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Navigating the digital landscape in Hungary: exploring the interaction between knowledge management and emerging technologies in the era of digital transformation

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Navigating the digital landscape in Hungary: exploring the interaction between knowledge management and emerging technologies in the era of digital transformation

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Abstract

The primary objective of this doctoral dissertation is to formulate an approach that is both theoretically robust and practically applicable, aimed at aiding organisations in their knowledge management endeavours, especially in the context of emerging digital technologies. This approach underscores the importance of understanding the relationships between knowledge management and emerging technologies technology in the current business landscape.

A significant component of this PhD research involves a quantitative analysis of knowledge management practices within Hungarian organisations. This analysis is based on data derived from a large-scale questionnaire-based survey.

Complementing the quantitative analysis, this doctoral research employs a qualitative methodology to offer an in-depth understanding on knowledge management practices applied within firms in Hungary. The data used in this research is collected via semi-structured interviews.

In essence, this dissertation provides a holistic view of knowledge management in the digital age, with a specific focus on Hungarian organisations, and lays the foundation for future explorations in this domain.

Kivonat

A doktori értekezés elsődleges célkitűzése egy olyan elméletben és gyakorlatban is hasznosítható megközelítés kidolgozása, amely segítheti a tudásmenedzsment jelen helyzetének megismerését, valamint a szervezeteket tudásmenedzsmenttel kapcsolatos törekvéseikben. A megközelítés hangsúlyozza a tudásmenedzsment és a feltörekvő technológiák közötti kapcsolatok megértésének fontosságát a jelen üzleti környezetben.

A PhD kutatás jelentős részét képezi a magyarországi szervezetek tudásmenedzsment gyakorlatának kvantitatív elemzése. Ezen elemzés egy a szerző által kidolgozott és lebonyolított kérdőíves felmérésből származó adatokon alapszik.

A kvantitatív elemzést kiegészítve a kutatás kvalitatív módszertant is alkalmaz, mely a tudásmenedzsment gyakorlatok mélyreható megismerésérét tűzi ki célul a vizsgált magyarországi vállalatoknál. A kutatás során felhasznált adatokat félig strukturált interjúk segítségével gyűjtötte össze a szerző.

Az értekezés áttekintést ad a tudásmenedzsment helyzetéről a jelen digitális korban, elemzi e két területet és azok kapcsolatát, különös tekintettel a feltörekvő technológiák jelentőségére, a kutatás szempontjából releváns szakirodalmon és az empirikus kutatásokon keresztül, ezzel megalapozva letehséges gyakorlati alkalmazhatóságot és jövőbeni kutatási irányokat is ezen a területen.

Résumé

L'objectif principal de cette thèse de doctorat est de formuler une approche à la fois théoriquement robuste et applicable en pratique, visant à aider les organisations dans leurs efforts de gestion des connaissances, notamment dans le contexte des technologies émergentes. Cette approche souligne l'importance de comprendre les relations entre la gestion des connaissances et les technologies émergentes dans le paysage commercial actuel.

Une composante importante de cette recherche doctorale implique une analyse quantitative des pratiques de gestion des connaissances dans les organisations hongroises. Cette analyse est basée sur les données dérivées d'une enquête à grande échelle basée sur un questionnaire.

En complément de l'analyse quantitative, cette thèse utilise une méthodologie qualitative pour offrir une compréhension approfondie des pratiques de gestion des connaissances appliquées dans les entreprises en Hongrie. Les données utilisées dans cette recherche sont collectées via des entretiens semi-structurés.

Essentiellement, cette thèse propose une vision holistique de la gestion des connaissances à l'ère numérique, avec un accent spécifique sur les organisations hongroises, et jette les bases des explorations futures dans ce domaine.

Acknowledgement

In the journey of academic pursuit, one seldom walks alone. As I reflect upon the years of my PhD studies, I am filled with profound gratitude for people who have been instrumental in guiding, supporting, and encouraging me. This acknowledgement is a heartfelt attempt to convey my deepest appreciation to all those who have made this journey possible.

First and foremost, I would like to express my sincere gratitude to my esteemed supervisors, Dr. Nora Obermayer and Dr. David Mate Hargitai. Their support, invaluable guidance, and relentless pursuit of excellence have served as the cornerstone for my academic studies. With their keen insights, vast knowledge and enthusiasm and meticulous attention to details, guidance through the most challenging phases of my research and have constantly inspired me to push boundaries and think beyond the conventional. Their combined expertise, patience, and mentorship have not only shaped my doctoral journey but have also instilled in me a lifelong passion for learning and discovery.

I am grateful to my family, their unwavering belief in my abilities, even in moments of self-doubt, has been my anchor. Their efforts have ensured that I had the resources to pursue my dreams.

My friends deserve special mention. They have been the source of endless encouragement. Through late-night study sessions, discussions, and moments of sheer exhaustion, they have stood by me, offering a listening ear, a word of advice, or simply a much-needed break.

This journey, though mine, has been enriched and made possible by the collective efforts, love, and support of all the aforementioned individuals. To my supervisors, my family, and friends, I extend my deepest gratitude. Thank you for being a part of my journey.

Köszönetnyilvánítás

Az akadémiai törekvés útján ritkán jár az ember egyedül. Ahogy visszatekintek PhD tanulmányaim éveire, hálával tartozom mindazoknak, akik segítették ezt az utat számomra útmutatásukkal, támogatásukkal és bátorításukkal.

Szeretném köszönetem kifejezni témavezetőimnek, Dr. Obermayer Nórának és Dr. Hargitai Dávid Mátének. Támogatásuk, útmutatásuk és a kiválóság iránti elkötelezettségük az akadémiai tanulmányaim alapkövévé vált. Éleslátásukkal, hatalmas tudásukkal és lelkesedésükkel, valamint a részletekre való alapos odafigyelésükkel kísérték végig a kutatásom legnehezebb szakaszait és folyamatosan inspiráltak. Szakértelmük, türelmük és mentorálásuk nem csak formálta doktori utamat, de élethosszig tartó szenvedélyt is táplált a tanulás és a felfedezés iránt.

Köszönöm családomnak, akiknek szeretetéért felbecsülhetetlen hálával tartozom. Rendíthetetlen hitük képességeimben, még a nehéz pillanatokban is, mindig előre vitt. Erőfeszítéseik biztosították, hogy legyenek forrásaim az álmaim megvalósításához.

Köszönöm továbbá csodálatos barátaimnak, akik állandó támogatásukkal, végtelen bátorításukkal segítettek.

Ez az út, bár az enyém, témavezetőim, családom és barátaim által gazdagodott és vált lehetővé. Köszönöm mindenkinek, aki részese volt ennek.

Research motivation

My initial step into the field of knowledge management during my Master's studies was an eye-opener. It revealed the vast potential of knowledge management in harnessing organisational knowledge and knowledge sharing, fostering innovation.

As digital transformation began to reshape industries, my interest increased: how the interplay between knowledge management and digital transformation, especially with the advent of emerging technologies will shape knowledge management? This curiosity, coupled with my intrinsic enthusiasm, laid the foundation for my PhD research.

The emergence of new technologies and digital transformation could be both challenges and opportunities for organisations. While these technologies offer innovative tools for knowledge capture, dissemination, and application, they also introduce complexities in knowledge governance, security, and integration. Understanding how knowledge management can navigate these challenges and leverage opportunities is crucial for organisations aiming to thrive in the digital era.

A significant source of inspiration has been my supervisors, whose insights and guidance have been instrumental in shaping my academic journey. Their profound understanding of knowledge management and its implications in the modern digital landscape has further fuelled my passion. Through discussions and brainstorming sessions, it became evident that as emerging technologies gain traction, their impact on knowledge management practices becomes paramount. Yet, the literature in this domain was limited, especially for Hungary, which highlighted the need for further in-depth research.

In conclusion, my motivation for this research stems from a combination of personal interest, academic curiosity, and the recognition of a significant gap in the existing literature. I believe that this research will not only contribute to the academic community but will also provide practical insights for organisations navigating the changing landscape of digital transformation.

1. Introduction

In a time characterised by a tremendous growth in data generation and rapid technological advancements, the role of knowledge management (KM) has never been more vital.

Organisations across the globe are going through a digital transformation that is reshaping the way they create, capture, store, and utilise information. This transformation is significantly influenced by emerging technologies that hold the potential to revolutionise knowledge management practices. In this digital age, knowledge management crosses organisational boundaries. There are many different information sources available to organisations, such as expert networks, social media platforms, external repositories, and internal databases. The growth of cloud computing and collaboration platforms facilitates remote work, global partnerships, and seamless knowledge sharing among employees, customers, and partners. This shift has implications for knowledge accessibility, security, and privacy. Knowledge management is a strategic framework that facilitates the conversion of data into insightful understandings, encourages teamwork, and advances organisational learning (Kusnadi et al., 2021).

1.1. Overview

Over the last decade, organisations have been challenged not only by disruptive innovation resulting from technological advancements, which is now accelerated by digitalisation and artificial intelligence (AI) (García-Villaverde et al., 2018), but also by complex emerging market players that are rapidly growing, developing, and transiting and challenging Western dominance (Li et al., 2019). Chatbots, AI, machine learning, smart robotics, big data, and the internet of things are just a few examples of the rapidly evolving technological landscape. At the same time, individuals and organisations are producing and being eligible to access data that could benefit more useful information and knowledge. The increasing pervasiveness of digital technologies in the Industry 4.0 era necessitates a more sophisticated, all-encompassing strategy centred on managing human-machine knowledge. Utilising the full potential of digitalisation, which leverages knowledge and information exchange and data analysis to support data-driven decision-making, is the biggest challenge (Natarajan, 2018).

Adomako (2021) characterises a dynamic environment ‘by frequent changes, leading to unpredictability and high levels of uncertainty’. In these highly dynamic environments, characterised by volatility (Wu, 2010), uncertainty (Adomako, 2021), complexity

(D'Innocenzo et al., 2016) and ambiguity (Hansen et al., 2019) (VUCA) (Pereira & Bamel, 2021), when unpredictable multilevel crisis events leave very limited time for planning possible solutions and next steps. Knowledge-based businesses in the market have proven to be more resilient and competitive (Metaxiotis et al., 2003). In today's dynamic business environment, more and more organisations are realising that effective knowledge management is a key enabler of success that helps them stay agile and ready for change, with a hybrid knowledge management strategy that incorporates the three major pillars of business process management: people, process, and technology as a facilitator.

Knowledge flows within organisations are key for successful innovation (Coradi et al., 2015) and are considered as a competitive advantage (Schiuma & Carlucci, 2006) that could improve the decision-making process, reduce time and costs and facilitate efficiency (Masic et al., 2017). The increasing amount of data coming from several business areas and sources is increasingly proving that proper management of data, information and knowledge is a critical task for companies (Abonyi & Miszlivetz, 2016).

As knowledge management is not new but a newly structured concept that has embraced new technologies (Masic et al., 2017) which are improving in parallel, it is interesting to discover their (possible) relationship. Digital technologies are helping new companies, particularly start-ups, to flourish. Today's businesses view digitalisation and emerging technologies as a driving force behind the fusion of scattered knowledge (Bereznoy et al., 2021).

As we progress toward a future driven by data, it is critical to investigate how the link between knowledge management and emerging technologies may be leveraged to harness technology more effectively. Numerous studies on the most recent developments in knowledge management systems, methods and best practices as well as their impacts on organisations were conducted (Al-Emran et al., 2018, Salloum et al., 2018).

To achieve organisational goals and reap the rewards of their investments in digital technologies, organisations must provide their staff with the necessary digital skills (Kane et al., 2019). Thus, the era of digital transformation creates a demand for workforces with digital capabilities, highlighting the significance of digital skills and human characteristics for corporate growth (Scuotto et al., 2021). The broad use of digital technologies by businesses has a considerable added value, increasing corporate competition and, ultimately, the economy as a whole (Gfrerer et al. 2021).

Traditional knowledge management approaches have relied on well-established methodologies, but emerging technologies may change the game. Since we now are not only having human-human but also human-machine interactions, rising human and machine intelligence is likely to revolutionise knowledge management. Research is lagging behind practice currently - how could AI be accompanied by knowledge management facilitating and enhancing the future of businesses and augmenting the capabilities of knowledge workers? Could a possible combination of knowledge management and cutting-edge technologies' features lead organisations to immense growth? The synergy between knowledge management and emerging technologies promises to shape the future of how organisations create value from their intellectual assets. However, it also brings challenges related to data governance, ethical considerations, and the need for a workforce skilled in both technology and knowledge management practices.

