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Examining Contactless Digital Technologies (CDTs) in the Midst of the COVID-19

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Abstract

The COVID-19 pandemic brought CDTs to the forefront of business life. This study provides an important insight into a specific country's context, which has not been sufficiently investigated. This paper aims 1) to investigate how companies' general characteristics impact the use of contactless digital technologies (CDTs) in Hungary; 2) to examine employees' attitudes regarding the use of CDTs; and 3) to explore how firms have tried to enhance employees' acceptance of CDTs. A computer-assisted data collection (CAPI) was carried out during the coronavirus (COVID-19) period. The online questionnaire was completed by employees of Hungarian companies. Descriptive statistics and relationship analyses (Cramer's V and Kendall's Tau) were used to analyse the collected data ($n = 151$). Results indicate that 1) the general characteristics of companies, such as their profile and size, have a significant impact on the use of CDTs; 2) the typical attitude of employees towards CDTs is rather positive; and 3) the acceptance of the use of CDTs can be supported by practical rather than theoretical solutions. The result can add value and stimulate new research related to the usage of CDTs, potentially serving as a useful benchmark for other countries.

Keywords:

COVID-19;
Contactless; Attitude;
Digital; Technology;
Relationship Analyses.

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1- Introduction

Digital transformation has become an imperative for most organisations in our world of emergent and continuous change. This generates a disruptive effect with respect to traditional procedures in terms of the way products are produced and exchanged as well as how business is carried out [1]. Advances in digital technologies occur at breath-taking speed, such as cloud-based applications [2], big data analytics [3], social media [4], artificial intelligence [5], machine learning, Internet of things [6], autonomous robots [7], 3D printing, virtual and augmented reality (VR & AR), and the platforms built with these technologies [8]. In this context, digitalisation refers to the adoption of digital technology for turning interactions, communications, business activities, and business models into (more) digital versions, interconnecting people, products, systems, and industries through real-time data exchange [9–11]. Thus, a digital company is an organisation that partially or fully manages significant business processes and relationships with its stakeholders (suppliers, customers, employees, and business partners) by digital means [12].

The global outbreak of the coronavirus pandemic (COVID-19) has led to an exponential boost in the growth and use of contactless digital technologies (CDTs) [13]. CDTs have been a powerful enabler for business continuity in the context of confinement. Most organisations have been forced to implement new ways of remote working using CDTs for communication and to completely rethink their business models to adapt to the realities of the COVID-19

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environment [14]. For example, with the rise in teleworking, videoconferencing tools such as Apple's FaceTime, Microsoft's Skype, or Zoom, have experienced huge growth [15]. Flexible manufacturing systems have helped companies to quickly change their production processes and produce some of the tools urgently needed to treat patients in hospitals, for example, ventilators for patients and hand sanitisers for medical staff [13]. Ford has started to produce face shields using its 3D printing capabilities [16]. Finally, Amazon recently opened a convenience store with no human cashier in Seattle [17].

Recent studies have investigated the use of CDTs in many countries, such as South Korea and Japan [18], UK [19], US [20], Australia [21], China, and France [22, 23]. However, studies regarding Central European countries are missing. Central European countries such as the Czech Republic, Hungary, Poland, and Slovakia (hereafter, the CE4) play a key role in the European supply chain, especially in relation to Germany [24]. German firms shifted large parts of their production to these countries, thereby deepening economic integration within the region. The coronavirus (COVID-19) pandemic has profoundly disrupted supply chains throughout the world and in Europe as well [25–27]. The CE4 companies also experienced heavy disruptions in nodes of their supply chains, especially in Hungary, where the rate of disruptions in supply chain nodes was extremely high (95.92%) compared to the other three countries [28]. While Hungary is among the most industrialised countries in Europe in terms of manufacturing output versus GDP, the country is below the European average in terms of using digital technologies and the degree of automation [29]. This paper therefore seeks to investigate the use of CDTs at company level in Hungary during the COVID-19 crisis. Current studies also show that these technologies are mainly used by large and manufacturing companies [30–32], but the COVID-19 pandemic has accelerated the organisations' implementation of CDTs regardless of company characteristics. This raises the question as to whether organisational factors such as profile and size influence the use of CDTs. The answer to this question is important since organisations that include large companies and small-and medium-enterprises (SMEs) are considered the engine of economic growth in Hungary [33, 34].

In addition, recent studies highlight the importance of the human dimension to using digital technologies [35, 36] revealing that human resources are identified as one of the main barriers to implementing new digital technologies [37]. Organisations have had to adopt CDTs during the pandemic, thereby changing their traditional business models and moving to online services and products and have had to implement alternative workspaces to comply with social distancing requirements [38, 39]. The increased use of CDTs has caused several problems from a human perspective. Companies have been forced into rapid 'big bang' introduction of contactless technologies in an unprecedented and time pressured manner [14]. In many cases there has been little training on how the practices and associated technology should be introduced and integrated or adopted to suit the new workplace context. This can cause problem to employees, who may be afraid of not having the appropriate skills to use new CDTs [33]. In addition, the increasing use of new digital technologies will decrease the number of jobs [40, 41], which creates the fear of job loss [42, 43]. An important source of negative attitudes towards new digital technologies can be traced back to employees' fear of losing their jobs because technology may replace human work [44]. Therefore, a lack of understanding of the new CDTs, and employees' fear of losing their jobs can be critical factors affecting the successful implementation of CDTs. As employee attitudes play a key role in the implementation of CDTs, in this paper we explore the typical attitude of employees regarding their implementation. For practitioners and companies venturing into CDTs implementation, this study also provides a fundamental understanding and identifies factors that can enhance employees' acceptance in terms of using CDTs. For example, several studies have highlighted that one of the biggest challenges in using new digital technologies is the requirement to retrain employees to fit changed circumstances [45–47]. Exploring employees' attitudes and factors enhancing employees' acceptance regarding CDTs are even more important given that CDTs are likely to continue to play an increasing role in the way that companies operate in a safer post-COVID-19 world [48].

Consequently, this study seeks to investigate the following research questions:

RQ1. Is the use of CDTs influenced by general characteristics of the companies, such as their profile and size?

RQ2. What is the typical attitude of employees regarding CDTs?

RQ3. How can employees' acceptance in terms of CDTs be enhanced?

This paper contributes to CDT research in the following aspects. First, we investigate how companies' general characteristics impact the use of CDTs in Hungary. Based on the DESI 2020 report (Digital Economy and Society Index), Hungary ranks 21st out of 28 EU Member States, lagging behind in the integration of digital technologies in businesses [49]. To improve the current situation, the Digital Workforce Programme including IT training supports companies to have digitally skilled workforces in Hungary [49]. Our paper discusses the use of CDTs and explores the current situation in Hungary. Relationship analyses are applied to address this topic. Second, we empirically examine employees' attitude regarding the use of CDTs. Previous literature finds that workers are afraid of new digital technologies in the context of manufacturing industry [42, 44]. However, our paper finds that Hungarian employees' attitude in that respect is positive. Third, the study explores how firms have tried to enhance employees' acceptance of CDTs. This is highly relevant because CDTs will play an increasing role in companies' operation after the COVID-19 world [48].

The following flowchart (Figure 1) summarises the process of the research. Section 1 listed the research questions (see above). Section 2 provides the theoretical background of the study. In Section 3, the research methodology of empirical data collection is outlined, and statistical analysis is introduced. This is followed by the empirical results in Section 4. We conclude the study in Section 5 by summarising key findings, practical implications, limitations of this study, and future research needs.

