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AKADÉMIAI KIADÓ

Expanding digitalisation for subsistence and sustainability in the heart of Europe, based on the examples of Hungarian companies

ANDREA KATONA, ZOLTÁN BIRKNER* and ERZSÉBET PÉTER

University of Pannonia Nagykanizsa – University Center for Circular Economy, Institute of Applied Management Sciences, H-8800, Nagykanizsa, Zrínyi Miklós str. 18, Hungary

ORIGINAL RESEARCH PAPER

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ABSTRACT

The rapid technological development that is still taking place today, with increasingly interconnected IT tools, is introducing dramatic changes. The development of computer programs is rapidly transforming traditional processes and the systems that support them. It is therefore natural that the fourth industrial revolution (Industry 4.0) and its impact on Hungarian companies is one of the key topics of our time. We conducted an exploratory quantitative survey, asking 140 managers of Hungarian small, medium and large enterprises about their current situation in the context of Industry 4.0. We sought to find out to what extent the specific R&D and innovation potential of Industry 4.0 is accepted, and whether it has already been introduced in the companies. On a qualitative side, 2 case studies and 3 interviews were conducted, in which structured interviews were used to further explore the issue. We aimed to find out where SMEs stood in terms of digital preparedness and what advantages, possible disadvantages, and goals they managed to identify. Our research showed that an increasing number of companies have already decided to take the first steps towards industrial digitalisation, which will completely transform their internal processes.

KEYWORDS

industry 4.0, industrial digitalisation, SME, corporate strategy, COVID-19 epidemic

* Corresponding author. E-mail: birkner.zoltan@pen.uni-pannon.hu

1. INTRODUCTION

1.1. Understanding digital competitive advantage

The Fourth Industrial Revolution is fundamentally changing economics, society and the way businesses operate. According to Hofmann and Rüsch (2017), Industry 4.0 can be said to have been achieved when products, devices and services are networked and machines exchange information with each other in cyber-physical systems, rather than only humans communicating with each other. Filep (2020) argues that the right structure, management style and HR can prepare companies for Industry 4.0 by simplifying learning, improving skills and innovation. The involved companies are focusing their financial and intellectual resources on value-generating processes, especially production, and are also looking to improve the entire corporate value chain. Without Logistics 4.0, Industry 4.0 is inconceivable, with the same applying to planning, procurement, marketing and even controlling (Péter & Németh, 2017). It is very important that companies are able to prepare for change in time, because this can even give them a competitive advantage. According to Prause (2015), Industry 4.0 requires completely new business models and structures; a transformational process that is digital transformation itself. In the case of companies that decide to pursue the digitalisation process, it can be observed that current production systems are no longer sustainable and need to be transformed. Oláh (2019) argues that the fourth and then the fifth industrial revolution will bring about a race to digitalisation. If firms fail to keep up in this competition, they could lose their market presence.

We used both the terms "digitisation" and "digitalisation" in the manuscript, but the two terms can be distinct. In general, the term "digitisation" can be used to describe the transformation from analoge to digital data. The term "digitalisation" can be defined as the application of digital technologies, in other words, digitalisation is the impact of digitisation on society (Brennen & Kreiss, 2016). The focus of our manuscript is on digitalisation for subsistence and sustainability in the context of Hungarian enterprises. The digitalisation is also interpreted in this study as the application of digital technologies, that brings about changes in their operations caused by digitisation. The description of digitisation as the transformation from analogue to digital data has not been examined.

There are two major obstacles to the evolution of domestic businesses towards Industry 4.0: the lack of knowledge and resources. Horváth and Szabó's (2019) research findings reveal that the fourth industrial revolution poses challenges for companies in a number of areas. A new factor not discussed in previous studies was identified: concerns about the profitability of firms and uncertainties in tendering systems may hinder firms in adopting Industry 4.0 technologies. As is the case with any change, organisational resistance to adopting new technologies can be the most significant hindrance if not properly managed by companies. Organizational resistance can come from employees who are afraid of innovation and of modern tools, are afraid of losing their jobs over time, or lack the skills needed to use new technologies. Sharma et al. (2023) have similarly identified the major barriers that may hinder the adoption of new technologies related to Industry 4.0, which are implementation costs, market competition and resistance to adoption. The results of Obermayer et al. (2022) show that the three most significant obstacles that hinder the adoption of Industry 4.0 technologies by manufacturing companies are: technology compatibility, human fears and lack of digital skills. A review of the literature has identified significant

obstacles, which further push companies to prepare for change in time and to have a thoroughly developed strategy.

According to Nagy (2019), the companies surveyed agree, as confirmed by the literature, that information and the data that can be extracted from it is an important key to Industry 4.0. This data can be shared with the appropriate departments through the network and used in decision-making processes to gain a competitive advantage. Tóth-Kaszás et al (2022) conducted an empirical study to investigate the level of participation of automotive actors in digital transformation. Their study mainly focuses on digital transition, focusing on the following dimensions: strategy and leadership, human resources, business processes, supply chain, manufacturing, products and services. Based on the results, the studied domestic automotive actors were grouped into clusters. In his research, Bencsik (2021) demonstrated that there is a significant difference in the way multinational firms and SMEs think, which was recognised by analysing the terms used. While multinationals emphasised the tools of digitalisation and the role of relationships, in the thinking of SMEs the presence of people was more prominent, highlighting the importance of online presence, communication and personal relationships. Half of the companies surveyed believed that the changes taking place would not have a major impact on their management style, and only a quarter of companies felt that they needed to review their current practices.