This dissertation aims to provide insight into the evolvement of knowledge management in the context of emerging technologies. As organisations continue to adapt to the digital age, understanding the symbiotic relationship between knowledge management and technology is crucial for staying competitive and innovative in an ever-changing world. It summarises empirical research on knowledge management with potential innovation by recent emerging technologies and their relationships focusing on Hungarian organisations. Within the current fast-developing technologies and changing environment it is beneficial to make an in-depth investigation on practical implications and future possibilities supported by latest technological improvements. Thus, the dissertation aims to reveal current implementations of knowledge management and its supporting and related technologies and conclude future practical implications.

1.2. Research problem

The digital transformation of the contemporary era has swept across nations and sectors, bringing about significant changes in operational procedures, organisational structures, and strategic approaches. As organisations struggle with this shift, knowledge management plays an increasingly important role.

Knowledge management is a well-researched topic already, according to Gartner, it has reached the 'plateau of productivity' thus it is considered beyond the scope of its 'hype-cycle' (Gartner, 2007). In order to fully grasp the complexity of this fast evolving study

field, academics urgently need to provide an overview of the recent and currently used advancements based on digital transformation and emerging technologies.

While the global discourse on knowledge management and digital transformation is rich, there remains a conspicuous gap when it comes to understanding these phenomena in the Hungarian context. This study, therefore, is a necessary step to fill this gap in the literature. By focusing on Hungary, the research aims to offer insights that, while rooted in a specific geographical context, have broader implications and can resonate with scholars and practitioners beyond the country's borders.

The dissertation, after summary of the most related and reviewed literature, is structured based on the method of research, which combines quantitative and qualitative analysis in order to improve comprehension and validate the studied phenomenon. To reach in-depth investigation, multiple data gathering techniques will be used, which is combined in a two-pillar research that includes: online questionnaire and interviews.

1.3. Research purpose and objectives

The purpose of this study is to provide a thorough, meaningful, and practical evaluation of organisational knowledge management in the context of digital transformation and emerging technologies in Hungary. It intends to fill a significant gap in the literature and suggests findings that may be valuable to other scholars pursuing this particular subject.

The primary objective of this research is to provide a holistic overview of the interplay between industrial characteristics, strategic knowledge management approaches, external factors, and the adoption of emerging technologies. To achieve this, the study employs empirical analysis methodologies, ensuring that the findings are both robust and grounded in real-world data. The central research question guiding this endeavour is: ‘How do industrial characteristics, strategic knowledge management approaches, external factors (including global events and sectoral differences), and the adoption and impact of emerging technologies collectively shape the implementation, challenges, and outcomes of knowledge management in organisations?’

In addressing this question, the study will explore several sub-themes. These include understanding how different industries in Hungary approach knowledge management, the strategies they employ, and the challenges they face. The research will also delve into the role of external factors, such as global events and sectoral differences, in influencing knowledge management practices. A significant portion of the study will be dedicated to

understanding the impact of emerging technologies. As digital tools and platforms become increasingly integral to organisational operations, it is imperative to understand how they intersect with knowledge management practices and what implications they hold for organisations.

The following figure presents the structure of the dissertation.

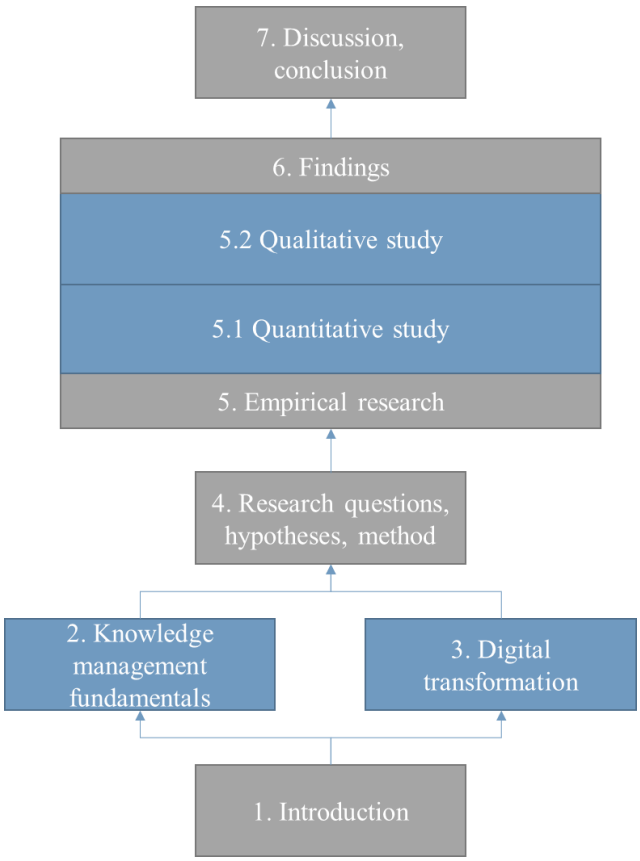

Figure 1. Structure of the dissertation

Source: own edition

The dissertation consists of four main parts that are the introduction, the theoretical discussion, the empirical study and the conclusions, these are structured into 7 chapters.

2. Knowledge management fundamentals

This part of the dissertation provides an overview on the most relevant literature on knowledge management fundamentals, including interpretation of knowledge and knowledge management, introduction of knowledge management elements and previous research that shaped this research.

2.1. Interpretation of knowledge

When discussing interpretation of knowledge, it is necessary to mention the conceptual model that describes the evolution of understanding from data through information to knowledge. The widely accepted view is that information gives data meaning, data reflects the raw facts, and knowledge is the result of acting upon the information.

Nevertheless, it was most likely Russell Ackoff (1989) who originally proposed the idea of a hierarchy (Figure 2), with data serving as the base and knowledge at the top. The development of the DIK (Data, Information, Knowledge) paradigm with a pyramid representation was aided by Zimmerman et al. (2003).

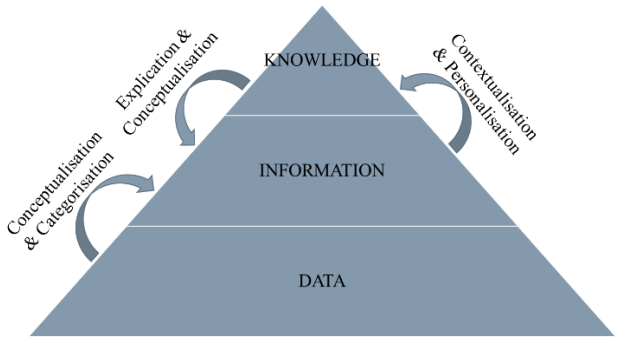

Figure 2. The DIK model

Source:Ackoff (1989), own edition

The pyramid suggests that data forms the basis and is processed into information, which when further refined or understood becomes knowledge. The concept has since been widely utilised in information science, management, and education to explain the progression of informational concepts and their interrelations.

At the bottom is the data, which is a fact, a sign, or a measurement result. **Data** in itself has neither meaning nor any textual context, but its recording, processing, transmission, and handling require "various and exceedingly sophisticated tools". Modern organisations store data in some technological system, arranging them into specific data structures for

the sake of data processes, statistical records, and standardising availability. Today, data processes are often realised electronically and often in an integrated manner. For users, data is accessible in some organised forms, through workstations. The problem usually arises when the data does not contain meaning, i.e., it does not explain the data, so the circumstances of the data's origin are unknown. There is no reference to the significance or importance of the data. They can relate to a phenomenon, concept, realisation, observation, experience, condition, process, document, person, and only become information when some connection is established between them.

Next is **information**, the 'interpreted data', which is a consolidated set of facts or measurement results (data) formed in a given situation, time, and circumstances. Transforming raw data into valuable information involves several key procedures. Contextualization ensures the purpose behind collecting the data is understood, while classification identifies the units of analysis and the main components within the data. Calculation allows for the mathematical or statistical analysis of the data. Correction is applied to eliminate any errors, and compression summarises the data into a more condensed form, making it easier to understand and use.

On the third rung of the ladder stands **knowledge**. Intangible and complex by nature, defining knowledge precisely is extremely challenging. One approach suggests that knowledge is a combination of information, ideas, rules, and processes; expertise possessed by those with knowledge. From a business perspective, for an organisation, knowledge is everything that can be known about customers, products, processes, failures, and successes.

However since it is a pyramid, it cannot depict the cyclical flow of information leading from data to knowledge, and knowledge to additional data, etc.

One of the most frequently cited philosophers regarding the concept of knowledge is Polanyi (1966), who famously stated, 'we can know more than we can tell', and to support this claim, he uses the example of cycling. The experience and technique of cycling cannot be described in words; it must be experienced. Essentially, Polanyi examined how knowledge may be expressed and understood. He also emphasised the socially constructed nature of knowledge when he introduced the concept of personal knowledge.

A number of researchers emphasise that there is no practical value in differentiating between knowledge and information in knowledge sharing studies (Bartol and Srivastava,

2002; Huber, 1991). As a result, they frequently use the words knowledge and information interchangeably. This perspective is pursued by understanding knowledge as information that individuals process; this includes ideas, facts, judgments, and expertise that are relevant to the functioning of the individual, the team, and the organisation (Alavi & Leidner, 2001; Bartol & Srivastava, 2002).

The debate over the DIK's structure, whether pyramid or cycle, centres on the blurred distinction between its components, leading to the misconception that data processing, information management, and knowledge management are equivalent, as highlighted e.g. by Girard in 2006.

In my opinion, the DIK hierarchy, while conceptually appealing, may oversimplify the complex nature of knowledge processes especially in today's dynamic information environments. The model's linear progression from data to wisdom does not account for the non-linear and often chaotic ways in which knowledge is created and used in organisations, especially in the age of emerging digital technologies, e.g. big data and AI.

2.1.1. Knowledge categorisations

The concept that knowledge is ‘justified true belief’ stands as one of the most widespread and dominant interpretations of the term (Oeberst et al., 2016). When seen from a different angle, knowledge might be equated to power. Viewed from an alternative perspective, knowledge can be considered synonymous with power. Described as intellectual capital, knowledge is identified as the crucial component in the process of production and the primary force behind wealth generation in an economy that emphasises the accumulation of knowledge (Carlaw et al., 2006).

Knowledge is a complicated concept that has multiple meanings and categorisations. Discussing knowledge needs to respect all its aspects and content (Davenport et al., 1998).

Knowledge can be typed into *explicit* and *tacit* knowledge (Polanyi, 1966). Explicit knowledge can be expressed in formal language or mathematical representations. It can be codified and stored in books and databases. However, tacit knowledge is personal knowledge embedded in individual experience and encompasses intangible elements such as beliefs, symbols, values and feelings. Tacit knowledge is a particular challenge to share, retain, capture, verbalise, visualise, and transfer or even teach. For example, emotional intelligence is the ability to perceive and apply emotions to influence outcomes

and it is extremely hard to teach or express. The interaction between these two modes is essential to create new knowledge (Ettore et al., 2015).

Knowledge is valid and confirmed information that organisational leaders utilise in their decision-making processes and activities to achieve success and secure competitive edge. It comprises skills, ideas, roles, principles, and trends, that aid decision-making. According to Alavi and Leidner (2001), knowledge aims to acquire information that employees can leverage for the advancement of the organisation. The timely sharing and transfer of knowledge among the appropriate individuals, coupled with its utilisation at the right moments, can significantly enhance an organisation's potential to boost its performance. (O'Dell & Grayson, 1998). Knowledge and information are used interchangeably. Nonaka (1995) highlighted that information and knowledge are often used interchangeably, noting that while they share similarities in many instances, they also possess distinct differences. Information is considered to be more factual, whereas knowledge encompasses beliefs and commitments.

Wang and Noe (2010) described knowledge as 'information that has been processed by individuals encompassing ideas, facts, expertise, and judgments that are pertinent to the performance of individuals, teams, and organisations'. Davenport and Prusak (1998) defined knowledge as, 'a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers'. In the context of an organisation, Nonaka and Takeuchi (1995) argued that knowledge is 'a justified true belief that increases an entity's capacity for effective action'.

Knowledge can thus be described as an intangible or invisible asset, whose acquisition is rooted in intricate cognitive processes including perception, learning, communication, association, and reasoning (Epetimehin & Ekundayo, 2011). According to Maurer's definition (1998), knowledge is understood information. Davenport, De Long, and Beers (1998) characterise knowledge as information unified with experience, context, interpretation, reflection, and perspective, which together contribute to a deeper level of understanding. Allee (1997) posited that knowledge gains significance within the broader context of culture, which emerges from underlying beliefs and philosophies. Sveiby (1997) defined knowledge as the ability to act upon information, thereby rendering it valuable, suggesting that knowledge is ineffective if it remains unused.

Within organisations, knowledge is not merely encapsulated in documents or repositories but also becomes ingrained in the routines, processes, practices, norms, and cultures of the organisation. Knowledge is closely connected to action, signifying practical know-how and comprehension. Davenport et al. (1998) explained that the knowledge held by each individual is shaped by their personal experiences and includes the standards they use to assess new information from their environment.