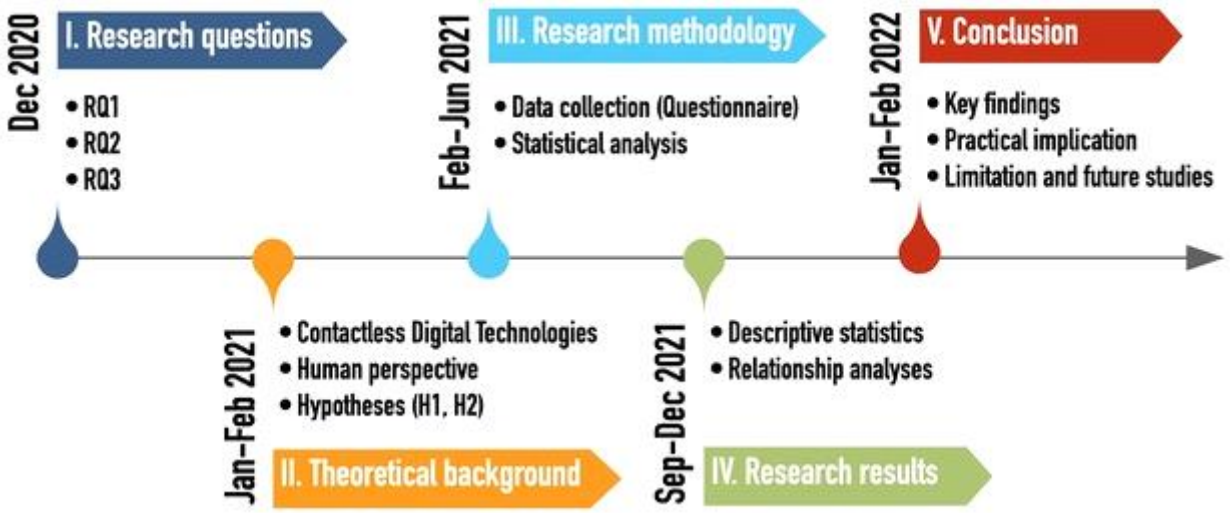


Figure 1. Flowchart of the research methodology

2- Theoretical Background

2-1- Contactless Digital Technologies

The new digital age is characterised by unstoppable change in the business environment. The "Contactless Economy" made the COVID-19 crisis different from previous ones, as this crisis was unprecedented and a "new normal" was being created. The most important factor differentiating this crisis is the rise of the contactless economy [50]. With the appearance of COVID-19, the contactless economy has been driven by the rise of the contactless (touchless/ remote/untact) digital technologies, which have become the new normal. The necessity for innovations and entirely new technologies has increasingly demanded more collaboration between humans and technologies [51]. These technologies play a central role in organisational innovation [52, 53] and enhance the dynamic capabilities of organisations, affording them the agility, flexibility, and adaptability required to align corporate strategies to changes in the environment [17]. Organisations are already adopting new concepts using CDTs, both to promote their businesses and grapple with pandemic-induced impacts [51].

Many studies have been conducted on digital technologies in the last decade. However, most of the research has been in fields related to large companies of manufacturing industry [30–32], and few have been in SMEs or in the service sector [54–57]. Huge opportunities lie in better flexibility and scalability of manufacturing systems through digital technologies and industrial automation [58]. By adopting digital technologies, manufacturing businesses create connections between their machinery, supply chain systems, and production facilities [30]. Advanced digital technologies allow manufacturing companies to reduce production, logistical and quality management costs [31], as well as to increase productivity, improve product development, achieve faster time-to-market, add value to products, and enhance customer focus [32].

In this paper, we investigate the usage of the following CDTs: Enterprise Resource Planning (ERP) system, social media, cloud-based collaborative technologies, flexible manufacturing systems/production planning and scheduling, autonomous robots, big data, and data mining.

2-1-1- ERP System

ERP is a comprehensive integrated system that governs all aspects of a business and provides remote automation and integration for core business processes such as taking customer orders, planning operations, and maintaining inventory records and commercial data. ERP may be hosted on a server outside the country and the services made available most of the time through the network as a contactless technology [59]. In most cases, the ERP system is used by large manufacturing companies, but nowadays it is extended to other sectors too [60].

2-1-2- Social Media

Social media equips organisations with powerful tools that are changing the means of communicating and collaborating. The rapid spread of social media can be characterised by three factors namely, interactivity, speed, and

cost-effectiveness [61, 62]. In a contactless environment, since transactions do not require human interaction, value is created using digital technologies [63]. Social media is adopted by both large companies and SMEs; however, large firms can readily use social media and develop competences more rapidly on account of their superior resources, which place them ahead of social network curve compared to smaller firms [61, 64]. Social media offers powerful channels for collaboration and contactless digital cooperation with clients, suppliers, and partners [65, 66].

In the EU, seventy-five percent of large organisations used social media as a part of their operations in 2019, to support image building and product marketing, as well as to build and maintain customer relationships [67]. The main purposes of using social media tools were communicating directly with clients (57.8%), and sharing marketing messages (53.4%) [68]. In Hungary there are 8.01 million internet users and 7.09 million social media users (the total population is 9.65 million), which means that more than 70% of the population use social media [69]. The most popular social media platforms, which are based on the number of people that marketers can reach using adverts are Facebook (6 million), Messenger (5.1 million) and Instagram (2.5 million) [69].

2-1-3- Cloud-Based Collaborative Technologies

These tools and systems are designed to better facilitate group work remotely. Collaborative tools use the Internet and central remote servers to maintain shared documents, files, software and applications through a cloud-based service that computers or mobile devices can access on demand. These technologies trim the costs and time associated with facilitating group work, in areas ranging from designating roles and responsibilities to routing in-situ documents to checking and approving project parts [70]. In recent days, virtual collaborative technologies have received increased attention from manufacturing industries. Collaborative infrastructure facilitates an effective integration of internal and external manufacturing resources, and supports business collaboration, where clients and providers are interfaced with each other virtually [71].

2-1-4- Flexible Manufacturing Systems/Production Planning and Scheduling

Flexibility of manufacturing systems has become an important issue which has led to the development of flexible manufacturing systems (FMS). This unique production system encapsulates various components such as computer programmed machine tools, automated material handling systems and robots [72]. FMS is a highly automated technology machine cell consisting of a group of processing workstations interconnected by an automated material handling and storage system and controlled by a distributed computer system [73]. Remote controlling and monitoring of the manufacturing through the automated systems negates the necessity of human presence [40]. FMS has supported organisations to quickly change their production processes and produce some of the tools that suddenly became an urgent requirement when COVID-19 appeared [13].

2-1-5- Autonomous Robots

An intelligent, autonomous robot is a machine directed to obtain information from its environment and apply the knowledge about its word to remote safely in a purposeful and significant manner [74]. Industrial robots are becoming more autonomous and cooperative, interacting with one another to improve productivity and product quality. These autonomous systems play an essential role in the successful digital transformation of manufacturing [75]. In production, autonomous robots are required for repetitive operations of high volume, where a robot has unrivalled advantages in terms of its speed, precision, and durability. Meanwhile, robots used to assist humans with more complicated activities afford further industrial automation solutions, allowing humans to concentrate on creativity, productivity, and other dynamic processes [76]. Moreover, as compared with a human workforce, autonomous robots have obvious advantages such as intrinsic immunity to the COVID-19 virus and the impossibility of a human-robot-human spread of any disease-causing pathogens, though there are still many technical hurdles for the robotics industry to overcome [40].

2-1-6- Big Data and Data Mining

The increased use of digital technologies comes from the growing amount of digital data. Big volumes of data processing and storage require infrastructure and resources. These volumes of data are called "*Big Data*" [77]. The 4V (Volume, Variety, Velocity, and Value) definition is recognised because it highlights the meaning and necessity of big data [78]. Data mining is the process of finding patterns and correlations within big data sets to predict outcomes [79]. Big Data gives, both SMEs and large companies, the inestimable opportunity to perform novel, dynamic and scalable data analysis more quickly than before [54]. However, their results showed that handling and enhancing Big Data is particularly relevant for large companies, as they are more affected by a huge growth of data. Big Data is stored in local servers if instant access is required, while confidential data can be stored in secured private cloud databases. The data can be retrieved or accessed from remote locations by authorised users leveraging the appropriate remote connection frameworks [51].

H1. The use of CDTs is significantly influenced by the general characteristics of the companies, such as the profile and the size.

2-2- Human Perspective

Digital transformation is associated with a high level of uncertainty, involves risks, and can lead to negative human reactions [80]. There are growing fears that automation will start displacing jobs at a very fast rate and leave less room for human work [44]. For now, though, automation is determining only a typical structural change and digital technologies will not have a deep impact on employment [81]. As manufacturing has moved from manual processes to automation, this will be followed by low-skilled jobs becoming redundant [82]. Hence, total automation is unbelievable, as digital technologies cannot completely replace human abilities. Human factors will still play a crucial role [83, 84].

Digital transformation increases the possibility for processes to be controlled remotely, using CDTs, thus allowing continuous adjustment of production and consumption cycles. These technologies provide a communication flow at all stages of the business process. The advent of digital technologies will decrease the number of jobs in assembling lines and productions [41], and in the meantime will increase the demand for high-skilled workers [85]. In dealing with human capital restructuring [86], all companies should retrain and upskill their workers to enhance their readiness to combat increases in unemployment and shortages of talent [87].

Companies have tried to implement digital technologies, but their workers often have refused to collaborate [29]. The resistance mostly originated from unskilled and low-skilled workers with routine jobs [43], who may have felt the fear of job loss most acutely [42, 43]. In many cases the lack of understanding of the digital technologies, and the employees' fear of the unknown are obvious. Employees are frightened of losing their jobs because of increasing digitalisation, and afraid of not having the appropriate skills to handle new technologies [33]. During the COVID-19 pandemic, individuals were willing to consider social innovations they would not have accepted under normal circumstances. The control of travelling and the replacement of humans by artificial intelligence and robots, ideas which were quite unpopular before the crisis, are now considered effective solutions [13]. COVID-19 prompted workers to change their work practises rapidly and to conduct meetings remotely. The pandemic has therefore brought CDTs to the forefront of human life [48].

H2. Employees are afraid of using CDTs.

3- Methodology

The aims of the research are to investigate how companies' general characteristics impact the use of CDTs in Hungary; to examine the employees' attitude regarding the use of CDTs; and to explore how firms have tried to enhance employees' acceptance of CDTs.