Managers of smaller companies can have much more influence over the operation of their businesses and the management of working hours than managers of large companies do. Research by Pech and Vrchota (2020) explored hypotheses on the differences between SMEs and large companies with respect to the implementation of Industry 4.0. The results of the comparisons show that SMEs have so far lower levels of Industry 4.0 implementation. This confirms the assumption that large enterprises have more opportunities to adopt new technologies and transform themselves into smart factories. However, this may change in the future if new technologies become more accessible (e.g. through leasing) for smaller companies. The research of Demeter et al. (2019) provides valuable information on the initial steps of adapting Industry 4.0 through the example of a Hungarian multinational company. This firm's experience shows that successful digital change requires high quality change management and project management skills. In an economic environment characterised by slow growth, low inflation, limited fiscal space, the resources (initial investment, training and learning time, more flexible labour market, etc.) needed to roll out Industry 4.0 and the digital economy, and the risks of a large and rapid transition to Industry 4.0, gradualism is an advantage rather than a disadvantage. This should be reflected in the time horizon and institutional functioning of support policies (Autor, 2015; Balgova et al., 2016; Barrot et al., 2017; Birkner, 2018).

Thus, according to our own interpretation, the Industry 4.0 strategy is the definition of a set of corporate objectives for the coordinated operation and organisation of production processes, within which the different tools are now able to communicate autonomously, which includes the analysis of the corporate environment, the definition of corporate objectives, the designation of areas, the steps to be taken to achieve the system of objectives, the potential changes in corporate culture as well as the internal training programmes and developments required to implement Industry 4.0. The strategy for Industry 4.0 can be short-term, medium-term and long-term, with companies gathering information on the market and through various other channels in order to build their own strategy. This definition served as the basis for our questionnaire.

1.2. Digital economy and societal development indicator in Europe

The DESI (Digital Economy and Society Index) is an annual indicator measuring the development of the digital economy and society in EU member states. The DESI allows EU countries to discuss their economic and budgetary plans and track their progress throughout the year. The indicator tracks Member States' progress in digital competitiveness in terms of human capital, broadband connectivity, business use of digital technologies and availability of digital public services (Fig. 1).

Most Member States have made progress in digitisation, but all need to make a concerted effort to achieve the 2030 targets set out in the Digital Decade for Europe policy agenda. The 2021 DESI has been revised to be in line with the main policy priorities of the initiatives, including the Digital Compass 2030 – A European Way to Deliver the Digital Decade, which sets out Europe's digital ambitions, outlines a vision for digital transformation focusing on four main points and identifies specific targets to be met by 2030: skills, infrastructures, entrepreneurship and the digital transformation of businesses, services and public services. The policy programme "The Road to the Digital Decade", presented in September 2021, has been regrouped around the four DESI indicators. Under the Recovery and Resilience Facility (RRF), EU Member States have committed to allocate at least 20% of their national resources from the Recovery and Resilience Plan to digitalisation, and so far Member States have met or significantly exceeded this target.

The most important findings in the four areas:

Significant improvements in digital skills are expected in the coming years, with 17% of the investment in digitalisation (around €20 billion out of a total of €117 billion) earmarked for digital skills in the Recovery and Resilience Building Plans adopted by the Council so far. The Commission has also published its scoreboard "Women in a digital world", which confirms that the gender gap in specific digital skills remains significant.

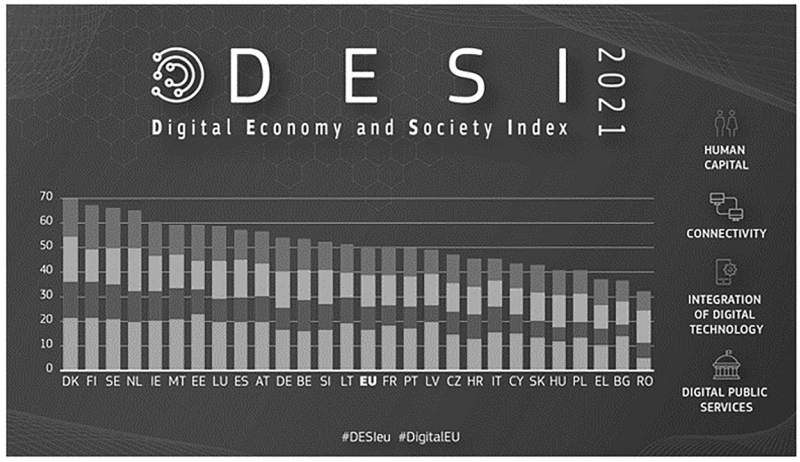

Fig. 1. DESI annual development indicator, 2021.
Source: https://digital-strategy.ec.europa.eu/en/policies/desi

Data on connectivity show an improvement in the penetration of very high capacity networks (VHCN), with 59% of households in the EU now covered, up from 50% a year ago, but still far from the overall coverage of gigabit networks that is the Digital Decade target for 2030. Commercial deployment of 5G has started in 13 Member States, mainly in urban areas.

Regarding the integration of digital technologies, the use of cloud-based technologies has increased significantly and large enterprises continue to be at the forefront of digital technology adoption. The EU aims for 90% of SMEs to have at least a basic level of digital intensity by 2030, up from 60% in 2020, and for at least 75% of businesses to use advanced digital technologies by 2030. Currently, even in the best performing countries, only a small proportion of businesses use big data technologies, so we are far from reaching the 75% target. However, it is crucial that in the Recovery and Resilience Building Plans adopted by the Council, 15% of digital investments (approximately €18 billion out of a total of €117 billion) have been earmarked for digital capacity building and digital research and development activities.

Data on digital public services do not yet show that there has been a significant improvement in the availability of e-government services. In the first year of the pandemic, several Member States upgraded their digital platforms or created new platforms to offer more services over the internet. With 37% of the investment in digitalisation (around €43 billion out of a total of €117 billion) earmarked for the development of digital public services in the recovery and resilience building plans adopted by the Council, we can expect significant improvements in this area in the coming years.