Koenig (2012) critiqued the traditional division of knowledge into explicit and tacit categories as overly simplistic. He proposed a more nuanced categorisation, suggesting that knowledge is better understood when divided into explicit, implicit, and tacit types. Explicit knowledge refers to information or knowledge that is articulated in a tangible form. Implicit knowledge, on the other hand, is not currently in a tangible form but has the potential to be articulated explicitly. Tacit knowledge encompasses information or knowledge that is inherently difficult to convey or formalise in a tangible manner.

Choo (2002), classified organisational knowledge into three categories: tacit, explicit, and cultural. Despite these distinctions, the crucial aspect remains ensuring the organisation's data and information are accessible to its members, whether the knowledge is tacit, implicit, explicit, or cultural.

Knowledge is regarded as a vital corporate asset, evident when companies prioritise experience in new hires over intelligence or education, recognising the importance of knowledge that has been cultivated and verified over time. Nonaka, in 1995, identified five key enablers within a company that facilitate the creation of knowledge: vision, strategy, structure, system, and staff. These elements collectively support and nurture the development and sharing of knowledge within the organisation.

Knowledge is one of the most valuable assets in organisations nowadays and the catalyst of economic growth, technological progress and productivity (Chien et al., 2015, Masa’deh, 2016).

Knowledge has an important role in society as well as within the field of the economy nowadays. As a matter of fact, knowledge’s strategic role is increasing and for this reason, economy shifts from an industrial to a knowledge economy. If we think about organisations in the growing market competition, knowledge’s role is also appreciated more and more as a determinative factor of innovation.

According to Easa (2011), innovation is the outcome of knowledge creation and involves the interaction of internal and external assets. It is a combination of tangible and intangible elements that involves individuals' experiences and realities with their environment in a particular time and space (Nonaka et al., 2000).

Knowledge is often tacit and individually held, making it difficult to manage and control. For organisations to utilise this knowledge effectively, they need to codify and store individual knowledge, transforming tacit knowledge into explicit knowledge through various processes. This conversion allows for easier sharing and application of knowledge within the organisation (Martensson 2000). Within these transformation processes, an environment is required for knowledge creation, sharing, dissemination and presentation. Digital environments may provide more opportunities than conventional ones like books and newspapers for the different knowledge processes. Digital knowledge is knowledge not only accessed through digital tools, but also processed through digital tools. The use of technology means to access information (such as databases, digital libraries, or simply the Web) has led to the necessity to deal with information that is available at unconceivable speeds in immeasurable quantities, with high degree of complexity (Belisle, 2006). While the SECI model (see detailed overview in section 2.2.2) itself does not focus exclusively on digital knowledge or knowledge generated by emerging technologies, it is adaptable and could incorporate the use of these technologies to enhance knowledge management processes.

2.1.2. Individual and organisational knowledge

In the contemporary business landscape, knowledge has emerged as a pivotal asset for both individuals and organisations. Some researchers distinguish between knowledge shared or held at the individual and organisational levels. According to Polanyi and Weggeman, we can only speak of knowledge in the case of individuals (Polanyi, 1966; Weggeman, 1996). In contrast, several researchers consider individual and organisational knowledge as separate, tangible concepts (Nonaka, 1995; Spender, 1996).

Knowledge is individual and subjective for each person. On one hand, an individual's perspective cannot be transferred (Wiig et al., 1997), and on the other, one person's knowledge may merely represent data for another person (Stewart, 1997). However, moving upwards from the individual, several levels can be distinguished. Besides individual knowledge, it can also manifest at group, organisational, and inter-

organisational levels – customer, supplier, competitor, partner knowledge (Hedlund, 1994). Group knowledge is represented by norms, routines, and expertise developed through daily interactions. Organisational-level knowledge represents routines present throughout the entire organisation, and for example, the know-how possessed by the organisation (Winter, 1987).

Knowledge has value in an organisation, but it also carries risk if it is not developed or maintained. The majority of the time, management's responsibility is knowledge implication awareness. Since knowledge management necessitates change, senior management's support is crucial to ensure that the organisation benefits from the change (Lin & Lee, 2006). Based on three stages - knowledge management initiation, knowledge management implementation, and knowledge management institutionalisation - Lin (2011) identified that support from top management plays a critical role in the evolution of knowledge management within an organisation. This support has been defined as the level at which top management recognises the significance of knowledge management and the degree of their involvement in knowledge management practices. According to Beckett et al (2000), the ultimate aim of these efforts is to retain knowledge within the organisation, ensuring its availability and utility for ongoing and future initiatives.

Organisations learn by encoding events from their history into routines that influence behaviour. These routines are independent of the individuals executing them and can persist even if a large number of individuals leave the organisation (Levitt et al., 1988).

The debate continues among proponents of the knowledge-based organisational view. Some assume that organisational knowledge represents an aggregation of individual knowledge (Grant, 1996, Dalkir, 2005). The capacity of individuals to create, share, and apply knowledge significantly contributes to organisational learning and innovation (Argote, 2013). Some experts argue that knowledge can exist at the organisational level independently of individuals, embodied within informal routines, formal regulations, or integrated into technological processes. This perspective suggests that organisational knowledge is not solely the sum of individual knowledge but can also be embedded in the collective practices and systems of the organisation (Spender, 1996). Some consider the interplay between individual and organisational knowledge is a cornerstone for organisational success. Individual knowledge contributes to the organisational knowledge base, while organisational knowledge, in turn, shapes individual learning and performance. The symbiotic relationship between individual and organisational

knowledge engenders a learning organisation, characterised by continuous improvement, innovation, and adaptability (Senge, 1990).

At the individual level, knowledge is a set of beliefs held by a person about cause-and-effect relationships of certain phenomena, while at the organisational level, it is a set of shared beliefs held by individuals within the group (Sanchez et al., 1996).

Knowledge can be interpreted not only at individual and organisational levels but also at other defined levels. Internal knowledge is that which has been adapted according to the needs of an organisation, while external knowledge is awaiting adaptation before being applied within the organisation. At the level of knowledge carriers, a distinction must be made based on who carries the knowledge, i.e., which knowledge is considered an individual's, which belongs to a group within the company, or which can be said to be the property of the entire organisation. Group knowledge is nothing but a combination of the knowledge of individuals with common interests. In the case of organisational-level knowledge, the knowledge is embedded in the organisation's business processes, encompassing the organisation's entire know-how. Any materialised element in which knowledge can manifest is considered a knowledge carrier (Gaál, 2000).

Based on the approaches outlined above, I agree with the opinion of Obermayer, that knowledge is not only individual but also organisational capital, as it is becoming an increasingly important part of corporate assets nowadays. Organisational knowledge is processed information present in company processes and ensures the operation for an organisation. The fundamental knowledge resides in people's minds; however, for the success of the organisation, it is crucial that this knowledge becomes part of the organisation's systems, processes, and culture (Obermayer, 2007).

The notion that knowledge is both individual and organisational capital has been articulated in this section. In my opinion, it would be worthwhile to further examine the potential conflicts between personal knowledge ownership and the organisation's use of that knowledge. Additionally, to explore the ethical implications of exploiting individual intellectual capital for corporate gain, which could be a topic for a future research.

2.2. Knowledge management

The idea of knowledge management is not revolutionary. In every era of history, valuable experience and professional knowledge appeared that had to be managed and systematised in some way, which can be understood as an initial knowledge management

method. The importance of knowledge management in organisations is well-recognised and has been extensively discussed in academic literature (Quarchioni et al., 2022).

Knowledge management is a set of processes for creating, sharing and using knowledge, which help the company achieve its organisational goals (Lee & Yang, 2000). Knowledge management involves a systematic approach to acquiring, organising, managing, and disseminating knowledge within an organisation to enhance efficiency, repurpose best practices, and reduce costly redundancies from one project to the next. This process aims to streamline operations and leverage organisational knowledge for continuous improvement and innovation (Nonaka & Takeuchi, 1995). From a business perspective, knowledge management entails the processes of acquiring, safeguarding, and evaluating intellectual property, ensuring that valuable knowledge assets are effectively managed and utilised to drive organisational success.

Dalkir (2005) defined knowledge management as the intentional and methodical coordination of an organisation's people, technology, processes, and organisational structure. This coordination aims to generate value through the reuse of knowledge and innovation. It is accomplished by creating, sharing, and applying knowledge, as well as integrating valuable lessons learned and best practices into the organisation's memory. This process is designed to encourage ongoing learning within the organisation.

2.2.1. Evolution of knowledge management

Knowledge management is an area continuously developing with time alongside with other framing conditions like organisational and technological changes. The development of knowledge management took place over decades (Anklam, 2005).

The next part is about the introduction of the evolution of knowledge management grouped into 6 ‘generations’ according to Bencsik based on Anklam’s categorisation (Anklam, 2009, Bencsik, 2016).

In the **‘first generation’**, the focus was on technology. During this time, knowledge management operations were linked to the development and deployment of information technology opportunities everywhere (Anklam, 2009). Knowledge was perceived as a product and information is managed as a resource with the help of documents, databases, and content service solutions. It coincides with the emergence of Web-based technologies and focuses on the technology of knowledge generation and production (Nonaka & Takeuchi, 1995). Behind the rapid spread and development of knowledge management is

the expansion of the tools of IT (Wiig, 1997). As understanding evolved, it became clear that relying solely on information technology was insufficient for exploring, integrating, and transferring the more hard-to-find aspects of tacit knowledge. The complexity and personal nature of tacit knowledge require more than just technological solutions to be effectively managed and shared.

The **'second generation'** distinguished between explicit and tacit knowledge (Polanyi, 1966). New methods came to the fore, the main characteristic of his second era, according to Anklam, was the recognition and conscious handling of the difference between knowledge-based and experiential, problem-solving knowledge. The true knowledge of an organisation lies in its human resources.

The **'third generation'** goes beyond information technology, individuals, and even the organisation and emerges as a network (Snowden, 1997): the network plays the central role. One of the determining factors in this endeavour is the need for innovation that appears along with the rapid pace of change. Network systems appear within which cooperating organisational partners integrate new types of business models, complex structures, and innovation system ensembles. Knowledge increases in value (fundamental political, social, economic, business transformation), which result in the development of the knowledge economy.

The **'fourth generation'** focuses on the consideration of knowledge as a capital factor and looks for its quantification possibilities, while the **'fifth generation'** explores the relationship between corporate competitiveness and innovation. These are about to look for a way to articulate the value of human resources, which is becoming more and more important in business operations (Silva de Garcia, 2020).

As can be seen from the above, in the fourth and fifth era of knowledge management, advanced economic systems are looking for an expression of the value of human resources, which arises only occasionally in corporate practice in Hungary.

The **'sixth generation'** of knowledge management is considered to be started by the rise of artificial intelligence. Systems designed to support strategic decisions utilise artificial intelligence to apply rules and logic in the processing of large data sets, thereby enabling more informed and strategic decision-making within organisations. Relevant information can be extracted from the accumulated and large masses of data, which facilitate decision-making at different levels of the organisation. Certain decision-making situations can be

automated and are also suitable for making forecasts. It helps in formulating goals, especially in the case of 'what-if' type questions.

These generations developed one after the other as a natural consequence of thinking and technical development. However, today in Hungary all the listed eras can be found side by side, at different levels of development, in different companies. This is due to the reason that managers approach their work with different values, thinking on different scales and operate at different levels of success (Bencsik, 2021).

Development of knowledge management can be categorised differently, too. It is categorised into 4 stages Obermayer's consideration (Obermayer, 2022). The summary of this categorisation is described in the following part.

Obermayer (Obermayer, 2022) considers technology as main former of **'Knowledge management 1.0'**. The phrase 'knowledge worker', first used by Peter Drucker in 1959, is the origin of modern knowledge management. Polanyi's notable advancement (distinguished between tacit and explicit knowledge) from 1966 is also included in this category as one of the main drivers. The 1970s saw the rise of various tools like expert systems and decision support systems, enhancing the efficiency of information technology (IT) across multiple sectors. The initial phase of knowledge management, driven by technology, primarily featured knowledge in the form of reusable resources such as documents, databases, and files, aligning with the adoption of web-based technologies in the corporate world. The publication of a book by Nonaka and Takeuchi in 1995 shifted knowledge management towards being a managerial concern and an IT solution, with scholars attributing the swift growth and evolution of knowledge management to the broadening scope of IT capabilities.

'Knowledge management 2.0' is about the driving force of human resource. This second stage in knowledge management development is driven by the understanding that an organisation's true knowledge resides in its human resources, leading to a recognition of the distinction between explicit and tacit knowledge, and spawning new approaches like knowledge sharing and motivational systems. Davenport and Prusak (1998) highlighted that corporate strategic objectives should encompass managing organisational knowledge to ensure it's accessible, cultivable, and practicable. Probst (1998) emphasised the pivotal role of knowledge sharing in the six-step internal life cycle of knowledge management, asserting that merely acquiring and developing knowledge is inadequate without fostering a culture of knowledge sharing. During this period, researchers focused on exploring

individual traits and devising methods to motivate employees to share knowledge, as acquiring and nurturing employees with key knowledge, and integrating their expertise into products and services became vital organisational priorities.