3-1- Data Collection

During the data collection process, a pilot questionnaire was compiled, which was tested by companies' employees who had the opportunity to give feedback about the comprehensibility of the content. Based on the feedback, the questionnaire was finalised and sent out to approximately 1,000 Hungarian companies by the snowball sampling method. Computer-assisted data collection (CAPI) resulted in 151 evaluably completed questionnaires. The questionnaires were collected via the online LimeSurvey system. The study was conducted in 2021 from February 1 to June 30. Appendix I contains the complete questionnaire. All the main questions related to CDTs: how often they were used, the typical attitudes of employees of the implementation of CDTs, and the methods that can be used to bring workers closer to the adoption and application of CDTs. Three additional questions were included in the questionnaire about the general characteristics of the company: its profile (manufacturing or service provider), the number of employees (10 or less, 11-50, 51-250, more than 250) and the annual net sales in EUR million (2 or less, 2-10, 10-50, more than 50). Each question was closed and only one of the possible answers could be marked.

3-2- Sample

As a first step, the general characteristics of the sampled companies are described. Regarding the profile of the companies (B1), 56% of the sample are service providers and 44% are manufacturers. In terms of ownership, 68% are nationally owned, 29% are foreign subsidiaries, and 3% are jointly owned. The 3 industries from which most fills came are the following: 21% from the manufacturing industry, 11% from building industry and 11% from other services. The sample consisted mostly of small enterprises (employing 50 or less people) and medium-sized (employing 51-250 people), the least represented of large companies (see Figure 2). This reflects the entire Hungarian corporate sector in view of the predominance of small and medium-sized companies.

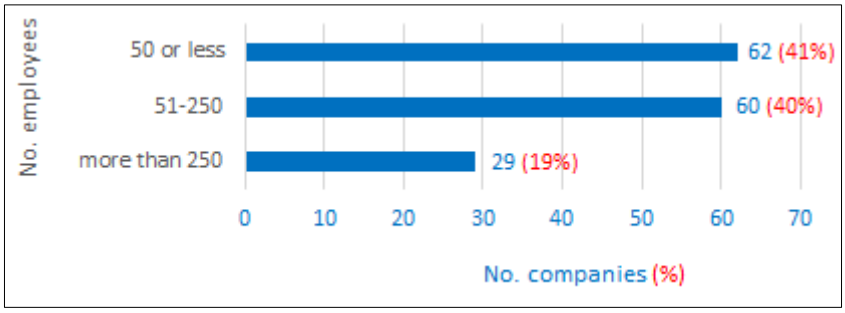


Figure 2. Number of employees (B2, n=151)

Figure 3 describes that the annual net sales are in the smallest category (maximum 2 million EUR) for the most part of the sample. This is not surprising, as Figure 2 shows that the sample typically included SMEs (companies with up to 250 employees).

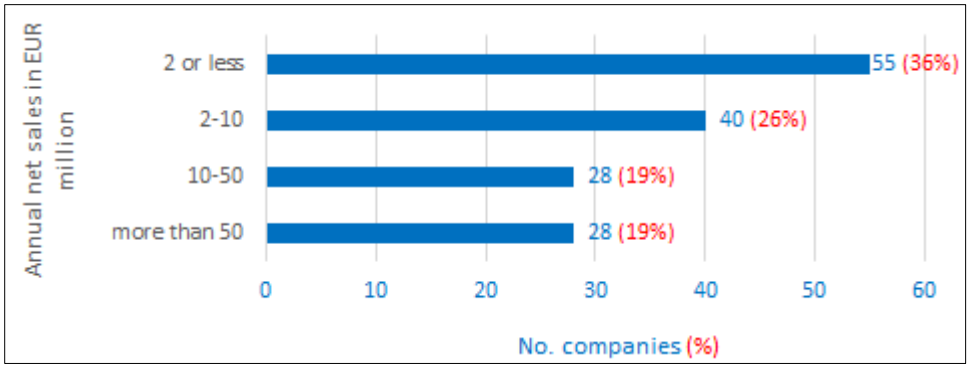
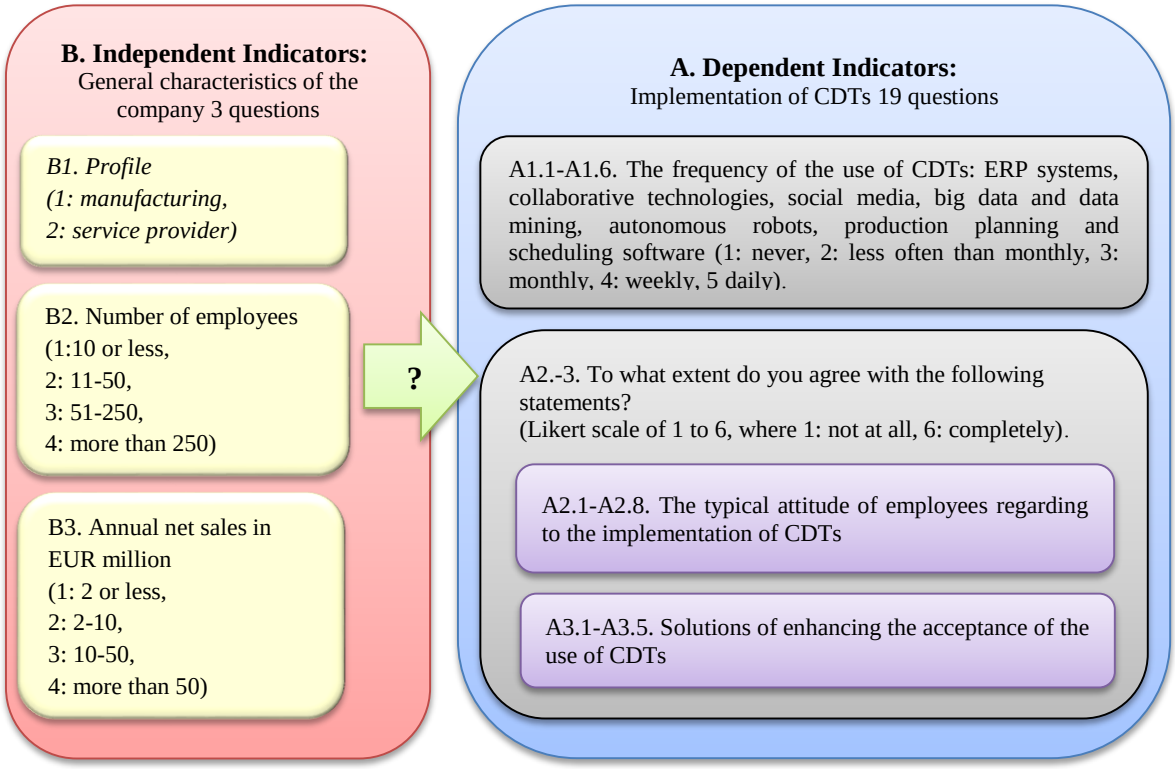


Figure 3. Annual net sales in EUR million (B3, n=151)

3-3-Analysis

The analysis is based on a quantitative methodology namely descriptive statistics and relationship analyses were applied. In the context of descriptive statistics, the distribution of answers for each question is illustrated in a diagram. Regarding relationship analyses Figure 4 shows the research model that categorises the questions of the survey into two groups: dependent (A) and independent (B) variables.



Note(s): *Italic fonts indicate variables that can be measured at only a nominal level.*
The measurement level of other variables is ordinal.

Figure 4. Research model

All variables can be measured on an ordinal scale, except the profile of the company (B1), which is nominal only. 57 relationships can be examined between the 19 dependent and 3 independent variables ($3 \cdot 19 = 57$). Their measurement scale determines the type of coefficient to be calculated for the relationship test. The effect of company profile (B1) on the implementation of new technologies (A) is interpreted as an association relationship and is quantified by Cramer's V coefficient (V), which can take on a value in the interval [0, 1]. The effect of the number of employees (B2) or annual net sales (B3) on the implementation of new technologies (A) can be interpreted as rank correlations. Kendall's Tau (τ) is suitable for exploring these relationships which vary in the interval [-1, 1]. The results were defined at a significance level of 5%. If the p-value of V or τ is less than 0.05, the relationship can be considered significant between the two variables. The absolute value of significant results indicates the strength of the relationship [88]:

- *0: there is no relationship*
- *[0, 0.2[: weak relationship*
- *[0.2, 0.7[: moderate relationship*
- *[0.7 1[: strong relationship*
- *1: deterministic relationship*

Since τ can take both positive and negative values, the sign of it can also be interpreted, which gives the direction of the relationship. Negative (positive) τ means that the higher the rank of one variable, the lower (higher) the rank of the other variable is expected to be.

4- Results

Figure 5 illustrates the frequency of application of six CDTs. Most companies use ERP system, social media, cloud-based collaborative technologies daily. This is not surprising, given that ERP is the most widely used technology, and social media and cloud-based collaborative technologies are the most used CDTs by individuals, who made even greater use of them during COVID-19.