Hungary is ranked 23rd overall in the EU in 2021, down two places from its 2020 ranking, but its performance has improved at a pace broadly in line with the EU average over the past few years. The country ranks 12th in terms of internet access. It is a leader in terms of broadband penetration of 1 Gbps or more (13.2% of lines are broadband, compared to the EU average of 1.3%) and performs well on 5G (5G is a new, faster, lower response time network, effectively an upgraded version of 4G LTE) The country ranks 22nd in human capital and performs below average on most indicators. Only 49% of Hungarians have at least basic digital skills, well below the EU average of 56%, and other indicators show relatively low levels of digital skills. Hungary has developed an ambitious policy framework to address the digital skills gap. The new Digital Agenda sets out three priority areas for digital skills: 1) developing digital skills (based on the DigKomp4 framework); 2) increasing the number and skills of IT professionals and engineers; 3) supporting structural changes in education and training to develop digital skills.

Hungary is still facing challenges in the DESI framework for the integration of digital technologies in enterprises and digital public services. Hungary is ranked 26th among EU countries in terms of the integration of digital technologies into business activities and 25th in the digitisation of public services dimension. Only 46% of SMEs operating in the country have at least a basic level of digital intensity, compared to the EU average of 60%, and the penetration of high-priority digital technologies (big data, artificial intelligence and cloud) is still low. More and better support would be needed to promote digital transformation (digital transformation is the shift in mindset through which a company integrates high technology into its day-to-day operations by moving its real-world work and business processes into the virtual space). A stronger focus on users would improve the acceptance rate and the quality of services alike.

Hungary adopted its National Infocommunications Strategy 2014–2020 in 2014, the Digital Wellbeing Programme was adopted in 2015 and the Digital Wellbeing Programme 2.0 was adopted in 2017, which has been managed by the Ministry of Innovation and Technology since

2019. Since 2017, a Digital Education Strategy, a Digital Startup and Digital Export Development Strategy, a 5G deployment strategy, strategies for Artificial Intelligence (AI), digitisation of the agricultural sector, financial technology (fintech) and e-health have been developed. The aim of the Superfast Internet Programme is to deploy high-capacity optical broadband networks in underserved areas. Hungary has largely completed the implementation of the National Infocommunications Strategy 2014–2020 and the Digital Agenda for Prosperity 2.0 ("DJP 2.0") launched in 2017. In autumn 2021, a new strategic framework for the next 10 years was adopted: the 2021–2030 National Digitalisation Strategy (NDS) 1. The strategy is based on the four main dimensions of the DESI: digital infrastructure, digital competence, digital economy and digital state. The overarching objective of the NDS is to identify and exploit the potential of digitalisation in the economy, education, research, development and innovation (RDI) and public administration, thereby improving the country's competitiveness and prosperity. Hungary aims to surpass the EU average in digital development by the middle of the decade and to be one of the top 10 EU economies in digitalisation by 2030.

1.3. The effect of the COVID-19 pandemic on digitalisation

The coronavirus outbreak has accelerated the spread of Industry 4.0. The pandemic has triggered processes that have radically transformed economic and business practices. In the short term, many companies were forced to shut down and, unfortunately, many were forced to close permanently. These closures mainly affected smaller companies and those that focused on a single area. In the best cases, workers had to take time off work, possibly working reduced hours, but increased hygiene standards and measures had to be taken by almost all companies. Companies that had more diverse operations were able to remain more flexible. According to Piller (2020), the impact of the COVID-19 pandemic on companies has been so drastic that it has become important to develop strategic options for the future. Business models that respond to changing economic and societal behaviour and new demands will prevail, leveraging the technological opportunities underpinning Industry 4.0. The future evolution and increasing digitalisation of industrial production offers huge opportunities to increase the sustainability of Industry 4.0. The COVID-19 crisis has confirmed the importance of governance with a strong focus on environmental and social sustainability. Digitalisation and new value chain constellations can lead to significant improvements in lower material and energy consumption throughout the product life cycle, from design to manufacturing, maintenance and waste management – and society is demanding that companies take advantage of these opportunities.

Companies are increasingly focusing on online communication, automating processes and creating home office conditions. The epidemic has made it necessary to ensure access to digital tools and the Internet, which help people to work from home. This situation has further highlighted the importance of digital readiness and flexibility for companies to adapt more quickly to changing circumstances. Priority was given to maintaining their productivity; in order to avoid being forced to shut down, companies were forced to react quickly to the pandemic situation, mainly through strict epidemiological measures and by outsourcing jobs not directly related to production from home office.

The organisational functioning of firms has also had to be completely rethought in the light of the situation. Many firms also had to change their performance management and how to

motivate employees in the long term. There were employees who became more motivated by working from home and were even more efficient than at the workplace.

The general crisis management strategy that is typical of Hungarian firms:
(*Source:* https://ifka.hu)

- Reducing company expenditure by cutting working hours, postponing investments, etc.
- Exploit flexible partnerships with employees, customers, and suppliers, e.g. by modifying delivery and payment deadlines
- Extensive gathering of information and experience from other companies
- Introduction of sanitary and epidemiological measures (provision of hand sanitizers and masks)
- Ensuring conditions of operation, avoiding downtime (reorganising work, setting up a home office, ensuring availability of raw materials, increasing stock)
- Launching new forms of sales (online ordering, home delivery),
- Finding out about government support programmes, soft loans and how to make use of them
- Modifying business models (restructuring, downsizing or adding new branches and activities)
- Creating conditions for more long-term, crisis-resilient operations (higher level of reserves, multi-faceted approach, conscious relationship management)

The companies that were able to adapt most quickly to the situation created by the epidemic were those in the IT sector, so moving their activities online was not a major problem. Consumer and business relations have also moved online, with more and more companies introducing online sales.