'Knowledge management 3.0', as the third stage of knowledge management emphasised networking, marking a shift in the perception of knowledge's value, driven by major political, social, economic, and business transformations that birthed the knowledge economy. This phase saw the introduction of network systems allowing enterprises to create collaboration platforms and communication channels to foster knowledge sharing, propelled by the internet and the emergence of Web 2.0 technologies or social media tools, which simplified and expedited knowledge acquisition and transfer. The growing utilisation of social media tools for establishing and maintaining private relationship networks has been noted, with some companies successfully integrating these tools into their business processes. However, despite the rising interest in social media, some individuals remained hesitant to embrace networked cooperation, often due to a lack of awareness regarding the benefits such technologies could offer in a professional setting.

The last stage in the evolution of knowledge management, **'Knowledge management 4.0'** is anchored on digitalisation, particularly in the context of Industry 4.0 (which is introduced in the next chapter), necessitating a more intricate and holistic approach towards managing the interplay between human and machine knowledge. A core challenge is unlocking the full potential of digitalisation through a knowledge management strategy that champions knowledge and information sharing, alongside data analysis to foster data-driven decision-making (Natarajan, 2018). The growing amount of data from diverse business sectors and sources and sources underscores the imperative of adept management of data, information, and knowledge for organisational vitality (Abonyi & Miszlivetz, 2016). Consequently, knowledge management, knowledge sharing, and human resources have emerged as pivotal elements in this digital-centric stage of knowledge management evolution.

2.2.2. Knowledge management directions

Despite the wide range of research on knowledge management, there seems to be no universal definition for it. In the following a few interpretations of knowledge management are presented.

Suresh et al. (2016) summarised that various definitions of knowledge management are particularly pertinent to the field of management because they emphasize the application of knowledge and view it as a pragmatic tool for shaping experiences and exchanging ideas. Thus, knowledge management entails a comprehensive understanding of how knowledge can be utilised to address practical challenges associated with activities that are based on knowledge.

Knowledge management is the process of capturing, organizing, sharing, and utilizing knowledge within an organisation. The goal of knowledge management is to improve organisational performance by ensuring that knowledge is readily available to those who need it, and by promoting innovation and learning.

Other researchers have visualised knowledge management from many angles aside from these ground-breaking ideas. For instance, a six-stage model was developed by Ginevičius et al. (2011) for the construction industry of Lithuania and used it to improve the knowledge level of construction managers and related organisations, as well as how knowledge influenced behaviour can be used to better solve the organisational problems. Another research by Zanuzzi et al. (2020) examines the digital transformation and knowledge management from the agriculture industry of Brazil, where they identified individuals depend on technical assistance for agriculture knowledge. This indicates that existing studies fall short in identifying the information processing needs and developing information processing capability for managing digital knowledge (Baptista et al., 2020; Tallon et al., 2019), which is crucial for ensuring business continuity.

The literature shows the outstanding role of knowledge management, the conversion of knowledge through the modes between tacit and explicit knowledge (Nonaka & Takeuchi, 1995; Astorga-Vargas et al., 2017). The basis of the concepts of knowledge and knowledge management is the philosophical approach of Polanyi, which stipulates that distinction must be made between explicit and tacit knowledge. Explicit knowledge includes recordable, collectable, editable, easily transmittable and learnable bodies of knowledge. Tacit knowledge can be described as “we can know more than we can tell". Tacit knowledge is an idea, a personal opinion or intuition that is personal, subjective and based on experience, and that is closely associated with the holder of the knowledge. Polanyi describes human knowledge as an iceberg, the visible part of which is explicit, the underwater part of which is tacit knowledge (Polanyi, 1966).

In the wake of Polanyi, based on the tacit and explicit knowledge categories, Nonaka and Takeuchi (1995) have developed the knowledge conversion model (one of the most renowned models today), popularised as the SECI model. Their model differentiates between four individual knowledge transfer methods: ‘socialisation’ is the transfer from tacit knowledge to tacit knowledge; ‘externalisation’ is the transfer from tacit knowledge to explicit knowledge; ‘combination’ is the transfer from explicit knowledge to explicit knowledge; and ‘internalisation’ is the transfer from explicit knowledge to tacit knowledge. The process always begins anew, as knowledge creation is a series of continuous and dynamic interactions between the four elements.

	To tacit knowledge	**To explicit knowledge**
From tacit knowledge	SOCIALISATION	EXTERNALISATION
From explicit knowledge	INTERNALISATION	COMBINATION

Table 1. SECI model of knowledge by Nonaka & Takeuchi

Source: Nonaka & Takeuchi (1995), own edition

During the past decade, numerous publications dealing with knowledge management from different perspectives have been published (Serenko, 2013; Omotayo, 2015; Ramadan et al., 2017; Shujahat et al., 2019). The surveys show tacit knowledge underpins all other forms of knowledge enabling the interpretation of knowledge leading at its highest levels to the concept of wisdom.

Examples from the four transfer processes are mentioned in the following part.

During socialisation, individuals share experiences to create and disseminate tacit knowledge, such as shared mental models and technical skills. This mode of knowledge conversion involves processes like observation, imitation, and hands-on practice, allowing individuals to learn from one another in an intuitive and informal manner.

The process of internalisation involves integrating explicit knowledge into tacit knowledge, a concept closely aligned with 'learning by doing'. Typically, this involves converting knowledge that has been captured in documents or conveyed through oral stories into personal, tacit understanding through practical application and experience.

Externalisation is a critical process where tacit knowledge is articulated into explicit concepts using metaphors, analogies, concepts, hypotheses, or models. This process underscores the importance of language as the primary medium through which the

essence of an idea or image is expressed and communicated, transforming intuitive insights into understandable and shareable knowledge.

Combination involves the systematic organisation of concepts into a coherent knowledge system. During this process, individuals exchange and combine knowledge using various mediums, including documents, meetings, and conversations. Through activities such as sorting, combining, and categorising, information is restructured into a more organised form. This method is typical of formal education and many training programs, where information is methodically compiled and presented in a structured manner to facilitate learning and knowledge sharing.

A culinary recipe is a nice example of explicit and tacit knowledge provided by Baloh et al. (2011). A summary of the cooking procedure and a list of the items to be used are examples of explicit knowledge used in cooking. Understanding what ingredients to use, how much to add, and how to prepare a particular dish are examples of tacit knowledge. It might be challenging to describe procedures like adding certain ingredients in a specific sequence, utilizing a specific method, or timing the cooking process. The importance of tacit and explicit knowledge as a management tool that can be used to manipulate organisational information communicated via human ware, groupware, intranets, and other means is growing in both practice and literature.

As summarised by Kiss (2023), Nonaka and Takeuchi's spiral (SECI) model has been a seminal framework in organisational knowledge generation discussions since its inception. The model highlights the dynamic nature of knowledge and its generation, viewing it as a cyclical process with a four-part structure that aids in practical application. However, it has faced criticism over time; Engeström (1999) noted its lack of problem-finding, a key component in innovation processes, making it unsuitable for innovation-based learning. Poell and van der Krogt (2003) emphasised the importance of self-organising learning, particularly in professional organisations, and discussed the limitations inherent in the model's four modes. Glisby and Holden (2003) argued that the SECI model is rooted in Japanese management practices, limiting its applicability in different cultural contexts. Adler (1995), Stacey (2001), and Tsoukas (2003) challenged the model's separation of tacit and explicit knowledge, asserting the necessity of tacit knowledge for understanding explicit knowledge. Gourlay (2006) questioned the model's starting point in the knowledge conversion cycle, suggesting a different approach when tacit knowledge is the source. Although the SECI model is a paradigm in corporate

management, relying solely on it for knowledge transfer is risky and unsustainable, leading to the recommendation of the capillary model (Noszkay, 2017). Understanding how organisational knowledge sharing cultures may emerge and take shape in a 'natural way' through self-organisation is made easier with the aid of the capillary model. As summarised by Véry (2021), knowledge creation is not sequential, but occurs in many forms simultaneously.

As per Wiig, the knowledge management process can be broken down into several steps, including knowledge creation, knowledge storage, knowledge sharing, and knowledge utilisation (Wiig, 1997). In the creation phase, knowledge is generated through various activities, such as research and development, brainstorming sessions, and innovation programs. In the storage phase, knowledge is organised and stored in a manner that makes it easy to access and use. In the sharing phase, knowledge is disseminated throughout the organisation through various channels, such as databases, wikis, and social media. Finally, in the utilisation phase, knowledge is applied to solve problems, make decisions, and develop new products and services.

Four types of knowledge management components are defined in recent studies as knowledge-generation, knowledge-codification, knowledge-transferring/sharing, and knowledge-utilisation in firms' sustainable success (Shujahat et al., 2019; Zaim et al., 2018).

The importance of knowledge management has been recognised by many scholars and practitioners. According to Davenport and Prusak (1998), 'knowledge is now recognised as one of the most important resources of a firm'. In today's knowledge-based economy, organisations must effectively manage their knowledge assets to remain competitive and innovative (Alavi & Leidner, 2001).

Effective knowledge management has many benefits. By sharing knowledge throughout the organisation, individuals and teams can learn from one another and improve their performance (Nonaka & Takeuchi, 1995). Effective knowledge management can help organisations to respond more quickly and effectively to changes in the business environment (Wiig, 1997).

However, there are also many challenges associated with knowledge management. One of the main challenges is getting individuals to share their knowledge with others (Becerra-Fernandez et al., 2015). Knowledge hoarding can be a problem, as individuals

may fear that sharing their knowledge will make them less valuable to the organisation. Additionally, there may be cultural or structural barriers to knowledge sharing, such as a lack of trust between individuals or a lack of incentives to share knowledge (Alavi & Leidner, 2001).

To overcome these challenges, organisations must develop a culture that supports knowledge sharing and collaboration (Becerra-Fernandez et al., 2015). This may involve providing incentives for individuals to share their knowledge, such as recognition programs or bonuses. Additionally, organisations may need to invest in technology and infrastructure that supports knowledge management, such as social media platforms or knowledge management systems (Dalkir, 2005). Knowledge management is a critical process for organisations that are aiming for remaining competitive and innovative in today's knowledge-based economy. By effectively capturing, organising, sharing, and utilising knowledge, organisations can improve their performance, promote innovation, and respond more quickly to changes in the business environment. However, there are many challenges associated with knowledge management, and organisations must work to overcome these challenges by developing a culture that supports knowledge sharing and collaboration, and by investing in technology and infrastructure that supports knowledge management. It is a discipline which is still in development, especially when come to the digital environment (Buntak et al., 2020).

Knowledge management is situated within the realm of management studies, yet it is intricately linked with information and communication technologies (ICT) (Mihalca et al., 2008). The widespread use of information technology in organisations positions it as a natural conduit for facilitating the knowledge management process. This integration of ICT in knowledge management underscores the role of technology in enhancing the capture, storage, dissemination, and application of organisational knowledge (Allameh et al., 2011).

There was significant discussion about the codification of tacit knowledge and the role of technology in knowledge management. On the one hand, there are strong criticisms about the artificial separation between tacit and explicit knowledge and the possibility to transform tacit into explicit knowledge, as these entities cannot be used without the other (Cohendet, 2014; Sanzogni et al., 2017). The topic of how emerging technologies could bridge the gap between codification and collaboration remains open. This point is directly connected to the tacit knowledge debate; that is the drive toward codification of

knowledge implicitly embedded in the development of new emerging technologies yet neglecting the knowledge-related limitations of this endeavour (Sanzogni et al., 2017).

This overview addressed important distinctions of the treatment of tacit and explicit knowledge. However, further critical examination on the challenges associated with expressing tacit knowledge could be beneficial to be addressed. It could question the effectiveness of existing methodologies in capturing the specifics of tacit knowledge, which is often deeply embedded in individual experiences and not easily transferable.

From my perspective, while the SECI model is discussed, a critical perspective would be to question its applicability in the context of rapid technological change. The model's stages may not fully encapsulate the iterative and networked nature of knowledge creation in digital workplaces, where e.g. social media and collaborative platforms play a crucial role.

2.2.3. Knowledge sharing

Knowledge sharing involves disseminating information and expertise to aid others and foster collaboration in solving problems, developing new ideas, or putting policies or procedures into practice. This practice is crucial for enhancing collective understanding and efficiency within teams and organisations, facilitating innovation and effective decision-making. Sharing knowledge can occur through written communication, in-person interactions, networking with other professionals, or recording, organising, and gathering information for future use (Cummings, 2004).While the terms ‘knowledge sharing’ and ‘knowledge exchange’ have sometimes been used synonymously (Cabrera et al., 2006), knowledge exchange include both knowledge sharing and knowledge seeking, when employees look for information from others.

