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**International investigation of organizational
transformation processes induced by Industry 4.0 -
through the example of Austria and Hungary**

doctoral (Ph.D) dissertation

THESIS

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1. Topicality of the research and structure of the dissertation

The Fourth Industrial Revolution is fundamentally changing the economy, society and the way businesses operate. Industry 4.0 is no longer just a "future trend", but is increasingly at the centre of the strategic agenda of more and more business leaders. In some manufacturing companies, the first steps towards Industry 4.0 have already been taken, but the path to this goal is an evolutionary process, not a revolutionary one. Information, automation and manufacturing technologies will be more intertwined than ever before, and networking is not just a goal but a requirement of this process. Approaches to Industry 4.0 already exist; however, full-scale implementation is likely to take a long time. Solutions within the scope of Industry 4.0 have fundamentally transformed business organisations, creating new cyber-physical systems where real business and IT processes are integrated and inseparable (Horváth, 2023, Veile et al., 2021). The concepts of industrial digitalisation are currently challenging manufacturing companies in various departments such as purchasing, production, intralogistics, sales and human resources. There is therefore a strong need for a systematic approach to development, strategy design and implementation. However, companies show different levels of maturity with respect to new technologies, processes and procedures and organisational aspects (Pessl et al. 2017).

The dissertation is structured in four main parts. In the first part, I examine the domestic and international relevance of the topic and discuss where Hungary and Austria stand in the European ranking based on the Digital Economy and Society Development Index (DESI), and why it is important to compare the digital development of these two neighbouring countries. In the second part, I present the results of my exploratory qualitative research, including interviews and case studies. Then, in the third part, I will present the details of the quantitative research, covering each section of the questionnaire. Finally, the fourth part will present the results of the research and new scientific findings.

I have formulated the following main research questions:

1. During my research, I paid considerable attention to examining the readiness and maturity of Hungarian and Austrian companies for digitalisation and Industry 4.0. On this basis, I was interested in whether there is a difference between the digital readiness of the two countries? What is the most important aspect of implementing Industry 4.0?
2. In which areas have improvements been made in Hungarian and Austrian companies that have supported Industry 4.0 initiatives in SMEs?

3. What kind of internal training programmes for Industry 4.0 are considered important by the managers of domestic and Austrian companies within their own industry?

4. It is also worth investigating how corporate culture is related to the Industry 4.0 strategy. Are there relevant differences in the corporate culture of firms with an Industry 4.0 strategy in the two countries? What is the corporate culture of companies that already have an Industry 4.0 strategy?

2. Aim of the research

I have a personal attachment to the chosen topic, as I have worked mainly in small businesses, where the implementation of Industry 4.0 has been difficult for various reasons. I wanted to find out what opportunities SMEs have to implement Industry 4.0 and whether they can even catch up with large enterprises in terms of Industry 4.0 maturity.

An important topic today is industrial digitalisation and its impact on companies. The topicality of the subject is given, as Industry 4.0 is transforming industrial sectors at an astonishing rate, with smart devices already capable of collecting, analysing, evaluating and using huge amounts of data at lightning speed. And these data will enable, make more efficient and accelerate the optimisation of production, business processes and industrial operations. This change is rippling through almost every industry, forcing managers to adapt and reorganise their strategies accordingly. Of course, when a business opens up to new technologies, it also requires a whole new strategy, which can be risky. However, there are also companies that do not want to take risks and are content with the situation they have already established.

My research is about the readiness of Hungary and Austria for Industry 4.0. I felt it was interesting to compare the digital development and direction of these two neighbouring Central European countries, as they share a common trade and historical past that has linked them, but they have also been important economic partners since their separation. Austria is one of the most economically stable countries in this region, while Hungary is trying to catch up after the regime change, although this is challenging due to the former socialist economic set-up.