Companies have become much more cautious in the wake of the epidemic, trying to be even more cost-efficient and making sure that any loss of suppliers or customers does not cause an insurmountable problem for them.

2. RESEARCH QUESTIONS AND METHODOLOGY

The study has been supported by the Ministry of Technology and Industry in the framework of the project "Studies in the service of business-based innovation and the performance of an analysis and research related to tourism security", IGSZF/2032-1/2021-ITM_SZERZ, in collaboration with Bay Zoltán Applied Research Non-profit Ltd.

We conducted a quantitative exploratory questionnaire survey with managers of small, medium and large companies in Hungary. In compiling our questionnaire, we mainly drew on the project of the "Industry 4.0 National Technology Platform" questionnaire developed by MTA Sztaki, which assessed the needs and expectations of industry and strategic economic management, and the current situation of Industry 4.0 in the companies surveyed. The data collection was carried out face-to-face, online, and by e-mail, with a total of 140 questionnaires having been collected, using a snowball sampling method. It was performed between December 2020 and January 2022.

The questionnaires were divided into three main areas, strategy and organisation, employees and new digital technology, to investigate the readiness, current situation, future plans and opportunities for Industry 4.0 in the companies surveyed. As for qualitative research, we conducted 2 case studies and 3 podcast interviews on where SMEs stand in terms of digital readiness, and what advantages and disadvantages they report. The interviews were conducted in 2022.

2.1. Characteristics of the companies included in the empirical research

The demographic data of the companies surveyed are presented below (Katona et al., 2020). In the selected industries, Industry 4.0 is already present, and where it plays a prominent role, we also surveyed manufacturing and service companies. Of the CEOs surveyed, 64% have a tertiary education, 2 have a Ph.D. or doctorate, and 87 CEOs have a college or university degree, which makes up 62% of the CEOs. 9 of them have a high school diploma + OKJ certificates (below college level post-high school education), 2 have a high school diploma, 27 have technical high school diplomas and OKJ certificates, 9 have technical high school diplomas and 4 company managers have a vocational training qualification (see Table 1).

In terms of company size, companies with less than 1,501 employees were more active, with 18 companies with more than 1,501 employees completing our questionnaire, of which 4 companies are in the electronics industry and 3 companies are in the machinery manufacturing industry. The latter industry is also prominent among smaller firms, with 25% of the companies surveyed responding from this industry. In terms of the distribution by ownership structure, there is only one state-owned company in the warehousing and support activities for transportation among the surveyed ones, most of them being domestic private companies, 88 in total. Thirty-nine companies are foreign-owned and 12 are jointly owned. The process of deciding on

Table 1. Presentation of surveyed companies by industry and size

	Company size (Number of employees)					
Industries	0–10	11–50	51–250	251–1,500	More than 1,501	Total
Manufacture of machinery and machine equipment	3	10	9	7	6	35
Trading and repair of motor vehicles and motorcycles	6	0	3	2	3	14
Repair of machinery, equipment and tools	4	2	0	0	0	6
Wholesale trade	1	7	8	3	1	20
Warehousing and support activities for transportation	2	9	5	1	1	18
Manufacture of miscellaneous transport vehicles	0	1	3	3	1	8
Wholesale and retail trade and repair of motor vehicles and motorcycles	0	7	0	0	0	7
Manufacture of rubber and plastic products	0	1	4	4	1	10
Manufacture of computers, electronic and optical products	0	2	1	5	4	12
Manufacture of chemicals and chemical products	0	5	1	1	1	8
Manufacture of electrical equipment	0	0	1	1	0	2
Total	16	44	35	27	18	140

Source: own editing, 2022.

a new strategy is much simpler for domestic privately owned firms, new ideas can be implemented in a much shorter time, and it is easier to implement a new strategy if needed.

2.2. Research results and evaluation

An increasing number of business leaders in Hungary believe that digital transformation is important, and it is time to take the first steps towards Industry 4.0 technology, or if this has already been done, to make further improvements. Out of 140 companies, only 37 CEOs said that Industry 4.0 is not at all important for competitiveness, while 103 CEOs said that it is important and indispensable for their companies. Of the 37 companies, the most common strategy is to follow and retreat, i.e. their competitive strategy consists of either defending their existing market share or stabilising their market positions, or specialising in a segment of the target market; this is more typical of small companies. Small firms are more adaptable to the specific needs of a particular area and can more easily become specialists in certain fields. The Table 2 below shows companies with an already implemented Industry 4.0 strategy.

The data show that three of the eight companies belong to the automotive and motorcycle dealership and repair industry, where the main focus is not on workflow but rather on the use of cloud-based systems, especially of smart applications and Big Data storage. The introduction of Industry 4.0 technology has enabled them to serve their customers even faster. Among the companies which have implemented Industry 4.0, there are three companies with between 11 and 50 employees, that have used EU grant funding, development loans, or domestic grant funding. The companies that have already implemented an Industry 4.0 strategy are all thinking in terms of a medium-to long-term strategy. In total, only two companies are planning to implement a short-term strategy; one company is in the process of implementing a strategy and the other is in the process of developing its own, while all other companies have prepared their strategy for the medium term.

Table 2. The distribution of financing sources used for the company's Industry 4.0 developments in case of strategy implemented

Industry	Company size	Strategy	Source
Warehousing and support activities for transport.	11–50	Following	EU Grant
Trade and repair of motor vehicles and motorcycles.	251–1,500	Leading	Own source
Manufacture of machines and machinery equipment.	251–1,500	Leading	Own source
Wholesale	251–1,500	Leading	Domestic grant support
Trade and repair of motor vehicles and motorcycles	251–1,500	Leading	Own source
Wholesale	11–50	Following	Development loan
Trade and repair of motor vehicles and motorcycles.	11–50	Leading	Domestic grant support
Manufacture of computers, electronic and optical products.	More than 1,500 employees	Leading	Own source

Source: own editing, 2022.