Several researchers have concluded that knowledge sharing is a key activity of effective knowledge management (e.g. Gururajan & Fink, 2010; Lee & Choi, 2003; Amayah, 2013; Oluikpe, 2012; Paquette & Desousa, 2011).

Studying knowledge sharing may be done at the individual, collective, and organisational levels. Sharing of information inside an organisation and among its members is rooted in people's behaviour and influences (here, it implies incentive for knowledge sharing). (Argote & Ingram, 2000). Jeon, Kim, and Koh (2011) noted that both intrinsic and extrinsic motivation positively impact people's attitudes about sharing knowledge, which in turn influences how they behave when it comes to knowledge transfer and sharing.

Knowledge sharing in workplaces or communities is influenced by individual factors like awareness, trust, and job satisfaction; organisational aspects such as culture, structure, and rewards; and technological factors including the availability of ICT tools and infrastructure (Noor & Salim, 2011).

Electronic knowledge systems were used in almost all research on information sharing communities. Maintaining well-organised knowledge repositories with databases of systematically codified knowledge assets is essential to facilitate easy searching, browsing, and retrieval of information (Choo, 2002). Lessons learned, best practices, planning papers, project proposals, marketing presentations, and more may be found in knowledge repositories.

However, knowledge may be shared in a variety of ways, not just via technological means. This is significant because there are likely different factors at play when deciding whether to share knowledge in face-to-face interactions as opposed to exchanges facilitated by technology. For example, employees with high extraversion levels may be more willing to share knowledge in face-to-face interactions as opposed to electronic ones because knowledge exchange takes place more in the context of relationships (Wang et al., 2010).

The importance of knowledge sharing in organisational context has been covered in this section. I think, the underlying difficulties, such the possibility of information hoarding due to competitive pressures or knowledge loss resulting from turnover could be further examined. Given the influence of organisational culture and technology on collaborative practices, a more nuanced analysis of the challenges associated with knowledge sharing in cross-cultural and geographically distributed teams could be required for future research.

2.3. Introduction of knowledge management elements

In this section, foundational elements of knowledge management, such as projects, strategies and practices are investigated.

2.3.1. Knowledge management projects

Knowledge management projects initiated within organisations have a key objective of capturing, recording, and sharing the knowledge residing in people's minds, transforming individual knowledge into organisational knowledge. Various methods are available for this purpose (KPMG, 2006, Obermayer-Kovacs, 2007).

One of the most crucial project types focuses on the establishment of formal information channels. Information channels can be categorised into formal and informal. Informal information channels encompass the dissemination of information in the form of gossip, corridor news, and expressions of opinion between individuals. Some of this might be useful, or even necessary, for the company's operations. However, a significant portion consists of information not directly related to individuals' work, which can have detrimental effects on organisations. This can result from information being inaccurate, distorted, or taken out of context. Therefore, from a knowledge management perspective, the emphasis is on the establishment of formal information channels.

In the case of promoting knowledge sharing, the project emphasises the introduction of some motivational and incentive system. The performance evaluation system focuses on designing, measuring, and evaluating human resource management policies, personnel guidelines, methodological tools, techniques, and practices related to individual and group-level contributions to organisational performance (Bakacsi, 2000). In achieving the success of knowledge sharing, the use of incentive tools plays a pivotal role in creating motivation for knowledge workers. The incentive system can be characterised, on one hand, by psychological incentives, which are defined by leadership stance, role modelling, recognition, and involvement. On the other hand, there is the recognition of personal utility, where there is a personal interest attached to easier task execution. Also, there is the material incentive for the acquisition of rewards and the avoidance of penalties.

For the effective operation of knowledge management, new planning and coordination organisational units are established. These units are known as knowledge centres, whose

task is to record the necessary knowledge in an appropriate form and transmit it to users. The staff of the knowledge centre play a consultancy role, contributing to the successful operation of the knowledge management program with their advice and suggestions (Fehér, 2004). The establishment of a knowledge centre is a tool but the target itself, it is an association with intellectual and physical infrastructure aimed at better utilisation of resources, reducing unnecessary overlaps, and improving chances of accessing additional resources. However, knowledge centres must contend with the following challenges. The quantitative increase in information does not coincide with an improvement in quality, so their greatest opportunity for adding value lies in ensuring quality information. Also, the information overload leads to a specific information deficit, but reliable scientific methods for evaluating searches in online sources have not yet been developed. Relevance of information is always relative and dependent on the individual.

An efficient document-sharing system and quick access to information and knowledge at any time of the day have become a priority in recent years. It is crucial for every organisation to consider how efficiently their employees work, as individual and group efficiency influences the role the organisation plays in market competition. However, to achieve this, there is a need to enhance collaboration and document management efficiency, which demands the use of advanced technological solutions. The document-sharing system is designed to establish the electronic aspects of sharing, storing, accessing, displaying, using, and creating organisational knowledge. The system also covers the process of overseeing the organisation's official business and decision-making documents in document format. Additionally, the system ensures that the documents used by the organisation and the information stored within them are freely and easily accessible to all members of the organisation.

Benchmarking is a process in which specific practices are identified and adapted from any area of the world to assist organisations in enhancing their performance (Marr, 2004). Benchmarking involves searching for, studying, and comparing the best practices with an organisation's own practices, and then applying the lessons learned to improve the organisation's own methods. In the field of knowledge management, according to the APQC benchmarking methodology (McDermott et al., 2001), it is essential to understand the operations of organisations engaged in similar activities. By acquiring these experiences, it becomes easier and more efficient to integrate knowledge management practices into an organisation's daily operations.

One of the most effective tools of knowledge management is training aimed at understanding activities related to knowledge management. In these sessions, participants engage interactively, and information transfer can occur in numerous ways, such as through lectures, discussions, publications, collaborative work, analysis and evaluation of studies, and more. Most commonly, these training sessions and courses are initiated by external consulting organisations and can be either open to the public or tailored specifically for an organisation.

According to Wenger, a leading figure in the study of professional communities, people are the building blocks of an organisation as members of a unit. As members of specific groups, they are responsible for various projects. They shape the organisation's network of relationships based on personal connections, and within the framework of professional communities, they produce the knowledge that enables the aforementioned activities (Wenger, 1998). Essentially, professional communities like ‘communities of practice’ are based on three factors: knowledge related to a specific field, a community of people who work in that field, and a common practice developed to facilitate effective collaboration (Wenger et al., 2002).

The measurement of intellectual capital or intangible assets has been included even among comprehensive programs aimed at measuring knowledge assets. The management of intellectual capital presents new challenges for managers. Intellectual capital has certain characteristics that significantly differ from financial and tangible assets. There are four methods to define intellectual capital. Direct methods try to determine the components of intellectual capital and then estimate its monetary value. Models based on market capitalisation focus on the difference between the company's market value and its book value. In calculations based on Return on Assets (ROA), by multiplying the deviation of the company's ROA indicator from the industry average with the value of the assets, the yield of intellectual capital can be determined. The yield divided by the return rate can be perceived as the value of intellectual capital. Finally, scorecard-type methods define the individual components of intellectual capital, evaluate these using non-financial indicators, and compare them with expectations derived from the strategy (Gyökér, 2004).

In my opinion, challenges due to dependency on technology, together with potential for information overload, the dehumanisation of knowledge processes, and the challenges of

ensuring digital literacy across an organisation could be a good potential to be addressed, as investigated studies that were not focusing on them.

Another interesting finding of the literature review of knowledge management projects is that recent studies and research seems to be lacking. Reason for this may be that in the international scene, knowledge management is increasingly perceived as not a discrete but more and more as an integral component of strategic organisational area, therefore it is not considered anymore to be executed in the forms projects which is only an operational and one-time fulfilment, but more on the strategic layer within organisations.

2.3.2. Knowledge management strategy

Kabeyi (2019) asserts that the journey towards gaining a competitive edge for an organisation starts with the formulation of a vision or strategies aimed at enhancing performance. Ferreria and colleagues describe a KM strategy as the comprehensive plan an organisation employs to coordinate its knowledge assets for KM initiatives. According to Rigby and Bilodeau (2007), strategic management is the continuous process of formulating plans, keeping an eye on how those plans are being carried out, and assessing how well those plans are working to secure the organisation's success. Research indicates that a significant portion of strategies, ranging from 60 to 90 percent, do not succeed (Kalyal et al., 2020), with less than 15 percent of strategies being effectively executed.

The treatment of knowledge as a tool of strategic importance has been raised in several early studies and research (Winter, 1987; Probst et al., 1998; Kalseth, 1999). The foundational elements of a company's success and its ability to implement strategies effectively are its knowledge management systems, which determine whether it thrives, merely survives, or folds under external challenges (Twum, 2021). While a system consists of interconnected components functioning together (Jia, 2020), a strategy defines the overarching decisions shaping the long-term goals of an organisation (Devinney & Dowling, 2020). Proper implementation of knowledge management strategies leads to positive outcomes and maximizes results in businesses and academic institutions (Ngoc-Tan & Gregar, 2018).

Knowledge management can be examined in a strategic perspective, and similar to functional strategies, the definition of knowledge strategy also appears in the literature. The term ‘knowledge management strategy’ has been utilised early by Zack (1999) that represents the set of objectives related to knowledge management within a company and

the methods aimed at achieving them. Ferreria and colleagues (2018) describe a KM strategy as the comprehensive plan an organisation employs to coordinate its knowledge assets for KM initiatives.

The formulation of a knowledge management strategy is indispensable for the operation of organisations, as the organisational knowledge accumulated through their activities must be collected, applied, and transmitted. Sara et al. (2021) outline strategic planning as an organised approach that establishes the direction of an organisation and undertakes strategic decisions to ensure the achievement of its objectives. This requires the creation of a knowledge management strategy, either integrated into the organisational strategy or articulated as a sub-strategy for a department, division, or unit.

Organisations fundamentally have two strategic approaches to choose from: the organising – organisation-centric and the relational – product-centric strategies (Hansen et al., 1999). Associated with these is a third, the environmental – customer-centric strategy (Mikulás, 2005).

Jennex (2019) discussed the dual function of KM strategies in organisations, highlighting how KM strategies manage knowledge content to ensure the right knowledge is captured and utilised, and align KM initiatives with organisational strategies. The findings underscore the necessity of a KM strategy for effective knowledge capture, usage, and alignment with organisational objectives, contributing to improved KM performance and organisational success.

Pertaining to the utilisation of knowledge, a principal decision arises between exploration and exploitation, encapsulated as ‘the exploration of new possibilities and the exploitation of old certainties’ (March, 1991). This implies that a judicious balance between the present and the future is a critical component of any business strategy, a key element that numerous organisations fail to address accurately. Josephine and Kimencu (2021) describe the execution of a strategy as the transformation of strategic plans into actionable steps that achieve the objectives of an organisation. Weiser et al. (2020) highlight the pivotal role of strategy execution in management practices, employee performance, and the overall success of an organisation.

Among the most prevalent strategies for managing knowledge are codification and personalisation (Bordeianu, 2015). The personalisation strategy posits that knowledge predominantly resides within the head of individuals, thereby rendering it tacit. The

primary objective of such strategies is to facilitate effective and direct communication and location of individuals. Conversely, the codification strategy in knowledge management adopts the perspective that the most pertinent knowledge for the organisation can be made explicit, codified, and stored in a digital format, thereby enabling widespread dissemination.

A characteristic of the organising strategy is that knowledge is stored in databases and made available to stakeholders from there. Its primary task is the codification of knowledge, documentation, and the development of various methodologies (‘push’). Explicit knowledge is at the forefront, with an emphasis on efficiency. It views knowledge as an asset and primarily invests in organisation-specific training. It develops an electronic document management system that stores, transmits knowledge, and allows for its reuse, encouraging and rewarding users of the knowledge base system (Hansen et al., 1999).

Out of the previously discussed the research questions is formulated how the relationship is between knowledge management strategies and information gathering by employees (see in chapter 4.1, as RQ3).

In the case of the relational strategy, IT is used to support individuals' communication. Tacit knowledge is central, with an emphasis placed on innovation. It also views knowledge as an asset but leans more towards investments based on unique solutions. It strives to develop systems that support the sharing of tacit knowledge (‘push-pull’), employs professionals with good problem-solving abilities, and trains them through personal mentoring. It rewards direct knowledge sharing and carries out minimal IT investments (Hansen et al., 1999).

The environmental strategy is based on the application of knowledge management that highlights connections. The strategy consciously prompts responses and provokes discussions, which enhances the awareness and critical thinking of the organisation's staff. Productive knowledge is at the forefront. It primarily focuses on developing the organisation's ability to change, building the system based on customer needs (‘pull’). Investments are decentralised and depend on the nature of the area. It favours knowledge exchange between line experts, recognising and rewarding added business value (Mikulás, 2005).