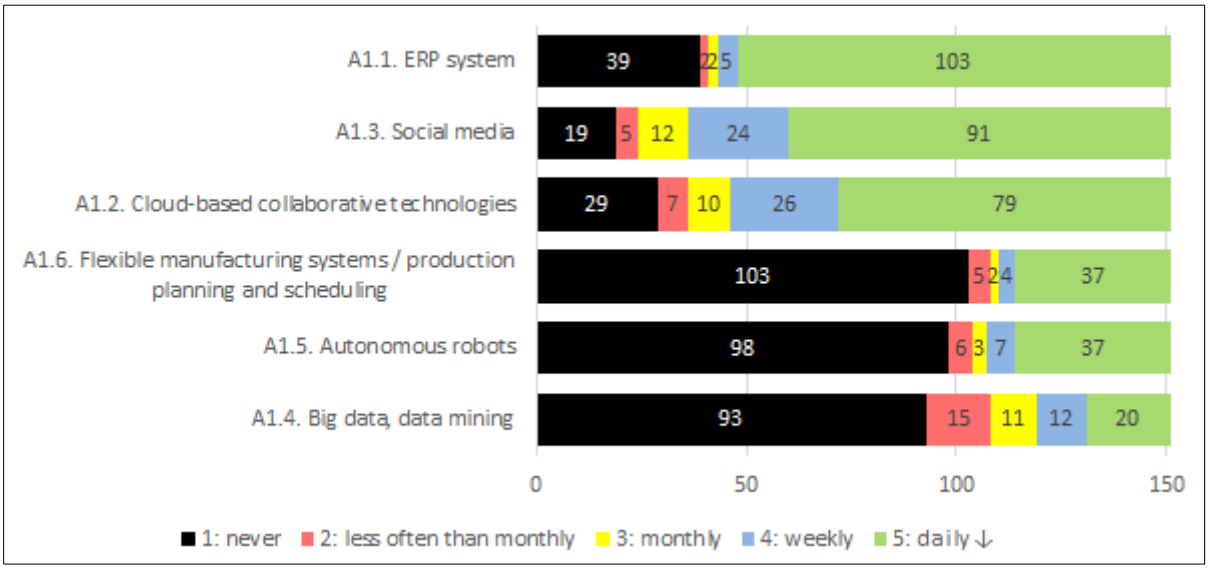


Figure 5. The frequency of the use of CDTs (A1, n=151)

If we distinguish the responses in Figure 5 by whether the company uses the CDT with any frequency (response codes 2-5) or has never used them (response code 1), it can be concluded that social media (A1.3) are used by most respondents, and the flexible manufacturing systems/production planning and scheduling (A1.6) have never been used by the majority.

Figure 6 describes the typical attitude of employees when introducing new technology. They are waiting for the implementation of new technologies typically with interest. In Figure 6, distinguishing the answers in such a way that respondents tend to agree with it (4-6 coded answers) or not (1-3 coded answers), it can be concluded that most employees have a positive attitude regarding to the implementation of CDTs. They welcome these changes (A2.1) or at least await them with interest (A2.2), and do not reject (A2.8) or ignore them (A2.7). In addition, the fears of implementing CDTs are also clearly visible in Figure 6. Among the fears, employees are most afraid of the possibility of a failure (A2.4) and being controlled (A2.5), and they are less afraid of losing their job (A2.6). The reason for these findings may be that during COVID-19 employees were not taught how to use these technologies; working independently from home may also have caused some to fear being controlled more strictly.

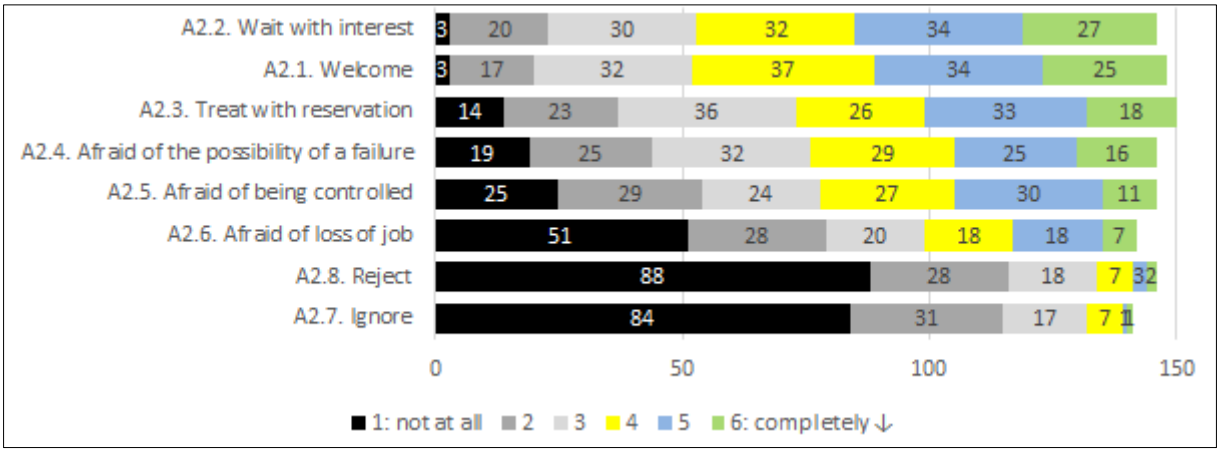


Figure 6. The typical attitude of employees regarding to the implementation of CDTs (A2, n=141-150)

Figure 7 illustrates that the workers typically can be brought closer to the use of CDTs most with practical training (A3.4), however, least with as part of a presentation on CDTs (A3.2).

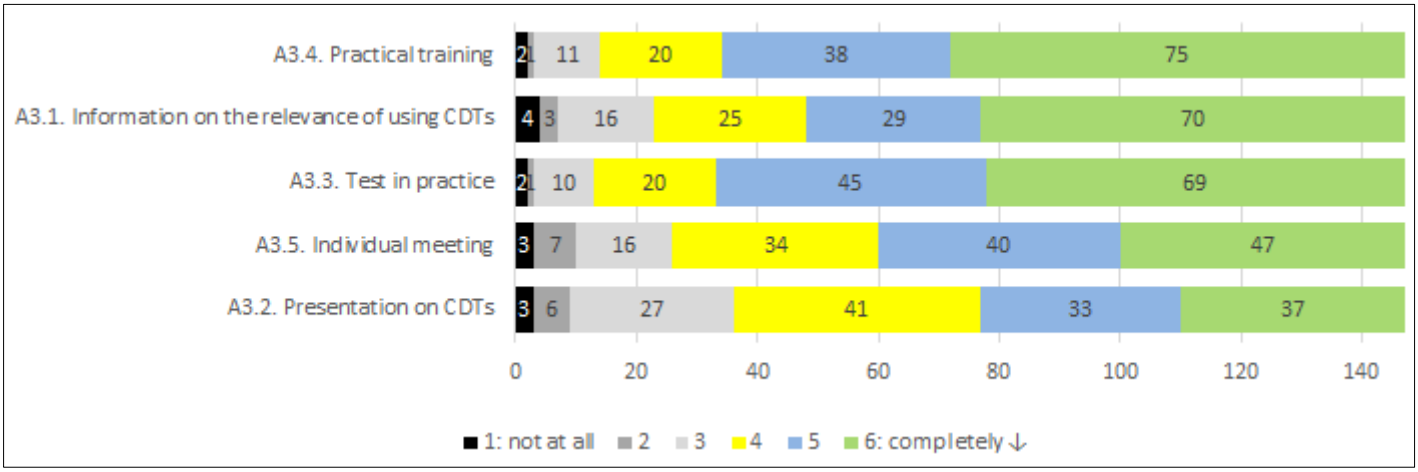


Figure 7. Solutions of enhancing the acceptance of the use of CDTs (A3, n=147)

Separating the responses in Figure 7 by agreeing more (4-6 coded answers) or not (1-3 coded answers), the results show that the majority tend to agree that any of the 5 techniques listed can bring workers closer to implementing CDTs, the most popular options being testing in practice (A3.3), and practical training (A3.4). However, COVID-19 made this difficult to achieve, due to the decrease in physical contact. Theoretical methods were thought to be the least effective, such as presentation on CDTs (A3.2) information on the relevance of using CDTs (A3.1) and individual meeting (A3.5).

In the second step, the results of the relationship tests are presented, which are summarised in Table 1. Based on the results, the companies' profile can be analysed to see whether it influences the implementation and use of CDTs. According to the results of Cramer's V, a statistically significant, moderate relationship was identified between the profile (B1) and the following variables: the frequency of use of CDTs (A1), workers' fear of being controlled (A2.5) and loss of job (A2.6), bringing employees closer to the use of CDTs with individual meeting (A3.5). Comparing the service and manufacturing sectors, we can conclude that there is a higher proportion of companies within the manufacturing sector that:

- Use the listed CDTs (A1) at any frequency (all answers but 1, which means never).
- Employees are more afraid of CDTs (answers with 4-6 codes) because they fear being controlled (A2.5) or the loss of their job (A2.6).
- Rather agree (answers with 4-6 codes) that workers can be brought closer to the use of CDTs with individual meetings (A3.5).