My study examined the digital development of Austrian and Austrian companies, from the perspective of strategy and organisation, employees and the use of new digital technologies, and how the corporate culture of companies is related to the Industry 4.0 strategy. I wondered whether there were similarities in their Industry 4.0 readiness and how they were progressing with the digital transition. Nick et al. (2019) in their study showed that Industry 4.0 differs at different stages of digitalisation: for Hungary, the goal is to catch up with the leaders and join the international value chain, Austria is in a booming stage of development, the main goal for the country is to ensure dynamic growth. I am confident that my research findings and theses will help companies that have not yet made the transition to digitalisation to start on their journey.

3. Test methods used

3.1. Qualitative research

In the course of the exploratory qualitative research, I conducted a total of six semi-structured interviews, three with Hungarian company managers, one with the head of the working group on corporate digitalisation of a professional-industry association and two with Austrian company managers, which I supplemented with two Hungarian and one Austrian case studies. In Hungary, four interviews were conducted, the first one with László Fükő, the factory manager of a large tool manufacturing company in Borsod-Abaúj-Zemplén County, where Industry 4.0 technology is already in use. I also visited two other SME managers, István Liker from Liker Motors Kft and István Sándor from EMR Kft. I present companies with completely different market situations and business approaches through my interviews. The fourth domestic interview is with Balázs Tordai, Industry 4.0 expert from the Association of Information Technology Enterprises (IVSZ). Balázs explained how the Association of Information Technology Enterprises can help a company in its move towards digitalisation.

In the Austrian interviews, Michael Vinatzer from Transalpina GmbH presented the digitalisation journey of a dynamic medium-sized company, and I spoke to Dr. Ewald Koppensteiner from HPW Metallwerk about how a large Austrian company, one of the leading suppliers to the automotive industry, works.

The interviews and case studies were conducted in 2021-2022, mainly to answer the following questions:

- How does industrial digitalisation affect the development of the company?
- What digital tools does the company use?
- In which areas of digitalisation are improvements planned in the near future? Has the Covid epidemic accelerated these developments?
- What advantages and disadvantages do companies face in their daily life when applying digitalisation?
- To what extent has digitisation increased efficiency in your company?
- How important is the development towards Industry 4.0 for an SME?
- What should companies that are now planning to implement digitalisation take into account?

3.2. Quantitative research

I carried out a questionnaire survey within a quantitative study of an analytical nature, in which I interviewed managers of domestic and Austrian SMEs and large companies. When compiling the questionnaire, I mainly drew on the project "Questionnaire for the national technology platform Industry 4.0" developed by MTA Sztaki, which assessed the needs and expectations of industry and strategic economic management, the current situation of Industry 4.0 in the interviewed companies, and I supplemented and elaborated the topics identified in the interviews based on the literature. The data collection was conducted both face-to-face and online, and a total of 156 companies were interviewed, 102 Hungarian and 54 Austrian companies. The target was also to survey 100 companies on the Austrian side, but they were very closed, with a lower response rate than domestic companies.

The quantitative survey was carried out in the following industries:

- Machine building, industrial equipment manufacturing, electrical equipment repair, electrical equipment manufacturing,
- Manufacture, sale and repair of motor vehicles, motorcycles,
- Warehousing and support activities for transportation,
- Manufacture of computer, electronic and optical products,
- Manufacture of chemicals, chemical products

Based on my literature search, Industry 4.0 is already present or plays a prominent role in the selected industries, which is why I chose the industries listed. I also interviewed manufacturing and service companies. The full survey was conducted in 2021-2022.

Questionnaire research was the most useful method for the survey, as it allowed me to interview a wider range of companies and to draw the most important conclusions by aggregating their data. The analysis was carried out using the IBM SPSS 25.0 software package.