We further explored the issue, wondering what the most important aspects of implementing an Industry 4.0 strategy are. The survey showed that the most important benefits managers expect to gain from digitalisation are competitiveness, improved market position and higher profits, i.e. the ability to operate more efficiently.

We looked at companies that have already implemented Industry 4.0 and those that are still in the process of implementing it, to see which aspects influence the decision-making of company managers the most. This is shown in Fig. 2.

Out of the 8 companies already applying Industry 4.0, only 1 company highlighted that environmental constraints influenced their decision to implement it, and out of the 24 companies where the strategy is still under implementation, 3 firms' managers believe that environmental constraints are the reason why they want to implement digital transformation in their companies. Very few CEOs think that they would implement Industry 4.0 because of environmental concerns, with 2.85% of the 140 companies surveyed selecting this response option. They are much more motivated by the improved competitiveness they hope to achieve through industrial digitalisation, in order to generate higher profits or strengthen their market position.

For the question on the internal training programme, managers could select more than one response option. Most respondents thought that data protection, mobile technologies, apprenticeship programmes, and robotics were the most essential. Robotics is mainly prioritised in the electronics industry, mobile technologies and data protection were also ranked highly by smaller companies, but innovation management, additive processes, cyber-physical manufacturing systems, Web2, and Big Data management were not considered as important by CEOs, with fewer than 10 executives indicating these internal training programmes as important. The list also included ITIL training, which was not considered by any of the managers to be an important internal training programme for employees in Industry 4.0 (see Fig. 3).

The above data clearly shows that most companies (70) do not yet have an internal training programme for Industry 4.0, although many more companies could embrace digitalisation if more interest was shown in internal training programmes. The implementation of Industry 4.0 depends to a large extent on expertise, and it is important that managers are engaged in training their employees.

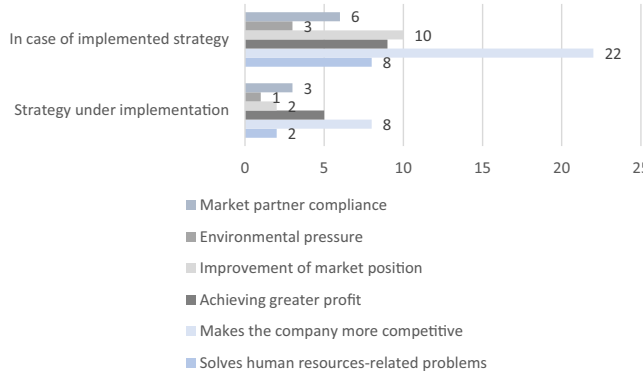

Fig. 2. Key aspects of implementing an Industry 4.0 strategy.
Source: own editing, 2022

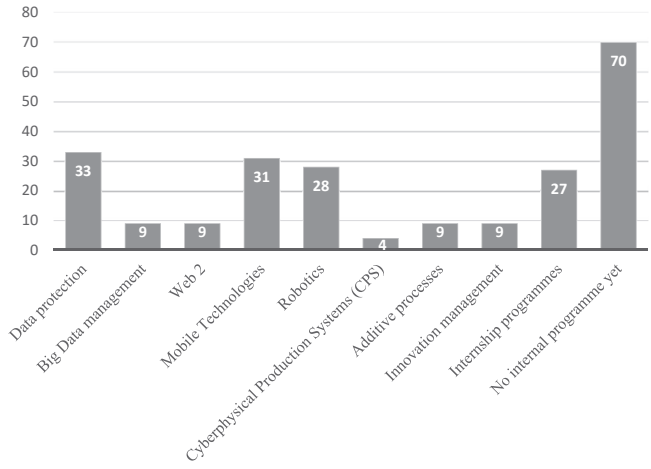

Fig. 3. Distribution of internal training programmes in the surveyed companies. *Source:* own editing, 2022

It is essential that employees are motivated to learn new knowledge, as this will determine to a large extent the digital development of the company and how actively employees participate in the process.

2.3. Introduction of the qualitative research results

2.3.1. Case studies and their results. The case studies were conducted with medium-sized companies. The first case study relates to Grif-Tools Kft, one of the most dynamically growing Hungarian-owned companies in Eger. It is a market-leading manufacturer of industrial electronic special purpose tools, producing parts for Tesla, Volvo, BMW, but also playing a prominent role in other areas of the electronics industry. The company has been active in the machinery industry since 2007. They design and manufacture production support machines and tools for their domestic and foreign customers. Owing to their high-tech machinery and skilled employees, they have established a stable market position in Hungary.

The company's managers, Zsolt Csufor and István Forgács, are innovative-minded professionals, who emphasize continuous development and innovation, thus encouraging the efficient operation of their own business. They believe it is particularly important to identify problems at an early stage and then find effective solutions to address them. Continuous self-training is of paramount importance, much of which is gained through professional experience, which creates opportunities for portfolio expansion. The uncertainty caused by the COVID 19 pandemic was only a problem for a short period: the company was able to adapt quickly to the changed market situation, for example by changing the way it communicates by implementing web-meetings. Furthermore, other improvements have continued being carried out as well. In addition, the industry, despite the constant challenges (such as shortage of parts and logistical difficulties), has also encouraged its suppliers to launch several new projects.

The management of Grif Tools Ltd. is entirely focused on the future, thinking with the customers in mind, and has worked on developing solutions that make the users' work easier and open up the possibility of using new technologies (robotization).