According to Kendall's Tau coefficients (the last two columns), several statistically significant, weak, or moderate positive relationships were identified between independent variables and company size (number of employees (B2) and sales (B3)). The more employees a company has and the higher its sales, the more often they use the listed CDTs (A1). The only weak, rather than moderate relationship can be noticed for social media. It means that firms with different

number of employees and sales use social media with similar frequency. The strongest relationships are experienced between variables such as using ERP systems (A1.1) and company size. This may be due to the facts that 1) ERP systems have been used for the longest time in organisations and 2) in large companies, the ERP system is an important condition for efficient operation [60].

Table 1. The results of the relationship analysis

					B. Independent variables		
					B1.	B2.	B3.
					Profile	Employees	Sales
					V*	τ**	τ**
A. Dependent variables	A1. The frequency of the use of CDTs (1: never, 2: less often than monthly, 3: monthly, 4: weekly, 5: daily)		ERP systems	A1.1.	0.372	0.440	0.442
			Cloud-based collaborative technologies	A1.2.	0.344	0.309	0.242
			Social media	A1.3.	0.274	0.192	0.144
			Big data and data mining	A1.4.	0.275	0.278	0.286
			Autonomous robots	A1.5.	0.564	0.437	0.383
			Flexible manufacturing systems / production planning and scheduling	A1.6.	0.569	0.298	0.325
	A2-3. To what extent do you agree with the following statements? (Likert scale of 1 to 6, where 1: not at all, 6: completely)	A2. The typical attitude of employees regarding to the introduction of CDTs	Welcome	A2.1.			
			Wait with interest	A2.2.			
			Treat with reservations	A2.3.		0.268	0.199
			Afraid of the possibility of a failure	A2.4.		0.222	0.189
			Afraid of being controlled	A2.5.	0.282	0.196	
			Afraid of loss of job	A2.6.	0.280	0.243	0.207
			Ignore	A2.7.			
			Reject	A2.8.			
		A3. Solutions of enhancing the acceptance of the use of CDTs	Information on the relevance of using CDTs	A3.1.		0.176	0.212
			Presentation on CDTs	A3.2.			
			Test in practice	A3.3.			
			Practical training	A3.4.		0.145	0.141
			Individual meeting	A3.5.	0.324		

*V: Cramer's V, **τ: Kendall's Tau; Colour Key: the strength of the significant results is weaker stronger

In addition, as Figure 6 shows, most employees have a positive attitude regarding the implementation of CDTs. In case of variables that show a positive attitude such as wait with interest (A2.2), welcome (A2.1), not reject (A2.8), and not ignore (A2.7) we could not find any significant relationship with company size. However, in case of variables that show a negative attitude such as treat with reservation (A2.3), afraid of the possibility of a failure caused by CDTs (A2.4), afraid of being controlled (A2.5), and afraid of loss of job (A2.6) we found a significant relationship with company size. This means that the smaller (larger) the company is, the lower (higher) the fear of their employees. In larger companies, the employees appear to be less cared about and they were more afraid of all the factors such as making failures, being controlled, and losing their job. In smaller companies, the culture was more cohesive, and the company could pay more attention to the employees; consequently, the employees were more loyal.

Moreover, regarding efforts to enhance the acceptance of the use of CDTs, our results show a positive significant relationship with company size. The larger the company is, the more their employees think practical training (A3.4) and information on the relevance of using CDTs (A3.1) are important. However, we could not find any significant relationship in the case of a presentation on CDTs (A3.2) and testing in practice (A3.3). The distribution of responses was similar for manufacturing and service companies on the 1-6 scale, and there was no significant difference between companies' responses when the number of employees and sales categories were taken into account.

5- Conclusions

5-1- Key Findings

The goal of this study was to investigate how companies' general characteristics impact the use of CDTs in Hungary; to examine the employees' attitudes regarding the use of CDTs; and to explore the firm's solutions to enhance employees' acceptance in terms of the usage of CDTs. Regarding the first research question (RQ1), we hypothesised that the use of CDTs is significantly influenced by the general characteristics of the companies, such as their profile and

size (H1). This hypothesis is accepted based on the results of relationship analyses (see Table 1), and the following statement can be formulated. The more the profile is geared towards manufacturing and the larger the company is, the greater the use of CDTs. Along similar lines to Ardito et al. [30], Rojko [31], and Savastano et al. [32], our empirical research results show that CDTs are used more often by large manufacturing companies. Other previous studies, such as Galati et al. and Pekkala and van Zoonen, indicated in parallel that most organisations use social media as a part of their operations [61, 67]. Our findings are also consistent with the Shamsuzzoha et al. empirical survey [71], as collaborative technologies are adopted by the manufacturing industry, which was the second most used CDT. The findings also agree with the results of Salih and Abdulrazaq regarding the large extent of use of ERP systems in the manufacturing sector, as it is the third most popular technology [60].

The second research question (RQ2) concerned the typical attitude of employees regarding CDTs. We hypothesised that employees are afraid of using CDTs (H2). This hypothesis is rejected by our research results. The typical attitude of employees towards CDTs is more positive than negative. The smaller the company is, the lower the fear of its employees. In terms of their attitude, most employees are not afraid of losing their job due to the increasing use of digital technologies, a discovery which contradicts the findings of Horváth and Szabó [33], Kinzel [42], and Sciutti et al. [43].

The third research question (RQ3) relates to the solution of enhancing the acceptance of the use of CDTs. Our results have shown that the acceptance of CDTs can be supported by practical rather than theoretical solutions. Along similar lines to the verdict of Molino et al. [89], we found that opportunities for information, practical training, and testing in practice can lead to greater technology acceptance. In addition, the larger the company is, the more their employees tend to expect practical training and information on the relevance of using CDTs.

5-2- Practical Implications

Our findings have a useful practical implication for the companies using CDTs. The advent of CDTs, investigated in this paper, is changing the nature of work and the future of employment and the job market. The recent COVID-19 pandemic has accelerated the use of CDTs and put the emphasis on the skills and attitudes of workers. The use of CDTs changed the types of competencies needed in the workplace and demanded a shift in mindset among workers. Our research results show that employees are willing to get information on the relevance of using CDTs and need practical training and testing on digital technologies in practice. Moreover, as most of the respondents welcome these changes or at least await their implementation with interest, and they neither reject nor ignore them, companies may now adopt CDTs if they have the financial background.

The European Commission monitors EU Member States' digital progress through the Digital Economy and Society Index (DESI) [49]. In the DESI 2020 report, Hungary ranks 21st out of 28 EU Member States. According to the data, Hungary lags behind other countries in terms of the integration of digital technologies into businesses. Most Hungarian companies do not exploit the opportunities provided by digital technologies, such as cloud computing and big data. The use of ERP systems is the lowest in the EU. Unexpectedly, it does not match the findings of our results. On digital technologies, only 6% of companies rely on big data solutions and 11% use cloud computing. Most businesses, especially SMEs, still do not take advantage of digital technologies. Where human capital is concerned, over half of the population lacks basic digital skills and software skills. The COVID-19 pandemic affects companies and employees' attitudes. The use of CDTs encourages workers to be much more independent. It can shorten the time of problem solving and learning with practical (online) training. One of the most important elements in digital transformation is the role of training employees and providing ongoing professional support to them. In Hungary, the Digital Workforce Programme includes different training programmes, such as general IT training, on-the-job training, and specific training for career changers, which can support companies to have digitally skilled workforces [49].

Based on our research findings, we wish to highlight two of the studied CDTs in particular: cloud-based collaborative technologies and social media. Cloud-based collaborative technologies are designed to facilitate group work remotely, and in the meantime, reduce costs and time. Social media tools could bring information sharing, communication, and marketing to a new level. It offers a great opportunity for high exposure at a low cost and the possibility for interactive communication. These findings also agree with the results obtained by Criado et al. regarding the use of collaborative technologies and social media, as these technologies had a significant role during the COVID-19 pandemic [90].

5-3- Limitation and Future Studies

Despite these contributions, the current study has certain limitations that offer opportunities for further research. First, the study's results were based on a sample drawn from Hungary. For further research, since the topic is relevant and under-researched, other countries should be analysed. Thus, the conclusions of this paper can be testified by samples in different countries' contexts and can be compared and extended. This would provide further validity to our study.

Second, given the quantitative nature of the research, further qualitative research may be needed to produce more nuanced insights. A case study method, for example, would make it possible to investigate the phenomenon of interest

within its broad context [91]. A case study is suitable for exploring corporate best practices, especially where they concern workers' skills and attitudes, and their practical training related to CDTs. Third, this study investigated the relationship between the usage of CDTs and organisational general characteristics and human attitudes during the COVID-19 pandemic. A longitudinal study would further develop our understanding of how the role of CDTs changed after the COVID-19 period.

Despite these limitations, this study advances our knowledge of understanding the relationship between the use of CDTs and general company characteristics. Besides, as an important socio-technical phenomenon, we investigated the attitude of employees regarding the implementation of CDTs and explored the solutions that can lead to greater technology acceptance.