The questionnaires in English and Hungarian consist of the following four sections:

- I. *Questions on the qualification of Industry 4.0 companies:* within this, I examined the readiness of companies for Industry 4.0, their current situation, future plans and opportunities through the subsections Strategy and Organisation, Employees and Application of New Digital Technologies. I am looking for the answer to the question of how open the companies surveyed are to development and the changed technological environment, and whether they are able to position and develop their strategy according to their own correct self-image.
- II. *Examining corporate culture:* another central element of the research is the impact of corporate culture on openness to digital transformation, I use Cameron and Quinn's culture analysis to assess corporate culture, which provides useful information for analysing the organisational culture of firms. For the organizational culture analysis, I

used an OCAI (Organizational Culture Assessment Instrument) questionnaire, which contains one statement per six dimensions for each of the four culture types:

1. main characteristics of the organisation
2. organisational leadership
3. Leadership style
4. organizational culture - leadership style
5. strategic focus
6. success criteria

To characterise each dimension, 4 to 4 statements are assigned to each of the four culture types, with the questionnaire respondents allocating 100 points according to the proportions they assign to each. The mean scores for the different statements are assigned to each culture type. The higher this value, the more likely the culture type is to be said to be the dominant culture in the organisation (Cameron - Quinn, 2006).

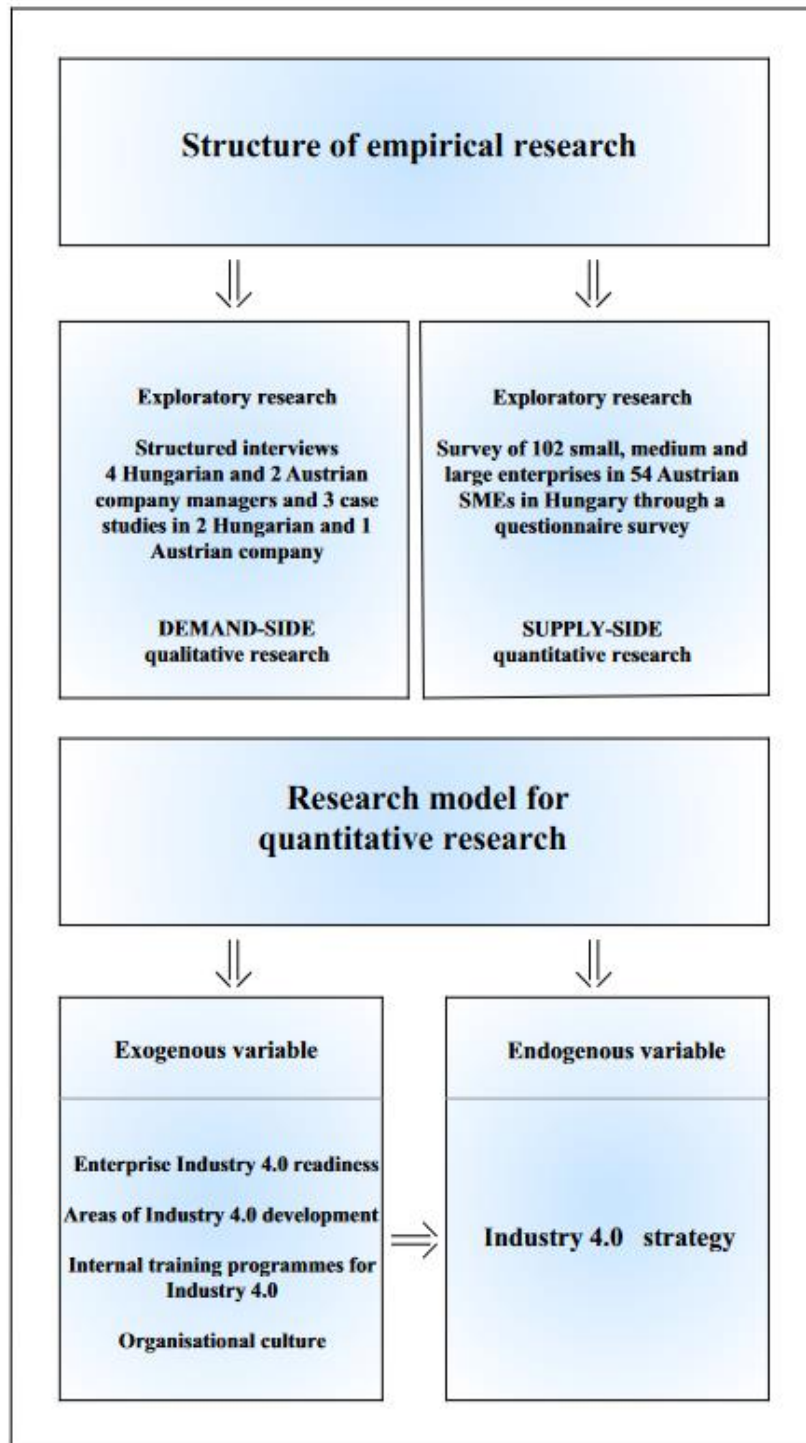
III. *General characteristics*: containing demographic data of the enterprise.

