduce the elements of Industry 4.0.

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