6- Declarations

6-1- Author Contributions

Conceptualization, N.O., T.Cs. and Zs.B.; methodology, Zs.B.; software, Zs.B.; validation, Zs.B.; formal analysis, Zs.B.; investigation, Zs.B.; resources, N.O. and T.Cs; data curation, Zs.B.; writing—original draft preparation, N.O., T.Cs and Zs.B.; writing—review and editing, N.O., T.Cs and Zs.B.; visualization, Zs.B.; supervision, N.O. and T.Cs.; project administration, N.O. and T.Cs.; funding acquisition, N.O. and T.Cs. All authors have read and agreed to the published version of the manuscript.

6-2- Data Availability Statement

The data presented in this study are available on request from the corresponding author.

6-3- Funding

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6-4- Institutional Review Board Statement

Not Applicable.

6-5- Informed Consent Statement

Not Applicable.

6-6- Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

7- References

[1] Llopis-Albert, C., Rubio, F., & Valero, F. (2021). Impact of digital transformation on the automotive industry. Technological Forecasting and Social Change, 162, 120343. doi:10.1016/j.techfore.2020.120343.

[2] Wang, N., Liang, H., Ge, S., Xue, Y., & Ma, J. (2019). Enablers and inhibitors of cloud computing assimilation: an empirical study. Internet Research, 29(6), 1344–1369. doi:10.1108/INTR-03-2018-0126.

[3] Lidong, W., & Guanghui, W. (2016). Big Data in Cyber-Physical Systems, Digital Manufacturing and Industry 4.0. International Journal of Engineering and Manufacturing, 6(4), 1–8. doi:10.5815/ijem.2016.04.01.

[4] Li, Y., Shi, S., Wu, Y., & Chen, Y. (2021). A review of enterprise social media: visualization of landscape and evolution. Internet Research, 31(4), 1203–1235. doi:10.1108/INTR-07-2020-0389.

[5] Lee, J., Davari, H., Singh, J., & Pandhare, V. (2018). Industrial Artificial Intelligence for industry 4.0-based manufacturing systems. Manufacturing Letters, 18, 20–23. doi:10.1016/j.mfglet.2018.09.002.

[6] Wan, J., Tang, S., Shu, Z., Li, D., Wang, S., Imran, M., & Vasilakos, A. V. (2016). Software-Defined Industrial Internet of Things in the Context of Industry 4.0. IEEE Sensors Journal, 16(20), 7373–7380. doi:10.1109/JSEN.2016.2565621.

[7] Ingrand, F., & Ghallab, M. (2017). Deliberation for autonomous robots: A survey. Artificial Intelligence, 247, 10–44. doi:10.1016/j.artint.2014.11.003.

[8] Bollard, A., Larrea, E., Singla, A., & Sood, R. (2017). The next-generation operating model for the digital world. Digital McKinsey, 1-8.

[9] Costa Climent, R., & Haftor, D. M. (2021). Business model theory-based prediction of digital technology use: An empirical assessment. Technological Forecasting and Social Change, 173, 121174. doi:10.1016/j.techfore.2021.121174.

[10] Correani, A., De Massis, A., Frattini, F., Petruzzelli, A. M., & Natalicchio, A. (2020). Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects. California Management Review, 62(4), 37–56. doi:10.1177/0008125620934864.

[11] Ghobakhloo, M. (2018). The future of manufacturing industry: a strategic roadmap toward Industry 4.0. Journal of Manufacturing Technology Management, 29(6), 910–936. doi:10.1108/JMTM-02-2018-0057.

[12] Laudon, K. C., & Laudon, J. P. (2004). Management information systems: Managing the digital firm. Prentice Hall, New Jersey, United States.

[13] Brem, A., Viardot, E., & Nylund, P. A. (2021). Implications of the coronavirus (COVID-19) outbreak for innovation: Which technologies will improve our lives? Technological Forecasting and Social Change, 163, 120451. doi:10.1016/j.techfore.2020.120451.

[14] Carroll, N., & Conboy, K. (2020). Normalising the "new normal": Changing tech-driven work practices under pandemic time pressure. International Journal of Information Management, 55, 102186. doi:10.1016/j.ijinfomgt.2020.102186.

[15] Lev-Ram, M. (2020). Here's why Zoom was zooming even before the coronavirus pandemic. Fortune. Available online: https://fortune.com/2020/03/18/zoom-is-zooming-despite-coronavirus/ (accessed on April 2022).

[16] Etherington, D. (2020). Ford, 3M, GE, and the UAW to Build respirators, Ventilators and Face Shields For Coronavirus Fight. TechCrunch. Available online: https://techcrunch.com/2020/03/24/ford-and-3m-ge-and-the-uaw-to-build-respirators-ventilators-and-faceshields-for-coronavirus-fight/ (accessed on March 2022).

[17] Lee, S. M., & Lee, D. (2019). "Untact": a new customer service strategy in the digital age. Service Business, 14(1), 1–22. doi:10.1007/s11628-019-00408-2.

[18] Kim, R.; Jeon, M.; Lee, H.; Choi, J.; Lee, J.; Kim, S.; Lee, S.; Seo, Y.; Kwon, J. (2018). Trend Korea, Mirae-book Publishing Co., Seoul, South Korea.

[19] Aldag, L., Renaud, K., Berens, B., Duezguen, R., Mossano, M., & Volkamer, M. (2020). Reporting on Insights Gained into UK Citizens' Perceptions of Contactless Card Risks. Karlsruher Institute for technology (KIT). doi: 10.5445/IR/1000137542

[20] Brynjolfsson, E., Horton, J., Ozimek, A., Rock, D., Sharma, G., & TuYe, H.-Y. (2020). COVID-19 and Remote Work: An Early Look at US Data. National Bureau of Economic Research. doi:10.3386/w27344.

[21] Hutchings, O. R., Dearing, C., Jagers, D., Shaw, M. J., Raffan, F., Jones, A., Taggart, R., Sinclair, T., Anderson, T., & Ritchie, A. G. (2021). Virtual health care for community management of patients with COVID-19 in Australia: Observational cohort study. Journal of Medical Internet Research, 23(3), 21064. doi:10.2196/21064.

[22] Shao, Z., Ding, L., Li, D., Altan, O., Huq, M. E., & Li, C. (2020). Exploring the Relationship between Urbanization and Ecological Environment Using Remote Sensing Images and Statistical Data: A Case Study in the Yangtze River Delta, China. Sustainability, 12(14), 5620. doi:10.3390/su12145620.

[23] Rowe, F. (2020). Contact tracing apps and values dilemmas: A privacy paradox in a neo-liberal world. International Journal of Information Management, 55, 102178. doi:10.1016/j.ijinfomgt.2020.102178.

[24] Elekdag, S., Muir, D., & Wu, Y. (2015). Trade linkages, balance sheets, and spillovers: The Germany-Central European Supply Chain. Journal of Policy Modeling, 37(2), 374–387. doi:10.1016/j.jpolmod.2015.01.003.

[25] Araz, O. M., Choi, T. M., Olson, D. L., & Salman, F. S. (2020). Data Analytics for Operational Risk Management. Decision Sciences, 51(6), 1316–1319. doi:10.1111/deci.12443.

[26] El Baz, J., & Ruel, S. (2021). Can supply chain risk management practices mitigate the disruption impacts on supply chains' resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era. International Journal of Production Economics, 233, 107972. doi:10.1016/j.ijpe.2020.107972.

[27] Karoluk, M., Koenig, G., & Kurzynowski, T. (2021). Method of medical equipment evaluation and preparation for on-demand additive manufacturing with the conventional supply chain being broken: A case study of mask filter adapter production during COVID-19. Applied Sciences (Switzerland), 11(24), 12016. doi:10.3390/app112412016.

[28] Veselovská, L. (2020). Supply chain disruptions in the context of early stages of the global COVID-19 outbreak. Problems and Perspectives in Management, 18(2), 490–500. doi:10.21511/ppm.18(2).2020.40.

[29] Nagy, J., Oláh, J., Erdei, E., Máté, D., & Popp, J. (2018). The role and impact of industry 4.0 and the internet of things on the business strategy of the value chain-the case of hungary. Sustainability (Switzerland), 10(10), 3491. doi:10.3390/su10103491.

[30] Ardito, L., Petruzzelli, A. M., Panniello, U., & Garavelli, A. C. (2019). Towards Industry 4.0: Mapping digital technologies for supply chain management-marketing integration. Business Process Management Journal, 25(2), 323–346. doi:10.1108/BPMJ-04-2017-0088.

[31] Rojko, A. (2017). Industry 4.0 concept: Background and overview. International Journal of Interactive Mobile Technologies, 11(5), 77–90. doi:10.3991/ijim.v11i5.7072.

[32] Savastano, M., Amendola, C., Bellini, F., & D'Ascenzo, F. (2019). Contextual Impacts on Industrial Processes Brought by the Digital Transformation of Manufacturing: A Systematic Review. Sustainability, 11(3), 891. doi:10.3390/su11030891.

[33] Horváth, D., & Szabó, R. Z. (2019). Driving forces and barriers of Industry 4.0: Do multinational and small and medium-sized companies have equal opportunities? Technological Forecasting and Social Change, 146, 119–132. doi:10.1016/j.techfore.2019.05.021.