Since the company's foundation, the requirements of Grif Tools Ltd's operation and Industry 4.0 have been very similar, although the definition of Industry 4.0 emerged later. Digitalisation within the company has been present from the very beginning, which has now evolved into an extensive production coordination, logistics, and administration system, and has been continuously expanded as the company has evolved. The internal part of Industry 4.0 is used in the company to manage the available material and resource capacity for production and traceability through laser marking, RFID and QR code technologies. In addition, a database-driven web-based IT system has been developed, which carries personalised information based on unique identifiers for all position levels, be it for physical labourers, logistics personnel or management. The external part of the system is used for customer relations and customer satisfaction. This creates opportunities to free up internal capacity, e.g. for a web-based order confirmation system or tracking system.

Digitalization is a key tool for Grif Tools Ltd. to interact with its customers, and the motivating force for each development always comes from thinking with the customer in mind, with the intention of improving and making everyday life easier. They are proud of the excellent relationship they have with their customers and the company's staff are also helpful and eager to help with any needs that arise. They apply a high level of 'DFM - design for manufacturing' in their manufacturing and organisational operations. This allows them to be efficient both in terms of materials and time, with mutual benefits for both the end user and the manufacturer.

The company's managers say that maintaining continuous improvement is key, and they place a strong emphasis on this in their daily work and firmly believe in the importance of innovation.

The other case study is about ECT Hungary Kft. ECT Hungary Kft is a Hungarian company based in Zalaegerszeg, Hungary. The company's activities include: design and manufacture of ICT and functional Test Fixture, test software development and on-site installation of test fixtures. The company was founded on 25 September 2001, then in 2020 Mac-Tech Kft. and Elite Interfaces Ltd. joined forces to become the owners of ECT in Hungary, and in 2021 Mac-Tech Kft. became the sole owner of ECT. The current number of employees is 70. ECT Hungary Kft. is a dynamically expanding and developing team, with the main objective to implement LEAN approach to the maximum extent possible and to meet the ever increasing customer requirements beyond ISO certification.

The management of the company is continuously striving for improvements in digitalisation and believes that the implementation of Industry 4.0 is not an ideal goal for ECT Hungary Kft., as custom product development and specifically unique prototyping requires a uniquely solution-oriented approach at both project and manufacturing level, where people are the main participants and creators of value. Continuous improvement and efficiency gains are thus considered of paramount importance.

There was no downtime due to the COVID-19 pandemic, and investments in company laptops in 2019 were "just in time", so the transition to home office did not cause any problems. Company executives said they increasingly prefer online meetings to face-to-face meetings.

ECT Hungary Kft. has taken further advances towards digitalisation on several fronts. They use proprietary software in their work. The PAS (Production Assistant Software) is an AI-based

self-developing program created by their own staff, specifically designed for the company's needs, and is under continuous development. It displays information on all current projects in progress, including status, scheduling, customer expectations and missing materials.

An upgrade is planned by the end of 2022, by which time all new projects will be entered into the system, with detailed information on the project, i.e. its complexity, the materials needed to implement the project, what is in stock, and what is not, and when it will be delivered, as well as the capacity of the project and the approximate time of completion. In case the date calculated is unsuitable, a recalculation can be requested, with modifications that would allow the project to be completed at an earlier date. With this software development, the company will achieve increased efficiency, especially in scheduling tasks, capacity planning and thus production, reducing the time needed for information gathering, time-consuming face-to-face meetings and possible dead/standstill times. Work instructions, manuals and production support documents were previously issued on paper, but this is also being changed over time. It is planned that information will be displayed on a monitor at each workstation instead of on paper (such as work instructions, installation manuals, etc).

Customers used to receive product-specific documentation on CDs and later on flash drives, but the management changed this 2.5 years ago. All customers have a cloud storage to upload all the necessary data and documentation to. This is part of the company's internal administration, protected by a firewall and backed up regularly. Each customer is given a link and using the link anyone can access their own product-specific documentation, so they can log in and download the data they need, which is only available in the cloud for a limited time.

In recent years, ECT Hungary Kft. has invested a lot in digital development in order to ensure high-quality service. These developments also cover the transformation of the entire operational, electrical, IT and mechanical engineering, the results of which will be available to the employees, visitors and management based on unique authorizations, among other things, on the interactive interfaces. It is important for the company that its customers and business partners regard it as an innovative, rapidly developing, reliable partner that provides excellent professional quality and support.

2.4. The podcast interviews and their results

We have conducted three podcast interviews, the first one with Balázs Tordai, Industry 4.0 expert from the Association of IT Enterprises (IVSZ). We learned how IVSZ can help companies in the process of digitalisation. The other two interviews were conducted with two SME managers: István Liker from Liker Motors Kft. and István Sándor from EMR Kft. We gained insight into where these SMEs with very different market situations and business approaches stand in reality in the process of Industry 4.0 implementation.

2.5. Interview with Balázs Tordai, IVSZ's industry 4.0 expert

Balázs Tordai spoke about the important work of the IVSZ. The Association was originally set up to bring IT companies together in some way, and then its main activity became supporting digitalisation. The IVSZ is "the association for digitalisation": it is mainly companies who want to go digital that approach them. Their visibility is helped by their podcasts and projects through which they provide expertise.

Balázs said that in 80% of cases, an SME wants to go digital for some efficiency reason. The other motivating factor is more of an external pressure factor, there are for example industries where it is important to strive for zero waste, and digitalisation can help a lot in this respect. There is another important motivating factor: interest. The vast majority of businesses that come into contact with the IVSZ are family businesses. One of the main drivers of digitalisation in the future could be to engage these transforming family businesses and to focus on promoting intra-family work sharing for SMEs.

What Mr. Tordai said is confirmed by the results of the quantitative study in which 140 managers of SMEs and large companies were asked how open they are to the technology offered by Industry 4.0 and what they expect most from digitalisation (see Fig. 2).