IV. *Demographic issues*: which relate to the managers of the firm.

4. The research model

Literature research confirms that corporate digital readiness, development areas and internal training programmes for Industry 4.0, and corporate culture are related to the Industry 4.0 strategy.

Based on these findings, I set up my own initial research model, which is presented in Figure



1.

Figure 1: Research model

Source: own editing, 2023

5. Research hypotheses

Following the literature review, I reviewed the findings and gaps and formulated my hypotheses related to the research questions.

The hypotheses relate to the context of the areas presented in the research model.

H-1: When implementing Industry 4.0, Hungarian companies focus on strengthening competitiveness, while Austrian companies focus on improving their market position.

H-2: The development of certain areas of Industry 4.0 has a multiplier effect on other areas in both domestic and Austrian companies.

H-3: The internal training programmes for Industry 4.0 are production-oriented in the domestic companies, while the two most important areas for Austrian companies are human resources and digital work processes.

H-4: There is a correlation between the type of organisational culture measured by the Cameron-Quinn culture model and the degree of readiness for Industry 4.0 in the firms studied.

6. Results of the research

In my review of the national and international literature, I pointed out that more and more business leaders are taking the first steps towards Industry 4.0. Progress depends mostly on the ability of owners to implement change and it is essential that managers prepare for the changes that will occur in time.

In the course of the literature review, I have also identified the main barriers and enablers. In Austria, barriers are IT and data security problems and the lack of a technology roadmap. In Hungary, the lack of appropriate experts, money and the lack of an Industry 4.0 strategy are slowing down the transition. In Austria, companies are confident that the introduction of digitalisation will improve their market position and domestic companies hope to become more competitive. Digital transformation will increase efficiency and effectiveness, but there are not enough experts to create a new economic structure. Industry 4.0 can have an impact on the work environment, skills development, economic growth, but it is also important to consider sustainability and environmental aspects. Cross-cutting change will help to develop smart factories and smart manufacturing.

It is also very important to improve training systems and change company structures to make the digital switchover as fast and smooth as possible. The role of employees is essential in the introduction of Industry 4.0 technologies, and it is worth encouraging and motivating them, because they can help the company to develop digitally. Therefore, it is of paramount importance that companies support employee training, but governments should also support continuous internal training programmes.

In the literature review I found that in addition to the development of different areas, internal training programs, corporate culture is also an important aspect of the digital transformation, as corporate cultures can help companies to adapt to Industry 4.0, but I felt a lack of understanding about how corporate culture is related to the Industry 4.0 strategy, is it really necessary for companies that are open to digitalization to have an innovative culture?

I thought it was important to compare Hungary and Austria, because the two countries are similar in many ways, such as the size of their territory, the number of inhabitants, their shared history, but their economic structure is very different. In 2021, Hungary's GDP in purchasing power parity terms will be 37,443 USD per capita (KSH, 2021), while Austria's GDP will be 59. But it is not enough to rely on GDP, we can only catch up with Austria if we also reach the Austrian values for human and social indicators or life expectancy.