[34] Bogdány, E., Bogdany, Á. B., & Csizmadia, T. (2014). Leadership succession and the origin of successor in Hungarian SMEs. Management and Marketing. Challenges for the Knowledge Society, 9(3), 283–300.

[35] Inshakova, A. O., Frolova, E. E., Rusakova, E. P., & Kovalev, S. I. (2020). The model of distribution of human and machine labor at intellectual production in industry 4.0. Journal of Intellectual Capital, 21(4), 601–622. doi:10.1108/JIC-11-2019-0257.

[36] Longo, F., Padovano, A., & Umbrello, S. (2020). Value-oriented and ethical technology engineering in industry 5.0: A human-centric perspective for the design of the factory of the future. Applied Sciences (Switzerland), 10(12), 4182. doi:10.3390/APP10124182.

[37] Obermayer, N., Csizmadia, T., Hargitai, D. M., & Kigyós, T. (2020). Industry 4.0: Are we Robots?. 21th European Conference on Knowledge Management (ECKM 2020), 2-4 December 2020, Coventry University, Coventry, United Kingdom.

[38] O'Leary, D. E. (2020). Evolving Information Systems and Technology Research Issues for COVID-19 and Other Pandemics. Journal of Organizational Computing and Electronic Commerce, 30(1), 1–8. doi:10.1080/10919392.2020.1755790.

[39] Papagiannidis, S., Harris, J., & Morton, D. (2020). WHO led the digital transformation of your company? A reflection of IT related challenges during the pandemic. International Journal of Information Management, 55, 102166. doi:10.1016/j.ijinfomgt.2020.102166.

[40] Shen, Y., Guo, D., Long, F., Mateos, L. A., Ding, H., Xiu, Z., Hellman, R. B., King, A., Chen, S., Zhang, C., & Tan, H. (2021). Robots under COVID-19 Pandemic: A Comprehensive Survey. IEEE Access, 9, 1590–1615. doi:10.1109/ACCESS.2020.3045792.

[41] Salento, A. (2018). Digitalisation and the regulation of work: theoretical issues and normative challenges. AI & Society, 33(3), 369–378. doi:10.1007/s00146-017-0738-z.

[42] Kinzel, H. (2017). Industry 4.0 – Where Does This Leave the Human Factor?. Journal of Urban Culture Research 15(December), 70-83. https://doi.org/10.14456/jucr.2017.14.

[43] Sciutti, A., Mara, M., Tagliasco, V., & Sandini, G. (2018). Humanizing human-robot interaction: On the importance of mutual understanding. IEEE Technology and Society Magazine, 37(1), 22–29. doi:10.1109/MTS.2018.2795095.

[44] Schwab, K. (2017). The fourth industrial revolution. Currency, Redfern, Australia.

[45] Shamim, S., Cang, S., Yu, H., & Li, Y. (2016). Management approaches for Industry 4.0: A human resource management perspective. 2016 IEEE Congress on Evolutionary Computation (CEC). doi:10.1109/cec.2016.7748365.

[46] Müller, J. M., Kiel, D., & Voigt, K.-I. (2018). What Drives the Implementation of Industry 4.0? The Role of Opportunities and Challenges in the Context of Sustainability. Sustainability (Switzerland), 10(1), 247. doi:10.3390/su10010247.

[47] Kiel, D., Müller, J. M., Arnold, C., & Voigt, K. I. (2021). Sustainable industrial value creation: Benefits and challenges of industry 4.0. Digital Disruptive Innovation, 21(8), 231–270. doi:10.1142/9781786347602_0009.

[48] Barnes, S. J. (2020). Information management research and practice in the post-COVID-19 world. International Journal of Information Management, 55, 102175. doi:10.1016/j.ijinfomgt.2020.102175.

[49] European Commission. (2020). Digital Economy and Society Index (DESI) 2020 Hungary. Available online: https://digital-strategy.ec.europa.eu/en/policies/desi-hungary (accessed on February 2022).

[50] Puriwat, W., & Tripopsakul, S. (2021). Explaining an adoption and continuance intention to use contactless payment technologies: During the covid-19 pandemic. Emerging Science Journal, 5(1), 85–95. doi:10.28991/esj-2021-01260.

[51] Manimuthu, A., Dharshini, V., Zografopoulos, I., Priyan, M. K., & Konstantinou, C. (2021). Contactless Technologies for Smart Cities: Big Data, IoT, and Cloud Infrastructures. SN Computer Science, 2(4). doi:10.1007/s42979-021-00719-0.

[52] Szalavetz, A. (2019). Industry 4.0 and capability development in manufacturing subsidiaries. Technological Forecasting and Social Change, 145, 384–395. doi:10.1016/j.techfore.2018.06.027.

[53] Birkner, Z., & Máhr, T. (2016). Interpreting innovation – in another way. Vezetéstudomány / Budapest Management Review, 47(10), 39–50. doi:10.14267/veztud.2016.10.04.

[54] Del Vecchio, P., Di Minin, A., Petruzzelli, A. M., Panniello, U., & Pirri, S. (2018). Big data for open innovation in SMEs and large corporations: Trends, opportunities, and challenges. Creativity and Innovation Management, 27(1), 6–22. doi:10.1111/caim.12224.

[55] Ghobakhloo, M., & Ching, N. T. (2019). Adoption of digital technologies of smart manufacturing in SMEs. Journal of Industrial Information Integration, 16, 100107. doi:10.1016/j.jii.2019.100107.

[56] Chen, C. L., Lin, Y. C., Chen, W. H., Chao, C. F., & Pandia, H. (2021). Role of government to enhance digital transformation in small service business. Sustainability (Switzerland), 13(3), 1028. doi:10.3390/su13031028.

[57] Yawised, K., Apasrawirote, D., Chatrangsan, M., & Muneesawang, P. (2020). Factors Affecting SMEs' Intention to Adopt a Mobile Travel Application based on the Unified Theory of Acceptance and Use of Technology (UTAUT-2). Emerging Science Journal, 4(Special issue), 207–224. doi:10.28991/esj-2021-SP1-014.

[58] Dassisti, M., Giovannini, A., Merla, P., Chimienti, M., & Panetto, H. (2019). An approach to support Industry 4.0 adoption in SMEs using a core-metamodel. Annual Reviews in Control, 47, 266–274. doi:10.1016/j.arcontrol.2018.11.001.

[59] Zeebaree, S. R. M., Salim, B. W., Zebari, R. R., Shukur, H. M., Abdulraheem, A. S., Abdulla, A. I., & Mohammed, S. M. (2020). Enterprise resource planning systems and challenges. Technology Reports of Kansai University, 62(4), 1885–1894.

[60] Salih, A. A., & Abdulrazaq, M. B. (2019). Combining Best Features Selection Using Three Classifiers in Intrusion Detection System. 2019 International Conference on Advanced Science and Engineering (ICOASE). doi:10.1109/icoase.2019.8723671.

[61] Galati, A., Tinervia, S., Tulone, A., & Crescimanno, M. (2019). Drivers affecting the adoption and effectiveness of social media investments: The Italian wine industry case. International Journal of Wine Business Research, 31(2), 260–278. doi:10.1108/IJWBR-04-2018-0016.

[62] Kallmuenzer, A., Nikolakis, W., Peters, M., & Zanon, J. (2018). Trade-offs between dimensions of sustainability: exploratory evidence from family firms in rural tourism regions. Journal of Sustainable Tourism, 26(7), 1204–1221. doi:10.1080/09669582.2017.1374962.

[63] Lee, D. H. (2018). Strategies for technology-driven service encounters for patient experience satisfaction in hospitals. Technological Forecasting and Social Change, 137(12), 118–127. doi:10.1016/j.techfore.2018.06.050.

[64] Becker, K., & Lee, J. W. (2019). Organizational usage of social media for corporate reputation management. Journal of Asian Finance, Economics and Business, 6(1), 231–240. doi:10.13106/jafeb.2019.vol6.no1.231.

[65] Chemli, S., Toanoglou, M., & Valeri, M. (2022). The impact of Covid-19 media coverage on tourist's awareness for future travelling. Current Issues in Tourism, 25(2), 179–186. doi:10.1080/13683500.2020.1846502.

[66] Brink, T. (2017). B2B SME management of antecedents to the application of social media. Industrial Marketing Management, 64, 57–65. doi:10.1016/j.indmarman.2017.02.007.

[67] Pekkala, K., & Van Zoonen, W. (2022). Work-related social media use: The mediating role of social media communication self-efficacy. European Management Journal, 40(1), 67–76. doi:10.1016/j.emj.2021.03.004.

[68] Kemp, S. (2020). Digital 2020: global digital overview. We are Social and Hootsuite. Available online: https://datareportal.com/reports/digital-2020-global-digital-overview (accessed on April 2022).

[69] Kemp, S. (2021). Digital 2021: Hungary. Available online: https://datareportal.com/reports/digital-2021-hungary (accessed on February 2022).