IVSZ has already supported the transformation of hundreds of domestic companies. According to their experience, the smaller a company is, the more help it needs: mentoring, coaching, showing how to implement such a process and how to start a project based on it. In the future, a designated post-graduate training course will become instrumental in training future project managers on how to help SMEs in their digital transformation, even over a period of several months if necessary.

Several projects are currently underway to this end, such as GINOP 1.1.3, sometimes called Industry 4.0, or the pilot factory or pilot plant project. Within this framework, companies with exemplary performance are invited to show SMEs something new in the field of digitalisation. It is then up to the SMEs to decide whether they want to go further down this path, whether they want to learn more about this topic. This can be mastered in different depths depending on the company, such a transformation can take up to 1.5–2 years. Mr. Tordai suggests that if a company wants to open up to digitalisation, it should be a member of the IVSZ, so that they can get access to enough information, enough suppliers and colleagues from whom they can get more information, help and support on the topic.

The results of our national survey also showed that companies are open to digitalisation projects, but not many of those surveyed have taken advantage of them. Out of 140 companies that have already implemented an Industry 4.0 strategy (8 companies), a total of 3 small companies have used EU grant funding, development loans or domestic grant funding to implement Industry 4.0 technology. Among the large companies, four have implemented the development from their own resources and only one company has applied for domestic grant support (see Table 2).

2.6. Interview with the CEO of Liker Motors Kft

István Liker, Managing Director of Liker Motors Kft., said that digitalisation started early, many years ago, when his father was managing the company. The company was 40 years old last year. They manufacture and repair electrical machinery and have more than 200 employees. Their partners include major companies such as Siemens, Wilo, and ABB. They produce more than 70,000 electric motors a year, all of them hand-made, so for them, robotisation is not as important as digitalisation. Not only accounting and payroll, but the entire production, warehousing, recipe management, and every other process that occurs in the company is programmed and tracked by computer technology. Consequently, there were also disadvantages: digitalisation forced department managers into the office, to their computer. To compensate for this, colleagues have to spend a prescribed number of hours out in the production area: everyone has to spend at least 2 h of the working day moving between workers and monitoring workflow.

The efficiency gains from digitalisation are not usually measured in numbers, but they are measured in terms of employee performance and their pay is set on that basis. The company's improvement is continuous, although it has slowed down recently, because they have reached a higher level where they can only optimise minor details. But improvements are constantly being planned, for example, to ensure that delivery notes do not have to be compiled manually but are generated automatically, and to better integrate operations that are already partly digitised: processes that can be run automatically should be run that way, without having to be checked separately.

We also asked Mr. Likert about what he recommends for companies that are now planning to move forward with digitalisation. He said that these companies are a little late: it is worth accelerating their progress, because without digitised processes, a business will not be productive enough in a few years. Those that do not achieve this breakthrough in the upcoming time will have to spend a lot of their own energy (manager's and colleagues' overtime) on it. For anyone who wants to digitise, it is important to think carefully and research what computer software or system they are using to digitise, because it is easier to implement a system than to replace one. Replacing a system can be an almost insurmountable task for many companies that already have a system in place.

The interviews and the previous survey also show that among domestic SMEs, there are companies where the preconditions are not in place to implement improvements at a more rapid rate, but there are also companies where progress with digitalisation is happening at a faster pace. The interviews also confirmed that the process of deciding on a new strategy in domestic privately owned companies can indeed be carried out quickly, as there is no need to wait for the parent company's approval. This research showed that small companies are in many cases even more prepared for change than larger companies.

Out of the 140 small, medium and large companies surveyed, 30 small companies have taken measures towards implementing Industry 4.0 at various levels; some have only just formulated a strategy, while others have already developed, implemented, piloted or even completely implemented it (Table 3). This is a surprisingly high number compared to medium-sized companies, of which 20 companies claimed to fall into the listed categories.

Table 3. Summary table on the status of small businesses' Industry 4.0 strategy

Staff	Industry	Supply chain	Industry 4.0 status
0–10	Manufacture of machines and machinery equipment	Raw material supplier.	Strategy under development
0–10	Wholesale	End-product supplier	Strategy formulated
0–10	Repair of industrial machinery, equipment and tools	Parts supplier	Strategy being implemented
0–10	Trade and repair of motor vehicles and motorcycles	Service provider	Strategy formulated
0–10	Repair of industrial machinery, equipment and tools	Service provider	Strategy formulated
11–50	Wholesale	Service provider	Strategy formulated
11–50	Manufacture of other transport equipment	End-product producer	Strategy under development
11–50	Manufacture of chemicals and chemical products	End-product producer	Strategy under development.

(continued)

Table 3. Continued

Staff	Industry	Supply chain	Industry 4.0 status
11–50	Manufacture of machines and machinery equipment	Parts supplier	Strategy formulated.
11–50	Manufacture of chemical materials and chemical products	End-product producer	Strategy under development
11–50	Motor vehicle, motorcycle trade and repair	Service provider	Strategy under development
11–50	Warehousing and support activities for transportation	Service provider	Strategy being implemented
11–50	Manufacture of chemical materials and chemical products	End-product producer	Strategy formulated
11–50	Repair of industrial machinery, equipment and tools	Service provider	Strategy being implemented
11–50	Motor vehicle, motorcycle trade and repair	Service provider	Strategy formulated
11–50	Manufacture of machines and machinery equipment	Module or system supplier	Strategy being implemented
11–50	Manufacture of machines and machinery equipment	Module or system supplier	Strategy formulated
11–50	Warehousing and support activities for transportation	Service provider	Strategy realized
11–50	Motor vehicle, motorcycle trade and repair	Service provider	Strategy being implemented
11–50	Warehousing and support activities for transportation	Service provider	Strategy formulated
11–50	Repair of industrial machinery, equipment and tools	Service provider	Strategy being implemented
11–50	Warehousing and support activities for transportation	Service provider	Strategy being implemented
11–50	Motor vehicle, motorcycle trade and repair	Service provider	Pilot implementation started
11–50	Manufacture of computers, electronic and optical products	End-product producer	Strategy under development
11–50	Wholesale	Service provider	Strategy formulated
11–50	Wholesale	Service provider	Strategy realized
11–50	Motor vehicle, motorcycle trade and repair	Service provider	Strategy realized
11–50	Manufacture of machines and machinery equipment.	End-product producer	Strategy under development
11–50	Manufacture of machines and machinery equipment.	Parts supplier	Strategy formulated
11–50	Wholesale	Service provider	Strategy formulated