The DESI results show that there is also a big gap in digital development between Hungary and Austria. But the two countries have different co-operative advantages, for example, Hungary has a cheaper labour force than Austria, but it is well educated. In Austria, the digital switchover started much earlier and at a higher level than in Hungary, where digitalisation started in small steps a few years after the regime change. It takes a long time to catch up, if it is necessary at all. Austria is quite well placed in terms of innovative production. Its central geographical

location in the European Union and its proximity to suppliers in Eastern and Southern Europe are advantages. Its differentiated technical and scientific education ensures the education and training of a skilled workforce. Austria, and Vienna in particular, is also a very attractive destination for international professionals. However, Austrian businesses criticise strict market regulations and high bureaucratic barriers. In Europe, it seems to take longer to reach market maturity and companies with radical innovation ideas are often attracted to places where these barriers are lower and where access to venture capital is also less (Mayrhofer et al., 2023).

6.1. Presentation of the qualitative research results using SWOT analysis

The results of the Hungarian and Austrian interviews and case studies are summarised in Table 1 below using a SWOT analysis.

Strengths	Weaknesses
<ul style="list-style-type: none"> - Openness to innovation - Initial steps towards digitalisation - Flexibility - Own decision-making competence 	<ul style="list-style-type: none"> - Lack of measurement of effectiveness - Lack of resources - Short-term Industry 4.0 strategy - Lack of modern expertise.
Opportunities	Threats
<ul style="list-style-type: none"> - Industry 4.0 experts in companies - Expanding the product portfolio - Using more digital applications - Thinking "in partnership" 	<ul style="list-style-type: none"> - Funding problems - Investment only for existing orders - Lack of information on options

Table 1: SWOT analysis of company interviews and case studies

Source: own results, 2023

The interviews show that some of the companies interviewed do not have the prerequisites in place to accelerate the pace of development and some are moving at a tremendous pace to digitalisation. There are many benefits to be gained from implementing Industry 4.0. The main benefits are increased flexibility, quality standards, efficiency and productivity. It enables mass customisation, allowing companies to meet customer needs, create value by constantly introducing new products and services to the market. Moreover, the collaboration between machines and humans can have a social impact on the lives of future workers, particularly in terms of optimising decision-making (Tjahjono et al., 2017).

The interviews and case studies revealed that almost all business leaders are open to Industry 4.0 technology. At least the initial steps towards digitisation have been taken by all interviewed companies, both on the Hungarian and Austrian side, but digitisation was not considered important for specific products. The SMEs interviewed are mostly able to make their own decisions, so that the decision to move towards a new technology can be made much faster.

According to the answers of the surveyed firms, the managers do not have full information about their options, with only one manager having contact with a university. It would be an opportunity for firms to adopt Industry 4.0 if they thought in terms of "partnership", establishing links with universities, developing with other firms to enable them to work together more effectively.

In my opinion, it would accelerate the digitalisation transition in companies if there were Industry 4.0 experts in companies who would be responsible for digital development in companies, and it would also provide further opportunities to broaden the product portfolio with new digital technology, if feasible.

Based on the results of the interviews and the case studies, I believe that it would be important for SMEs to use more digital applications. A major barrier to adoption is the lack of state-of-the-art expertise in firms that could be drivers of digitalisation progress in their companies and the effectiveness of digitalisation is mostly not measured by the companies surveyed. CEOs' Industry 4.0 strategies are shorter term, they are not thinking in terms of a long-term strategy.

The interviews and the case studies also showed that some of the companies interviewed lack the prerequisites to implement improvements faster, lack the resources to invest more in Industry 4.0, but also have companies that are moving at a huge speed to improve digitalisation. CEOs are forced to react quickly to change, and if they fail to do so and reject new business paradigms, they may even find themselves being replaced by easily replaceable business partners (Kusmin, 2018).

The findings of Bánhidi et al. (2023) suggest that micro and small enterprises, if they want to expand their activities or their workforce, should pay particular attention to making the necessary 'step up' in ICT skills when developing their growth strategy, as confirmed by the case studies and interview results.

Based on the DESI, economic indicators and industrial readiness scores for the two countries, and after a comparative analysis through interviews and case studies, I continued the research on the quantitative side, where I examined a larger sample size.