[70] Lin, C., Wayne Yu, W. C., & Wang, J. (2014). Cloud Collaboration: Cloud-based Instruction for Business Writing Class. World Journal of Education, 4(6), 9–15 10 5430 4 6 9. doi:10.5430/wje.v4n6p9.

[71] Shamsuzzoha, A., Helo, P., & Kindi, M. Al. (2016). Implementation of Cloud-based Manufacturing Environment to Facilitate Virtual Collaboration between Industries. International Conference on Applied Mechanics and Industrial Systems (ICAMIS-Oman-2016), 6-8- December 2016, Muscat, Oman.

[72] Manu, G., Vijay Kumar, M., Nagesh, H., Jagadeesh, D., & Gowtham, M. B. (2018). Flexible manufacturing systems (FMS): A review. International Journal of Mechanical and Production Engineering Research and Development, 8(2), 323–336. doi:10.24247/ijmperdapr201836.

[73] Kaushal, A., Vardhan, A., & Rajput, R. S. (2016). Flexible manufacturing system a modern approach to manufacturing technology. International Refereed Journal of Engineering and Science, 5(4), 16-23.

[74] Sulaiman, N. B., Binti Mahmud, N. P. N., Nazir, U., Binti Abdul Latib, S. K. K., Muhammad Hafidz, H. F. B., & Abid, S. K. (2021). The Role of Autonomous Robots in Fourth Industrial Revolution (4IR) as an Approach of Sustainable Development Goals (SDG9): Industry, Innovation and Infrastructure in Handling the Effect of COVID-19 Outbreak. IOP Conference Series: Earth and Environmental Science, 775(1). doi:10.1088/1755-1315/775/1/012017.

[75] Kovács, G., Benotsmane, R., & Dudás, L. (2018). the Concept of Autonomous Systems in Industry 4.0. Advanced Logistic Systems - Theory and Practice, 12(1), 77–87. doi:10.32971/als.2019.006.

[76] Vicentini, F. (2020). Collaborative Robotics: A Survey. Journal of Mechanical Design, 143(4). doi:10.1115/1.4046238.

[77] Nyikes, Z., & Rajnai, Z. (2015). The Big Data and the relationship of the Hungarian National Digital Infrastructure. International Conference of Applied Internet and Information Technologies, 23 October 2015, Zrenjanin, Serbia.

[78] Zscheischler, J., Brunsch, R., Rogga, S., & Scholz, R. W. (2022). Perceived risks and vulnerabilities of employing digitalization and digital data in agriculture – Socially robust orientations from a transdisciplinary process. Journal of Cleaner Production, 358, 132034. doi:10.1016/j.jclepro.2022.132034.

[79] Prasdika, P., & Sugiantoro, B. (2018). A Review Paper on Big Data and Data Mining Concepts and Techniques. IJID (International Journal on Informatics for Development), 7(1), 33. doi:10.14421/ijid.2018.07107.

[80] Pfaffinger, K. F., Reif, J. A. M., Spieß, E., & Berger, R. (2020). Anxiety in a digitalised work environment. Gruppe. Interaktion. Organisation. Zeitschrift Fur Angewandte Organisationspsychologie, 51(1), 25–35. doi:10.1007/s11612-020-00502-4.

[81] Vermeulen, B., Kesselhut, J., Pyka, A., & Saviotti, P. P. (2018). The impact of automation on employment: Just the usual structural change? Sustainability (Switzerland), 10(5), 1661. doi:10.3390/su10051661.

[82] Tabarés, R.; Bartolomé, T.; Martelloni, L.; Marmo, D.; de Amicis, L.; Binenti, S.; Rushton, E.; Billy, L.; Sebastianelli, A. F. M.; García, J.; Shapiro, A. (2018). Towards the popularization of Open Manufacturing in European industry. OpenMaker, White paper version 2.0. Research and Innovation Action (RIA), 1-69.

[83] Obermayer, N., Csizmadia, T., Hargitai, D. M. & Kigyós, T (2020). Industry 4.0: are we robots? Proceedings of European Conference on Knowledge Management, 2020, Coventry University, 566-575, Coventry, UK.

[84] Obermayer, N., Csizmadia, T., & Hargitai, D. M. (2022). Influence of Industry 4.0 technologies on corporate operation and performance management from human aspects. Meditari Accountancy Research, 30(4), 1027-1049. doi:10.1108/MEDAR-02-2021-1214.

[85] Bertani, F., Raberto, M., & Teglio, A. (2020). The productivity and unemployment effects of the digital transformation: an empirical and modelling assessment. Review of Evolutionary Political Economy, 1(3), 329–355. doi:10.1007/s43253-020-00022-3.

[86] Bogdány, E., Balogh, Á., Csizmadia, T., & Polák-Weldon, R. (2012). Future Employee Preferences in the Light Of Organizational Culture. Knowledge and Learning: Global Empowerment; Proceedings of the Management, Knowledge and Learning International Conference 2012, International School for Social and Business Studies, 363-371, Celje, Slovenia.

[87] Kusmin, K. L., Ley, T., & Normak, P. (2017). Towards a data driven competency management platform for Industry 4.0. Proceedings of the Workshop Papers of i-Know. Available online: http://ceur-ws.org/Vol-2025/paper_hci_4.pdf (accessed on March 2022).

[88] Sajtos, L., & Mitev, A. (2007). SPSS Research and Data Analysis Manual. Alinea Publisher, Copenhagen, Denmark. (In Hungarian).

[89] Molino, M., Cortese, C. G., & Ghislieri, C. (2020). The promotion of technology acceptance and work engagement in industry 4.0: From personal resources to information and training. International Journal of Environmental Research and Public Health, 17(7), 2438. doi:10.3390/ijerph17072438.

[90] Criado, J. I., Guevara-Gómez, A., & Villodre, J. (2020). Using Collaborative Technologies and Social Media to Engage Citizens and Governments during the COVID-19 Crisis. The Case of Spain. Digital Government: Research and Practice, 1(4), 1–7. doi:10.1145/3416089.

[91] Yin, R. K. (2009). Case study research: Design and methods (4th Ed.). SAGE Publications, Thousands Oaks, United States.

Appendix I: Questionnaire

Companies' contactless digital technologies research

The survey aims to investigate how companies use contactless digital technologies (CDTs); to examine the employees' attitude regarding the use of CDTs and to explore companies' solutions on enhancing employees' acceptance in terms of the usage of CDTs. The research is supported by the TKP2020-NKA-10 project financed under the 2020-4.1.1-TKP2020 Thematic Excellence Programme by the National Research, Development and Innovation Fund of Hungary.

The survey should only take 5 minutes, and your responses are completely anonymous.

You can only take the survey once, but you can edit your responses until the survey is closed on June 30, 2021.

We really appreciate your input!

Implementation of new technologies

A1. How often are the following contactless digital technologies (CDTs) used within the organization? Please mark one in each row.

		1: never	**2: less often than monthly**	**3: monthly**	**4: weekly**	**5: daily**
A1.1.	ERP systems	○	○	○	○	○
A1.2.	cloud-based collaborative technologies	○	○	○	○	○
A1.3.	social media	○	○	○	○	○
A1.4.	big data and data mining	○	○	○	○	○
A1.5.	autonomous robots	○	○	○	○	○
A1.6.	flexible manufacturing systems / production planning and scheduling software	○	○	○	○	○

A2. To what extent do you agree that the following attitudes of employees are typical of the implementation of CDT? Please mark one in each row.

		1: strongly disagree	**2: disagree**	**3: slightly disagree**	**4: slightly agree**	**5: agree**	**6: strongly agree**
A2.1.	Welcome	○	○	○	○	○	○
A2.2.	Wait with interest	○	○	○	○	○	○
A2.3.	Treat with reservations	○	○	○	○	○	○
A2.4.	Afraid of the possibility of a failure	○	○	○	○	○	○
A2.5.	Afraid of being controlled	○	○	○	○	○	○
A2.6.	Afraid of loss of job	○	○	○	○	○	○
A2.7.	Ignore	○	○	○	○	○	○
A2.8.	Reject	○	○	○	○	○	○

A3. To what extent do you agree that the following methods can be used to bring workers closer to the adoption and application of contactless digital technologies (CDTs)?

		1: strongly disagree	**2: disagree**	**3: slightly disagree**	**4: slightly agree**	**5: agree**	**6: strongly agree**
A3.1.	Information on the relevance of using CDTs	○	○	○	○	○	○
A3.2.	Presentation on CDTs	○	○	○	○	○	○
A3.3.	Test in practice	○	○	○	○	○	○
A3.4.	Practical training	○	○	○	○	○	○
A3.5.	Individual meeting	○	○	○	○	○	○

General Characteristics of the Company

Please provide the following information about the company you work for! Mark one for each question!

B1. Profile
- ○ 1: manufacturing
- ○ 2: service provider

B2. Number of employees
- ○ 1:10 or less
- ○ 2: 11-50
- ○ 3: 51-250
- ○ 4: more than 250

B3. Annual net sales in EUR million
- ○ 1: 2 or less
- ○ 2: 2-10
- ○ 3: 10-50
- ○ 4: more than 50