Source: own editing, 2022.

This is confirmed by Liker Ltd's report: they believe it is important to be at the forefront of change, which can give them a significant competitive advantage over their competitors.

2.7. Interview with the CEO of EMR Kft

István Sándor, Managing Director of EMR Ltd., presented his 17-strong company, which operates as a family business. Their main activity is the manufacture and repair of electrical machinery, with repairs covering high-current electronic equipment. Their partners include the Budapest Transport Company, HÉV, MÁV and Metro Other activities include the repair of oily transformers. Their digital equipment consists mainly of CNC machines, lathes, bandsaws and tools for office and accounting. Mr. Sándor considers digitalisation important for all SMEs, because it can facilitate the work and reduce the time spent on it. However, he believes that Industry 4.0 can create a burden for an SME that is no longer profitable and is not very feasible for a repair company, for example.

For ease of storage and retrieval, whatever they can record on the computer in the EMR, such as the fault record sheet, is used as a basis for repairs. For as long as these were stored on paper, it was difficult to track and retrieve older repairs. Now they are recorded on a computer and searches can be made for previous repairs by job number, so it is easier to be prepared if they are ordered to repair the same type of engine.

Regarding development opportunities, the manager mainly uses the internet and is in contact with a company that writes grant applications and provides information on the opportunities available to his company. In the future, they would like to digitise the employee entry/exit system, so that it would be easier to transfer the information to accounting and payroll. In the past, they have been given several opportunities to upgrade to near-production status with a new engine design, but their company could not take up the opportunity due to its small size, as it would have meant an increased workload that could have made the company's operations precarious if it failed to cover the cost of production with the planned orders.

Finally, we also asked Mr. Sándor what he recommends to business leaders who are now planning to go digital. He believes it is important for companies to examine how much digital technology can be used in their vision for the future and only if they have future contracts and orders should they start to digitalise.

During the questionnaire survey, we were also interested in which of the information channels related to Industry 4.0 the company managers use, and where they obtain information about new developments and opportunities. Companies could indicate several answers to this question as well. We created the Table 4 below based on the feedback.

In line with this, István Liker mentioned getting information through personal exchanges, and István Sándor said he gets information about digital novelties from the internet.

Of course, when a business opens up to new technologies, it often requires a completely new strategy, which can be a risky endeavour. A professional association such as the IVSZ can help to ensure that such change can take place in the safest possible manner. However, there are also companies that do not want to take risks and are content with the status quo, or whose profile does not require a huge digital transformation, as the case of EMR Ltd. illustrates. While digitalisation can now make life easier for all SMEs, the same depth of change is not required everywhere, but openness and interest in new technologies is essential for SMEs to develop and compete.

Table 4. Assessment of information channels related to Industry 4.0

Information channels related to I. 4.0	Highly relevant	Rather relevant	Rather not relevant	Not at all relevant
Internet	78	51	9	2
Professional journals	24	56	49	11
Professional exhibitions.	26	78	27	9
Conferences	29	66	33	12
Personal information exchange	42	58	22	18
Contact with universities	11	46	46	37
Through dissemination via Centers of Excellence	5	33	54	48

Source: own editing, 2022.

3. CONCLUSIONS AND RECOMMENDATIONS

There is almost no industry that is not affected by this rapid change. The "smart" tools of Industry 4.0 are already capable of collecting, analysing, evaluating and using huge amounts of data at lightning speed. This data and information will enable, facilitate, improve and accelerate the optimisation of production, business processes and industrial operations. Digitalisation is now not only indispensable, but certainly one of the most important tools for business survival and sustainability.

Our quantitative study provided insights by surveying 140 small, medium and large enterprises about their level of readiness for Industry 4.0 and how many of them have already implemented the technology. The quantitative and qualitative surveys showed that more and more companies are moving towards digitalisation and that the most motivating factors in doing so are to become more competitive and efficient. Companies are still lagging behind in the area of internal training programmes, but perhaps this will become more of a focus in the future. Through case studies, two innovative medium-sized companies' CEOs were featured, who, even after the outbreak of the coronavirus pandemic, remained on the path of digitalisation and invested even more energy and time in further developing their company.

The interviews showed that not all companies are interested in digitalisation, and some do not want to take the risk of such a transformation. The key for all companies is to find a level of digitalisation that is accessible to them and that allows them to operate more efficiently. The survey showed that there are companies where the conditions are not right for further improvements, but there are also companies that are moving at a fast pace along the path of digitalisation. Through the examples of small and medium-sized companies presented in the interviews and case studies, it is clear that in a domestic private company, the decision process to go digital can be carried out quickly, giving them an advantage over large companies.

Managers need to adapt and give their employees all the support they can to keep up with market changes, but not all firms in the industry are under the same degree of market pressure. The way in which companies perceive and manage change and their flexibility is key to their success, and it is therefore essential that companies prepare for changes in the market well in advance so that they can respond appropriately and in a timely manner.

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