6.2. Presentation of quantitative results using SWOT analysis

To summarise the results of the quantitative analysis, I have prepared the following SWOT table:

Strengths	Weaknesses
<ul style="list-style-type: none"> - Openness to innovation - The large Austrian companies surveyed already have Industry 4.0 technology in place. - Hungarian companies have also embarked on the digitalisation path. 	<ul style="list-style-type: none"> - Lack of information on funding opportunities - Inadequate management of corporate culture - Lack of an Industry 4.0 strategy in domestic firms.
Opportunities	Threats
<ul style="list-style-type: none"> - More diverse digital applications - Partnership - Broadening information channels - Developing customer-specific areas 	<ul style="list-style-type: none"> - Lack of information from company management - Lack of expertise

Table 2: SWOT analysis of quantitative results
Source: own results, 2023

The quantitative results also confirmed that companies are open to innovation, all large companies in Austria have Industry 4.0 technologies and most of the domestic companies have also started on the path of digitalisation. My findings show that company managers are not fully aware of their options, neither on the financing side nor on the information channel side. The results were already similar during the interviews and case studies, but what came into focus even more during the quantitative study is that the management of corporate culture is a very important aspect when a company is embarking on the digitalisation journey, not only the development of a strategy. But the results show that there is a lack of focus on corporate culture management when companies start the digitalisation process and that an Industry 4.0 strategy is also missing in domestic firms.

It would be important to use more and more varied digital applications, also in small companies and cooperation with universities and other companies. I believe that the digital transition could be accelerated by broadening information channels, informing managers about the opportunities, possibly if domestic companies open up to developing customer-specific areas.

Companies that are transforming their business and operations according to the principles of Industry 4.0 face complex processes and high budgets due to interdependent technologies that influence process inputs and outputs. As the transformation of Industry 4.0 changes the way business is done and value is created, it becomes a critical concept that requires senior

management support for projects and investments. Therefore, it requires a comprehensive view of the company's strategy, organization, operations and products (Akdil at al. 2018).

6.3. Summary of qualitative and quantitative results

The main objective of the research was to assess the preparedness of companies in Hungary and Austria for Industry 4.0 and the influencing factors that are taken into account by company managers when implementing Industry 4.0 initiatives.

To summarise, the answers to the research questions formulated at the beginning of the thesis are as follows:

1. In the course of my research, I examined the readiness and maturity of Hungarian and Austrian companies for digitalisation and Industry 4.0. At the company level, there is a relevant difference between the two countries, 92.59% of the Austrian SMEs surveyed are already involved in digitisation, while 46.43% of the Hungarian SMEs are open to Industry 4.0. Of the large Hungarian enterprises surveyed, 88.89% already have some level of an Industry 4.0 strategy, while all Austrian enterprises surveyed have started to move towards Industry 4.0. Among the Hungarian companies, 18 companies consider it extremely important and 42 companies consider it important that Industry 4.0 technology makes their company competitive. But solving the human resources problem, meeting the needs of market partners, competitiveness and achieving higher profits are also important. For Austrian companies, the aspect of improving market position was significantly prominent. Nick et al. (2017) based on the results of the research "Questionnaire of the national technology platform for Industry 4.0" developed by MTA Sztaki, the majority of companies do not have an Industry 4.0 strategy, my results show that this has changed in a positive direction in recent years, more and more companies have an Industry 4.0 strategy.
2. I examined the areas where improvements supporting the implementation of Industry 4.0 have been implemented in Hungarian and Austrian companies. According to Ipar 4.0, the two main areas for Hungarian companies are the development of production and sales and the development of areas supporting production and sales. For Austrian companies, the two main areas are the development of internal processes and customer-specific areas. For them, there is a strong link between sales, service, IT, information security and customer relationship management and, for example, research and development is independent of sales development. In Austria, more and more

companies are already linking their systems with their customers in order to serve them more quickly and efficiently. Industry 4.0 technology is also extending outside the company. Hungarian and Austrian companies have mainly focused on internal improvements, but the results show that Austria is also open to developing customer-specific areas outside the company.