For the operation of organisations, efficient decision-making, and future planning, the integration of strategic thinking is indispensable. Kaburu and Simba (2020) contend that the longevity of an organisation hinges on the leadership's dedication to making strategic decisions that propel the organisation towards its defined success. Regardless of whether there is a written, official knowledge management strategy at the organisation, knowledge management still has a strategic aspect. This is because the organisational knowledge accumulated during processes must be collected, organised, applied, and transmitted. Regular reviews ensure that only truly relevant information remains in the knowledge base. Each of these phases has elements resulting from or impacting the corporate strategy (HR evaluation system, product development, sales strategy, etc.). A key aspect of knowledge management strategies that is widely accepted is the necessity of alignment between knowledge management strategies and business plans (Ettore et al., 2015).

This chapter was focusing on the strategic aspect of knowledge. I believe, the challenges of aligning knowledge management with ever-evolving business strategies is under-addressed. It might be considered that potential risks could arise by knowledge becoming obsolete and the need for agility in knowledge strategies to respond to market and technological shifts.

2.3.3. Knowledge management practices

In the contemporary business landscape, the ability to harness, manage, and disseminate knowledge effectively is a critical determinant of organisational success. As stated by Akhavan et al. (2016), knowledge management practices like knowledge sharing, knowledge acquisition, and knowledge application foster innovation and supports improving organisational performance.

To solve issues and seize opportunities, societies are focusing on developing robust and effective KM practices, highlighting the growing importance of KM (Tiwari, 2022). To define these practices, the idea of knowledge value chain emerged and has been debated in response to the rapid growth of KM in the previous several years (Wang and Ahmed, 2005; Carlucci et al., 2004), starting with ideas, know-how, and other intangible intellectual capital assets transformed into measurable, tangible intellectual assets.

Knowledge management practices play a pivotal role in this endeavour, ensuring that knowledge flows seamlessly across the organisation, fostering innovation, and driving competitive advantage. Knowledge sharing capacity assists in problem-solving, adopting

new technology, creating an invention, and enhancing the dynamic capabilities of an organisation (Ali et al., 2019).

Pinheiro and Antunes (2020) stated that knowledge management practices can support the development of small and medium enterprises (SME's) and their operations so they become more resilient and successful over the long term.

According to Obermayer (2023), 'the knowledge management practices of Hungarian organisations shall mean the totality of activities associated with knowledge management'.

Software and applications that attempted to address knowledge management and recording first appeared quite some time ago. These usually concentrated on a certain field and attempted to apply artificial intelligence since the 1970s to solve problems.

Information and communication technologies (ICTs) were viewed by most people and academics as the answer to knowledge management issues. Information technology's main contribution to knowledge management is to facilitate universal access to recorded knowledge and information. It offers a structure and infrastructure that users must populate with worthwhile information. Information technology facilitates the gathering, sharing, and transmission of data for organisational use (Sung & Gibson, 2005).

Information may be processed in a variety of ways, used for statistical analysis and decision-making, and processed in huge quantities through the use of the Internet, Intranet, Extranet, expert systems, data warehouses, and decision support products. Collecting, storing, and disseminating organisational knowledge is supported by solutions like different document management systems that make group work easier.

Information retrieval technologies focus on searching for unstructured, primarily text-based content within documents. These technologies are designed to efficiently locate specific pieces of information within vast amounts of text, making it easier for users to find relevant data or knowledge without having to manually sift through countless documents.

The benefit of ICTs and online databases is that people can always access and request information, no matter where they are. Moreover, as data may be transferred between two or more units effortlessly, knowledge management systems (KMS) may facilitate knowledge processes (Alavi & Leidner, 2001).

The empirical study of the dissertation that will be presented in details in chapter 5 is partially built on previous research in the topic of knowledge management (see chapter 2.4). Therefore, based on those fundamentals, the following section delves into various knowledge management practices, explaining their significance and application in modern enterprises (KPMG, 2014).

Document Management and Knowledge Base Systems

Central to knowledge management is the systematic storage, retrieval, and distribution of knowledge-bearing documents. Document management system is the systematic preparation, storage, retrieval and distribution of - electronic and scanned - documents containing knowledge (Bair, 2004). Document management systems (DMS) like Microsoft SharePoint or Documentum offer structured storage solutions, ensuring easy retrieval and distribution. On the other hand, Knowledge Base Systems, such as Confluence or Zendesk Guide, centralise structured knowledge in the form of FAQs, articles, or guides. Together, they form the backbone of knowledge management, ensuring that knowledge is accessible, up-to-date, and relevant.

Communities of practice

Communities of practice (CoP) (also known as Centres of Excellence (CoE)) are hubs that aggregate the best minds and expertise in a specific domain. This is a group of people who collaborate consistently in a certain field and have a shared issue, set of issues, or interest in a certain subject (Wenger et al., 2002). By bringing together consultants with profound knowledge and experience, CoPs ensure that best practices are established, disseminated, and adhered to. They drive innovation, foster continuous learning, and ensure that the organisation remains at the forefront of its domain.

Professional Communities

Professional communities or forums bring together experts from various domains, fostering collaboration, discussion, and knowledge exchange. Participation in such communities ensures that employees remain updated with the latest trends, best practices, and innovations in their field.

Knowledge Map

Knowledge maps are visual or database representations that showcase the competencies of individuals within an organisation. By pinpointing who possesses what skills or

knowledge, these maps facilitate collaboration, ensure that the right person is assigned to the right task, and help in identifying knowledge gaps.

Knowledge map is a practical approach to organising, simplifying, emphasizing, and navigating through complex collections of information (Wexler, 2001; Lee & Fink, 2013). It can assist in identifying knowledge sources within an organisation, tracking their flow, mapping their presence and changes, and understanding their connections to other knowledge sources. By using a knowledge map, workers can locate relevant sources of experience or expertise within the company, which can then provide the necessary knowledge (Lee & Fink, 2013).

Intra-organisational Social Technologies

These technologies, akin to popular social media platforms, are tailored for corporate environments. They foster connections between employees, facilitate the sharing of tacit knowledge, and promote a culture of open communication. Platforms like Yammer infuse social media elements, enabling employees to create profiles, join groups, and participate in discussions.

Internal Blogs

Blogs serve as platforms where employees can share insights, experiences, and perspectives. Internal blogs foster a culture of sharing, with employees elucidating on projects, innovations, or even challenges, ensuring that the entire organisation learns and grows together.

Information Sharing

At the heart of knowledge management lies the principle of information sharing. Tools that facilitate this, be it cloud storage solutions like Dropbox or collaborative platforms like Google Workspace, ensure that information flows seamlessly, reducing redundancies and ensuring that everyone is on the same page.

Enterprise social networking - Intranet

Online network of contacts connecting individuals in accordance with business interests and activities (Kane et al., 2014). Modern intranets, often dubbed as 'Internal Facebook', go beyond being mere information repositories. They are dynamic platforms that promote interaction, collaboration, and knowledge sharing. Features like profiles, activity feeds, and groups make them indispensable knowledge management tools.

Corporate instant messaging

Communication via a computer network that allows people to converse in real time. This might refer to interactions between two or more people that are written (messages) or vocal (Juhász, 2011). Real-time messaging networks, like Slack or Microsoft Teams, have transformed workplace communication. They facilitate instant communication, ensure that teams remain aligned, and foster a culture of collaboration and collective problem-solving.

Trainings

Training, both online and in-person, plays a pivotal role in knowledge management. It ensures that employees acquire new skills, understand best practices, and remain aligned with organisational objectives (Légrádiné, 2006). Modern Learning Management Systems (LMS) like Moodle or Blackboard facilitate online training, ensuring that learning can happen anytime, anywhere.

In essence, knowledge management tools are not just technological platforms but are the pillars that support organisational learning and growth. They ensure that knowledge is harnessed, managed, and disseminated effectively. As organisations continue to evolve in an ever-changing business landscape, these tools will play an even more significant role in shaping their future, driving innovation, and ensuring sustained success.

2.4. Previous research on knowledge management

The following part presents the most related previous research used as foundation of the dissertation.

Knowledge management is a factor that can influence how employees adopt new technology in their workplaces, according to Mostafapour et al. (2014). As they clarified, employees' effectiveness in their professional environments is probably going to be positively impacted by their awareness of these developments and their capacity to use them when completing tasks. Similarly, Rizwan et al. (2011) observed that when employees are actively involved in the knowledge management process, they are more likely to utilise a variety of information sources to learn about the dynamics of their organisation and to apply a range of technological advancements to effectively participate in the aforementioned process. As they concluded, these actions should help employees

gain technical and practical abilities that would likely help them succeed in the context of their organisations.

A survey by Ferreira et al. (2018) found that 92.2% of business owners think that a knowledge management system can affect employee learning and organisational progress; 66.2% say it supports them to collaborate as a team. 91% of those surveyed believe their knowledge management system aids them in developing new training programs based on their areas of expertise.

According to Ode and Ayavoo (2020), because businesses need a well-developed knowledge management approach, over 50% of knowledge management initiatives fail.

Zaim et al. (2018) pointed out that a common mistake among some businesses is focusing on document management rather than managing relevant knowledge. This issue often stems from the fact that many knowledge management technologies are designed with a greater emphasis on document management, leading to this misdirection in efforts.

KM and KM practices are studies related to larger firms and mostly focused on secondary and tertiary sectors. As stated by Bloomfire (2023), without effective KM, service industry professionals can struggle to meet client needs'. A study of Hanafi et al. (2021) discusses industry-specifics related to the implementation of Customer Knowledge Management (CKM) across various industries, emphasizing the distinct practices and outcomes in each. In the banking sector, information sharing on operational processes is highlighted, with innovation playing a key role in enhancing performance. The telecommunications industry underscores the critical role of IT in linking CKM with business model innovation. Marketing service firms focus on customer knowledge transfer, utilising both formal and informal methods. The food and beverage retail industry, exemplified by Starbucks, leverages social media for CKM, enhancing customer engagement and feedback. Lastly, in the sports services industry, CKM is linked to customer loyalty, with a focus on understanding customer expectations. Each industry adapts CKM to its unique context, demonstrating varied approaches to managing and leveraging customer knowledge. According to Saba (2022), in the service industry, KM is crucial for enhancing decision-making, innovation, and competitiveness. The paper identifies key components of KM in service sectors, such as knowledge accumulation, storage, and sharing. It highlights the importance of aligning KM practices with industry-specific needs and the role of technology in facilitating KM processes. The study suggests

that effective KM in service industries leads to improved productivity, innovation, and customer satisfaction.

Thus, the expectation of the current research is that sectoral and ownership-related differences have relationship with permitted and used knowledge management practices (see in chapter 4.3, as H2).

Since the current research largely builds on the questionnaire surveys and results of KPMG's research, in the following research studies conducted by KPMG are presented.

Using surveys used in worldwide research, KPMG Hungary carried out the first-ever KPMG knowledge management study in Hungary in 2000. Eighteen organisations, mostly in the trade, finance, telecommunications, and chemical industries, participated in the study. These organisations comprised Hungarian, mixed, and foreign-owned entities in addition to commercial and public ones. Senior executives from the IT and human resource management domains who had a direct connection to knowledge management answered the questionnaire. The results are suggestive and cannot be regarded as typical of a larger sample due to the low participation rate.

After analysing the data, it was found that domestic businesses acknowledge the value of knowledge as well, and that Hungary is likewise characterised by global trends. In the corporate world, knowledge management is becoming more and more important. Its advantages are well recognised, and successful firms are those who have implemented knowledge management initiatives. Nevertheless, the advantages offered by knowledge management are not yet fully utilised, and companies are not able to cope with the real challenges. The assessment of knowledge management is characterised by a technology-centric approach. It was concluded that there are knowledge management-based projects in Hungary, but they are not structured into a program (KPMG, 2000).

The Hungarian knowledge management survey was conducted again in the second half of 2002, using the same worldwide questionnaires as those used in Hungary in 2000, developed by KPMG. The target audience was made up of medium and upper level managers who were most directly related to knowledge management; these leaders were mostly from the IT and human resources departments. The financial, telecommunications, commercial, and chemical industries were all included in the study. Thirteen significant Hungarian corporations took part in that newer survey. However, the results of the survey can be interpreted with certain limitations.

Due to the size of the sample, and because among the companies approached, only those who were interested in knowledge management participated in the survey. The questionnaire was filled out in the context of an interview, which entailed a one-hour conversation (Stocker, 2003).