3. Based on my research, internal training programmes for Industry 4.0 are considered important by the managers of domestic and Austrian companies within their own industry. Based on my results, the internal training program for Industry 4.0 is production-oriented in the domestic companies and supports the two most important areas of human and digital workflow in the Austrian companies.
4. Based on the results, I believe that there is a partial difference between the domestic and the Austrian corporate culture in the companies studied and that this difference is also reflected in those companies where the Industry 4.0 strategy is already present at some level. The clan culture is also dominant in Austrian companies, but not as strongly as in domestic companies. The hierarchical culture and the market culture are also predominant in Austrian firms, and the adhocracy culture is only slightly behind the dominant culture, which promotes an innovative approach. So, based on the results, I believe that the organisational culture in Austrian firms is more supportive of the full adoption of Industry 4.0 than in domestic firms, but firms do not necessarily need to belong to the innovative adhocratic organisational culture to be open to Industry 4.0.

7. Independent, novel scientific results

Thesis 1:

When implementing Industry 4.0, domestic companies focus on strengthening competitiveness and Austrian companies on improving market position.

Thesis 2:

The development of certain areas of Industry 4.0 has a multiplier effect on the development of further areas in both domestic and Austrian companies. Domestic and Austrian companies have mainly focused on internal improvements, but the results show that Austria is also open to the development of customer-specific areas outside the company.

Thesis 3:

The internal training programme for Industry 4.0 is production-oriented in domestic companies and supports the two most important areas of human and digital workflow in Austrian companies.

Thesis 4:

There is a partial correlation between organizational culture type and the degree of Industry 4.0 readiness. While the domestic results show that the clan culture is the absolute dominant one, the Austrian results are not so clear, as the market company culture and the hierarchical one are also dominant. The organisational culture in Austrian firms is more supportive of the full implementation of Industry 4.0 than in domestic firms, but firms do not necessarily need to belong to the innovative adhocratic organisational culture to be open to Industry 4.0.

8. Conclusions, proposals

In the course of the study, I came to the conclusion that there are relevant differences in the digital readiness of Hungary and Austria, not only on a macro level, which I presented using the DESI indicator, but also on a micro level, based on qualitative and quantitative results. Domestic firms are lagging behind Austrian firms in the adoption of Industry 4.0 technologies. However, it is important to note that Hungarian managers also believe in the importance of digital transformation (Katona et al., 2023).

The analysis revealed that the biggest problem is that managers are not aware of or do not take advantage of financing opportunities, and there is also a gap in information channels. Since the Covid-19 epidemic, companies have been much more cautious about investing, and the findings suggest that the epidemic has not accelerated the digital switchover as expected.

The strengths, opportunities, threats and weaknesses identified from the SWOT analysis of the interviews were confirmed by the questionnaire survey. The results of the research show that, overall, both Austrian and Hungarian companies are open to digitalization, with all Austrian companies having Industry 4.0 technology and many Hungarian companies having already started on the path of digitalization. Small companies are also increasingly open to digitalization, for them it is essential to dare to open up to greater scope, not to remain in a constricted environment, not to shy away from innovation and renewal, even if this involves huge risks. Narrow margins can limit strategic development and raise growth problems. It can even reach the level of a medium-sized company, where management roles, work processes and organisational culture have changed completely. Of course, this also requires a completely new strategy and a new corporate culture, which may be dangerous. Some managers are happy with growth and open to new opportunities, while others are content with the status quo and do not want to open up to digitalization for fear of the risks. For large companies, digital development and the introduction of new technology takes much longer, from the decision-making process to implementation, than for a smaller company.

I think it is necessary to point out that the results of the study show that there is not enough focus on corporate culture management in domestic companies when starting digitalization processes. In the Hungarian companies studied, the clan culture is the dominant corporate culture, which does not support innovation. The DESI indicator showed the difference between the two countries, we are not at the same level of digital transformation as Austrian companies.

In my opinion, this can also be attributed to the results of the corporate culture, as the Austrian results show that companies are much more open to a market and hierarchical culture.

The literature has also repeatedly referred to the importance of management support for corporate culture in firms. The quantitative survey showed that this segment is important or highly important for 49.01% of domestic companies, unfortunately corporate culture is not a focus for the majority of companies, in contrast to Austrian companies where 79.63% of managers considered it to be highly important or important, a very positive result. This aspect could also explain the relevant difference in digital development between the two countries.

9. List of the author's relevant publications

SCIENTIFIC JOURNAL ARTICLE IN A NATIONAL JOURNAL IN A FOREIGN LANGUAGE

1. **Katona, A.** – Birkner, Z. - Péter, E.: 2023, *Expanding digitalisation for subsistence and sustainability in the heart of Europe, based on the examples of Hungarian companies*, Progress in Agricultural Engineering Sciences 19: 1 pp. 15-34., 20 p.
2. Péter, E. - Németh, K. - **Katona, A.**- Göllény-Kovács, N. – Lelkóné, T. I: 2018, *Skilled and Motivated Workforce – The Key to Success*, Pannon Management Review, Vol. 7, Issue 4, pp. 9-33

SCIENTIFIC JOURNAL ARTICLE IN AN INTERNATIONAL JOURNAL

1. **Katona, A.** – Birkner, Z. - Péter, E.: 2023, *Examining Digital Transformation Trends in Austrian and Hungarian Companies*, Sustainability, 15: Paper: 11891
2. Németh, K. - Birkner, Z. - **Katona, A.** - Göllény-Kovács, N. - Bai, A. - Balogh, P. - Gabnai, Z. - Péter, E.: 2020, *Can energy be a “local product” again?: Hungarian case study*, Sustainability, 12 : 3 Paper: 1118 , 21 p.

IN A NATIONALLY PUBLISHED JOURNAL IN HUNGARIAN

1. **Katona, A.** - Birkner, Z. - Németh, K. - Péter, E.: 2023, *Ipari digitalizációra való felkészülés eltérő méretű hazai cégeknél*, Vezetéstudomány 54: 6 pp. 47-59., 13 p.

FULL-LENGTH INTERNATIONAL CONFERENCE PUBLICATIONS IN HUNGARIAN

1. **Katona, A.** - Göllény-Kovács, N. - Péter, E.: 2021, *Ipar 4.0 megoldások a hazai vállalati szektorban*, In: Lukács, Gábor; Szanati, Angéla (szerk.) LXII. Georgikon Napok konferenciakötet A klímaváltozás kihívásai a következő évtizedekben, Keszthely, Magyarország: Szent István Egyetem, Georgikon Campus, Paper: Ipar 4.0 megoldások a hazai vállalati szektorban, 6 p.
2. **Katona, A.**: 2021, *A körforgásos szemlélet megjelenése a hazai vállalati szektorban*, In: Mezőfi, Nóra; Németh, Kornél; Péter, Erzsébet; Püspök, Krisztián (szerk.) V. Turizmus és Biztonság Nemzetközi Tudományos Konferencia tanulmánykötet, Nagykanizsa, Magyarország: Pannon Egyetem Nagykanizsai Campus (2021) 676 p. pp. 444-451., 8 p.
3. **Katona, A.** – Németh, K. – Péter, E.: 2019, *Kéz a kézben vagy külön utakon: Ipar 4.0 és a környezeti fenntarthatóság*, In: Pintér, Gábor; Csányi, Szilvia; Zsiborács, Henrik (szerk.) Innovációs kihívások a XXI. században: LXI. Georgikon Napok konferenciakötete, Keszthely, Magyarország : Pannon Egyetem Georgikon Kar, pp. 156-162., 7 p.

FULL-LENGTH NATIONAL CONFERENCE PUBLICATIONS IN HUNGARIAN

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