After two years, organisations perceived the problems related to knowledge management as less significant. Another advancement was the recognition of the influential effect of organisational culture. Establishing a knowledge-sharing culture is a time-consuming task, and Hungarian organisations still need improvement in this area. The management of knowledge in Hungary is on the right track, but requires certain factors (encouraging knowledge sharing, organisational culture, etc.). Hungarian businesses acknowledged that they have started the process of creating an organisational culture that supports knowledge sharing. Knowledge asset measurement projects have not yet become widespread. This can be explained by the fact that assessing knowledge assets is not a simple task, as it concerns the organisation's intangible assets. However, Intellectual Capital Management, which is one of the main areas of knowledge management, is already emerging (Stocker, 2003).

KPMG conducted another survey in Hungary in 2005/2006 justified by the economic development over the more than 3 years since its last study. The research aimed to provide an overview of the knowledge management practices of Hungarian companies and institutions, presenting the differences from the surveys conducted in the past years and the latest international survey results. In this survey, 130 organisations participated, with a total of 150 respondents completing the questionnaire, every industry was represented.

Main findings of the survey were that 77% of the participants believed that their organisation considers knowledge as a strategic tool. However, only 37% claimed to have a knowledge management strategy. 31% of the participants had no information about any knowledge management program, and only 22% stated that they have some kind of knowledge management program. Among these, the most common programs were those improving knowledge sharing and access, as well as those establishing a knowledge base.

The main hindering factors related to knowledge management implementation was the ‘lack of awareness of knowledge management benefits’. Other significant impediments included ‘insufficient resources’, the ‘management's lack of commitment’, and the fact that ‘people do not want to share their knowledge’.

During the implementation phase of knowledge management programs, the most significant challenges were that they ‘cannot find time for knowledge sharing’ and ‘they are not sufficiently aware of the benefits derived from TM’. Participants did not consider the low budget for R&D as a significant impediment, and they do not blame technology for the challenges (KPMG, 2006).

After 8 years, KPMG executed its next survey on knowledge management implementation and its influencing factors in Hungary with 299 participants and 5 expert interviews. The research aimed to provide an overview of the knowledge management practices of Hungarian companies and institutions, presenting the differences from the surveys conducted in the past years and the latest international survey results (KPMG, 2014).

According to the findings, the vast majority of Hungarian organisations still considered knowledge as a strategic tool, but just over a third feel compelled to develop a strategy for managing knowledge within the organisation. Despite this, there has been a significant increase, with nearly 70 percent of organisations had some kind of knowledge-sharing initiative or project in place (KPMG, 2014).

Out of these findings it is expected that the integration of knowledge management strategies has relationship with the information sources employees using to solve problems (see in chapter 4.3, as H3).

The application of knowledge sharing tools that already existed during the 2005/2006 research showed significant growth. The prevalence of document management systems, professional communities, and competence centres has greatly increased. Regarding external community technologies, organisations confirmed that they allow access at rates ranging from 20-60%, depending on the tool. They mostly restricted video and presentation sharing, while being most liberal with social media platforms and instant messaging. Researchers concluded that about half or even more of the employers demonstrate a cautious behaviour, preferring not to allow usage. One main finding of this research was that where internal technologies for knowledge sharing existed, whether old or new, employees typically used them. Moreover, where access to external tools was allowed, their usage was also widespread. Regarding impediments, the most common response to the factors hindering knowledge sharing was the fear of losing one's position. The higher the position of a leader, the more they lack the appropriate technology for knowledge sharing. At lower hierarchical levels, there was typically a lack of managerial

commitment. Representatives of Generation Y (born between 1980-1995) most often considered the lack of financial motivation for knowledge sharing to be a problem (KPMG, 2014).

In the study of Nascimento et al. (2020) it was found that there is a dynamic cycle of actions between strategic foresight and knowledge management, where each can enhance the other through a constructivist perspective. This reciprocal enhancement is crucial for both the development of emerging technologies and the identification of such innovations in the market that can be applied within companies. The study emphasizes that these interactions do not suggest a dominant relationship of one construct over the others but rather an equality in value among them, highlighting the importance of understanding and managing these dynamic interactions for organisational success and innovation.

Based on these results it is assumed that there is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects (see in chapter 4.3, as H4).

The next part presents studies related to the dissertation in contribution with the researcher.

A quantitative study has been conducted in 2014/2015 with its aim to identify individual and organisational traits that influence knowledge sharing behaviour by means of specific intrinsic and extrinsic motivators within Hungarian organisations (Obermayer & Toth 2017). The study aimed to explore whether knowledge sharing is influenced by individual and organisational characteristics, and to examine the relationship between these characteristics and the motivations behind information sharing behavior. Furthermore, the research delved into both organisational and individual factors that might impact the behavior associated with sharing knowledge (Obermayer & Toth 2017).

According to the findings of this research, knowledge sharing behaviour was shown to be correlated with both individual and organisational characteristics. Younger individuals are less fearful of losing their knowledge-based authority and more motivated to share it by organisational rewards and reciprocity. People are more motivated to share their information when their position is lower because of reciprocity and organisational rewards; conversely, when their position is higher, people are more afraid of losing their knowledge power. Employee’s fear over losing their knowledge base increases with the

size of the company. People are more motivated to share their expertise by organisational incentive the longer they have worked for a company (Obermayer & Toth, 2017).

Foundation of knowledge management and emerging technologies with focus on the future of human knowledge and artificial intelligence were described by Obermayer & Toth in 2019. The paper was focusing on the presentation of the most relevant literature and proposed a research agenda to examine the theoretical and practical underpinnings, challenges, and knowledge management aspects of artificial intelligence and machine learning. It specifically aimed to explore the role of tacit knowledge shared between humans and machines among knowledge workers in IT companies based in Hungary.

Related to digitalisation and its challenges in Hungarian Manufacturing firms, a research has been published in 2022 (Obermayer et al., 2022). The primary aim of the study was to investigate the digital skills of the workforce as influenced by digitalisation and to guide organisations in navigating the challenges of digital transformation. Data for the research was sourced from an online questionnaire survey conducted in the spring of 2021, targeting both managers and white-collar workers from Hungarian manufacturing entities. A significant finding was that 75% of the surveyed companies had employees equipped with basic digital competencies. In contrast, a mere 25% boasted employees with advanced digital skills. The research also highlighted that digitalisation has amplified the challenges associated with the lack of digital competence in the workforce. A staggering 95% of respondents felt that the significance of this challenge has grown due to digitalisation (Obermayer et al., 2022).

The study underscored the importance of enhancing digital competencies, especially given the rapid technological advancements in the Industry 4.0 era. It also emphasised the need for a strategic approach to digitalisation, ensuring that the workforce is adequately prepared and equipped for the digital age (Obermayer et al., 2022).

According to my examination, most papers study ICT, digitalisation or emerging technologies separately from knowledge management, and lack the analysis of the combination of them. As stated by Podrug et al., (2017), it is important to understand how technology supports knowledge management methods in addition to other organisational and individual aspects. Recent innovations in the field of language models like ChatGPT, which provide designers access to a vast amount of pertinent data, is challenging knowledge management by supporting in the design process (Xin et al., 2023).

3. Digital transformation

The word ‘digital transformation’ comes from the word ‘digitalisation’. Digitalisation is the ‘application of digital technology to innovate a business model and generate new income streams and value-producing opportunities in industrial ecosystems’, according to Parida et al. (2019). Digital transformation is defined as an adjustment in an organisation's business models to incorporate digital technologies (such as machine learning, augmented reality (AR), artificial intelligence (AI), and the Internet of Things (IoT) for the purpose of innovating processes, products, and services (Machado et al., 2021). Different machines, sensors, and devices can connect and communicate with each other in order to exchange and gather data real time. Interconnectivity in the industrial process results in increased transparency and cooperation. Digital transformation refers to a process intended to enhance an entity by initiating substantial changes to its characteristics through the integration of information, computing, communication, and connectivity technologies (Vial, 2019).

According to Matt et al. (2015), a close alignment of four dimensions is necessary for a successful digital transformation. These dimensions are: 1) technology use, which includes a company's readiness for new technology adoption and its perspective on using cutting-edge technologies; 2) shifts in value creation associated with technology adoption; 3) structural shifts related to the integration of new digital activities into existing organisational structures; and 4) financial aspects, which can either drive or result from the transformation.

Advantages that come with digital technology are now crucial differentiators, particularly as the world gets over the pandemic and other disruptive difficulties in the market. Organisations need to embrace a portfolio of applications that are easier to construct, dismantle, and expand in order to better adapt to business shifts. (Lindner, 2022).

Finding the right strategy to build competitive advantages, including the effect of digital transformation on corporate operation and performance in the era of Industry 4.0, is one of the largest issues organisations facing today.

Further potential research may address the practicality of such transformations, considering the significant investment and cultural shifts required, which may not be feasible for all organisations, particularly smaller ones.

3.1. Industrial evolution

Industrial evolution is structured into 5 main stages according to Maddikunta et al. (2021) that is shown in the following figure. It took over 100 years to develop the first three revolutions, but it only took 40 years to build the fourth from the third.

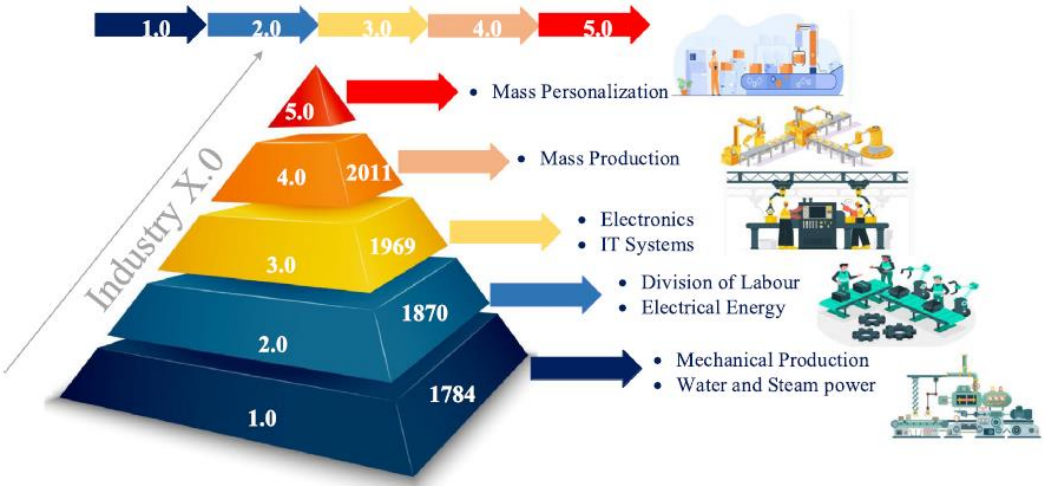

Figure 3. Illustration of industrial evolution

Source: Maddikunta et al., 2021

The creation of mechanical production infrastructures for steam- and water-powered machinery in the 1800s led to the evolution of Industry 1.0. The economy has benefited greatly from the growth in manufacturing capacity. In 1870, the concepts of electric power and assembly line production gave rise to Industry 2.0. The main focus of Industry 2.0 was workload distribution and mass production, which helped manufacturing organisations become more productive. In 1969, the concepts of electronics, partial automation, and information technology gave rise to Industry 3.0. In 2011, the idea of 'smart manufacturing for the future' helped to evolve Industry 4.0. Utilising cutting-edge technology, the primary goal is to enhance productivity and accomplish mass manufacturing. Industry 5.0 is an outlook of the future that combines the creativity of human experts with accurate, intelligent, and efficient machinery (Maddikunta et al., 2021).

According to Verhoef et al. (2019), digital transformation consists of three primary stages. The first stage includes digitalising organisations, which entails moving systems and procedures (such paper-based operations) to digital platforms. The following stage entails further integrating and optimising IT capabilities and digital technologies for the creation of processes and services. Digital technologies are applied systematically and

thoroughly throughout the process' final step, which is when digital transformation is truly completed. A radical transformation of workplaces has resulted from the effects of digital transformation, the scope and speed of current changes, and the emergence of digital technologies (Bertani et al., 2020). This has reduced the demand for workforces performing routine, manual tasks, which has decreased the demand for essential workforces (Szabó-Szentgróti et al., 2021).

The socio-economic consequences of this rapid evolution, such as job displacement and the environmental impact of new technologies has not been in focus of the current study, yet to be addressed in a separate future research. Related to that, potential benefits of such rapid technological advancements could also be questioned whether is equally distributed across society or not.

3.2. Industry 4.0

Since each European nation has long been aware of the threat posed by an aging population, the workforce is expected to diminish (Wang et al., 2016). Power-generating technologies have been around for a while, including automation and robotisation. As a result of the ongoing sharing of value-creating processes made possible by the growth of the Internet and technology, a competitive, completely tailored product for the customer can now be produced. This network of people, machines, and businesses is created continuously.

Industry 4.0 (I4.0) describes the increasing digitisation of the complete supply chain. This facilitates the integration of systems and objects through real-time data interchange (Dorst, 2015). Consequently, products, machines, and procedures embedded with artificial intelligence will possess the capability to adjust to shifting environmental conditions (Hecklau et al., 2016; Magistretti et al., 2019). The goal of I4.0 is to create a shift in production from machine-dominant to intelligent and digital (Zhong et al., 2017). I4.0 promises to boost manufacturing's flexibility and interconnection in addition to increasing mass customisation and productivity (Trstenjak and Cosic, 2017; Zhong et al., 2017) in order to successfully execute a digital transformation (Castelo-Branco et al., 2019). According to Zhong et al. (2017), it helps businesses become highly efficient and handle the difficulty of generating customised items with a short lead time to market and improved quality.

The increasing use of digital technologies in the I4.0 era implies a more sophisticated, comprehensive approach to knowledge management that is centred on managing human-machine knowledge. The biggest obstacle is realising the full potential of digitalisation through a knowledge management strategy that fosters data-driven decision-making through data analysis, knowledge and information sharing (Natarajan, 2018). Rüßmann et al. (2015) compiled nine technologies that define top businesses in I4.0. These include cyber security, cloud-based services, simulation, industrial Internet of Things, autonomous robots, augmented reality, big data analysis, and both horizontal and vertical system integration.

In my opinion, challenges of cybersecurity, the complexity of managing such interconnected systems, and the potential for significant disruptions in case of failures should be further addressed in future studies.

3.3. Transition to Industry 5.0

Industry 4.0 and digital transformation tend to disregard the importance of digital capabilities in the workforce in favour of a technology-centric approach (Kozanoglu and Abedin, 2021). Therefore, the idea of Industry 5.0 emphasises the creativity of people working in collaboration with effective smart technology. While Industry 4.0 put smart technology at the core of production and supply chains, Industry 5.0 is about enhancing that digital revolution with a more meaningful and effective collaboration between humans and the machines and systems inside their digital ecosystem. Industry 5.0 is anticipated to combine human critical and cognitive thinking with high-speed, precision machinery. Since intellectual experts deal with machines, Industry 5.0 fosters more skilled occupations than Industry 4.0. Another significant contribution of Industry 5.0 is mass customisation, which allows consumers to choose individualised and customised goods based on their preferences and requirements. Industry 5.0 will greatly boost production effectiveness and foster adaptability between humans and machines, allowing for accountability for communication and ongoing observation. The goal of human-machine collaboration is to quickly boost production. By giving people jobs requiring critical thinking and let robots or machines do the repetitive, monotonous duties, Industry 5.0 can improve the quality of production. Robust machinery paired with highly skilled professionals will promote efficient, sustainable, and secure production (Maddikunta et al., 2021).

Therefore, humans collaborate with intelligent machines to merge the precision and speed of industrial automation with human creativity, innovation, and critical thinking capabilities. Industry 5.0 serves to enhance Industry 4.0 technology by enhancing human-robot collaboration, rather than representing yet another Industrial Revolution. The goal of digital technologies is to foster human-technology collaboration rather than to replace human labour.

Products from Industry 5.0 are beginning to appear in a number of industries, including consumer electronics, food, healthcare, cosmetics, and wood manufacture. However, currently in most of the countries, especially in Hungary Industry 4.0 is still in place.

The importance of digital knowledge management as a business management tool is not only relevant due to the trends and industry 5.0, but also has been emphasised by the recent health crisis (Gupta et al., 2022; Klein & Todesco, 2021). Industry 5.0's potential uses in treating coronavirus illness (COVID) and giving patients individualised diagnosis and treatment were discussed (Javaid et al., 2020). They have supported the COVID epidemic by utilising Industry 5.0 technologies, including as holography, 4D scans, humanoid robots, telemedicine, and smart inhalers.

3.4. Emerging technologies

Growing interest in emerging technologies needs to be weighed against a body of research that lacks agreement on what constitutes an emergent technology. While there are overlaps in the definitions offered by various research, they also indicate different characteristics.

Some definitions, for instance, place a strong emphasis on the potential influence that emerging technologies may have on the economy and society (Porter et al., 2002; Martin, 1995), particularly when those technologies are more ‘generic’. Other definitions, on the other hand, place more weight on the uncertainty surrounding the emergence process (Boon and Moors, 2008); or on the qualities of novelty and growth (Small et al., 2014).

Stahl (2011) characterised emerging technologies as technologies with the potential to become socially significant within the next 10 to 15 years. This indicates they are presently in the early phases of their development but have progressed beyond mere conceptualisation.

Boon & Moors (2008) refer to emerging technologies as technologies in their initial developmental stages. This suggests that various aspects, including the technology's features, its intended usage context, and the setup of actor networks along with their associated roles, remain uncertain and not fully defined.

Rotolo et al. (2015) outlined five attributes of emerging technologies: radical novelty, relatively fast growth, coherence, prominent impact, and uncertainty and ambiguity. They defined emerging technologies as follows: ‘a technology that grows relatively quickly and is radically novel, characterised by a certain degree of coherence over time and possessing the potential to exert significant influence on socio-economic domains. This influence is observed in terms of the actors involved, institutional frameworks, patterns of interactions, and associated knowledge production processes. However, its most substantial impact lies in the future, making the emergence phase somewhat uncertain and ambiguous’.

Unlike traditional technologies which characteristics and impacts are widely known, emerging technologies can be understood as technologies in an underexplored, embryonic stage, which lack development or propagation in the market. The nature of emerging technologies is characterised by complex technological issues not yet known by companies and society in general (Kwon et al., 2017).

Emerging technologies are transforming work in unexpected ways, both on an individual and organisational level. According to Razkenari et al. (2019), emerging technologies could bring many benefits to industrialised construction, including better communicating with team members, improving sharing and accessibility information among partner firms, and improving work quality.

Businesses that had been concentrating on efficiency for years had weaknesses that COVID-19 brought to light. According to Gartner (2020), once-efficient organisations unexpectedly lost their flexibility at a critical point. Smart companies changed to a more modular structure and became composable. After preparing for a single possible future, organisations now need to consider several possibilities. Composable is about choosing the optimal technological solution for the task at hand instead of monolithic and standalone pieces, from customisation to content delivery. According to Gaspar et al. (2023), embracing composability, where businesses can quickly reconfigure their processes and systems, is vital for thriving in the digital age.

In an increasingly volatile environment, businesses need to focus more on designing for adaptability and building composability into various aspects of their operations. They should adopt a modular approach in their structure, enabling swift reconfiguration and adjustment in response to changes, whether from shifts in consumer preferences or supply chain disruptions (Panetta, 2020).

As described by Gartner, a composable enterprise is ‘an organisation that delivers business outcomes and adapts to the pace of business change. It does this through the assembly and combination of packaged business capabilities, which are application building blocks that have been purchased or developed’ (Gaughan et al., 2020).

Human aspects of digitalisation are studied extensively by other researchers, there are also research groups specified on the topic in the same university where this current study has been conducted in Hungary. The related research and findings are discussed in a later section ‘Industry 4.0 research’.

Thus, in the following section emerging technologies that will be in the centre of our research are described.

Artificial intelligence

AI is a field within computer science that aims to develop machines capable of operating autonomously in intricate and dynamic environments. There are two types of AI: narrow and strong. Narrow AI describes computer systems adept at performing specific tasks (e.g. Apple’s virtual assistant, Siri, which interprets voice commands). Strong AI, also known as artificial general intelligence (AGI) is a theoretical form of AI envisioned to attain or surpass human-level intelligence, capable of employing its problem-solving ability across various domains (Atkinson, 2018). AI encompasses a wide range of applications and techniques, including neural networks, speech/pattern recognition, genetic algorithms, and deep learning. Natural language processing (the process by which machines can comprehend and analyse human language), machine learning (algorithms that enable systems to learn), and machine vision are examples of common aspects that extend AI cognitive capabilities and can supplement human employment (algorithmic inspection and analysis of images). Emerging AI systems have remarkable ability to learn and grow, allowing them to be used for various knowledge-based tasks that were previously thought to be the sole province of humans. AI technologies are becoming increasingly intelligent, and they are operating as semi- autonomous decision makers in

increasingly complex and diverse situations (Davenport & Kirby, 2016). AI has advanced to the point where it can acquire knowledge independently of human interaction. AI capabilities are being incorporated by many firms into their daily operations. It is being utilised to provide solutions that are centred on the well-being of citizens as well as to increase performance, service levels, and accountability. Benefits of using AI in knowledge management are mainly in efficiency and productivity, team collaboration, explicit knowledge and customer relationship management.

VR technologies

Virtual reality (VR) is the computer-generated simulation of a three-dimensional image or an entire environment, within a specified space, which users can interact with in realistic manners. VR aims to provide an immersive experience and usually necessitates specialised equipment, such as a helmet or headset (PWC, 2016).

3D printing

Additive manufacturing encompasses techniques employed to fabricate three-dimensional objects according to digital models by depositing successive layers of materials, commonly referred to as 'printing'. This process relies on cutting-edge inks, including plastics, glass, or wood, among others, to realize the desired objects (PWC, 2016).

Chatbot

According to the dictionary, a chatbot is 'a computer program specifically created to simulate conversation with human users, typically conducted over the Internet or other digital platforms'[1]. Chatbots that possess the capability to access and respond to a wide range of user inquiries across various domains are referred to as generic chatbots (Adamopoulou and Moussiades, 2020).

Ticket management system

Within the system, when a user submits a problem, it is transformed into a ticket that gets routed to the IT Helpdesk for resolution. The process involves collecting comprehensive ticket data, receiving and approving tickets, delegating them appropriately, and overseeing the tickets until they are resolved. This web-based application serves as a

[1] https://www.lexico.com

ticketing tool, facilitating communication between the IT Department and users (Rachmawati et al., 2018).

Collaborative technologies

These tools and systems are designed to better facilitate group work, both in-office and remote. The Internet and remote servers can be used for sharing documents and software through a cloud-based service accessible via computer or mobile device as necessary (Lin et al., 2014). According to a study by Shamsuzzoha et al. (2016), collaborative infrastructure promotes the efficient integration of internal and external manufacturing resources, and supports business collaboration. These technologies trim the costs and time associated with facilitating group work, from designating roles and responsibilities to routing in-situ documents to checking and approving project parts.[2]

Content-based recommendation system

Content-based recommendation systems focus on suggesting items that contain similar attributes to other items that were favoured by the same user in the past. Certainly, the fundamental operation conducted by a content-based recommender involves comparing the attributes of a user profile, which contains preferences and interests, with the attributes of content objects. This process aims to recommend new and appealing items to the user based on this comparison (Lops et al., 2011).

Management information system (MIS)

Management Information Systems (MIS) encompass a collection of systems and procedures designed to gather data from diverse sources, organize it, and present it in an easily understandable format. Modern MIS heavily rely on technology to efficiently compile and present data.[3]

Fraud detection software

Fraud detection software is utilised to identify suspicious and high-risk transactions conducted online. These tools employ continuous monitoring of user behaviors and analyse risk metrics to flag potentially fraudulent purchases, transactions, or unauthorised access attempts. [4]

[2] https://consoltech.com/blog/types-of-collaboration-technology
[3] https://smallbusiness.chron.com/management-information-system-2104.html
[4] https://www.g2.com/categories/fraud-detection

Customer Relationship management (CRM)

CRM is a term in the information industry that refers to methodologies, software, and often internet capabilities aimed at helping organisations effectively manage their relationships with customers in an organised manner (Buttle & Maklan, 2019).

Biometric authentication

Security processes utilising biometric authentication verify a user's identity through distinct biological traits like retinas, irises, voices, facial characteristics, and fingerprints. Biometric authentication systems store this biometric data to authenticate a user's identity when accessing their account.[5]

Technologies supporting HR processes (e-HR)

Technology has equipped HR professionals with tools that streamline administrative tasks, enabling them to concentrate on matters demanding more personalised attention. The term 'e-HR' characterises the evolution of HR service delivery through the utilisation of web-based technologies (Johnson and Gueutal, 2011).

Robotic process automation (RPA)

RPA is a software technology simplifying the creation, deployment, and oversight of software robots that mimic human actions when interacting with digital systems and software. These robots possess the capability to interpret on-screen information, navigate various systems, recognise and extract data, all performed with greater speed and consistency compared to human counterparts.[6]

Business intelligence software

It is a set of tools to retrieve, analyse, and transform data into useful business insights. Examples of business intelligence tools include data visualisation, data warehousing, dashboards, and reporting.[7]

Gartner is a leading research and advisory company that provides insights into emerging technologies and their impact on various industries. In its latest studies, Gartner has

[5] https://www.jumio.com/what-is-biometric-authentication
[6] https://www.uipath.com/rpa/robotic-process-automation
[7] https://technologyadvice.com/business-intelligence

identified several emerging technologies that are supporting knowledge management in organisations.

At the beginning of this research process, in 2018, Gartner published its hype-cycle on artificial intelligence which also included knowledge management tools that is presented by the following figure (Gartner, 2018).

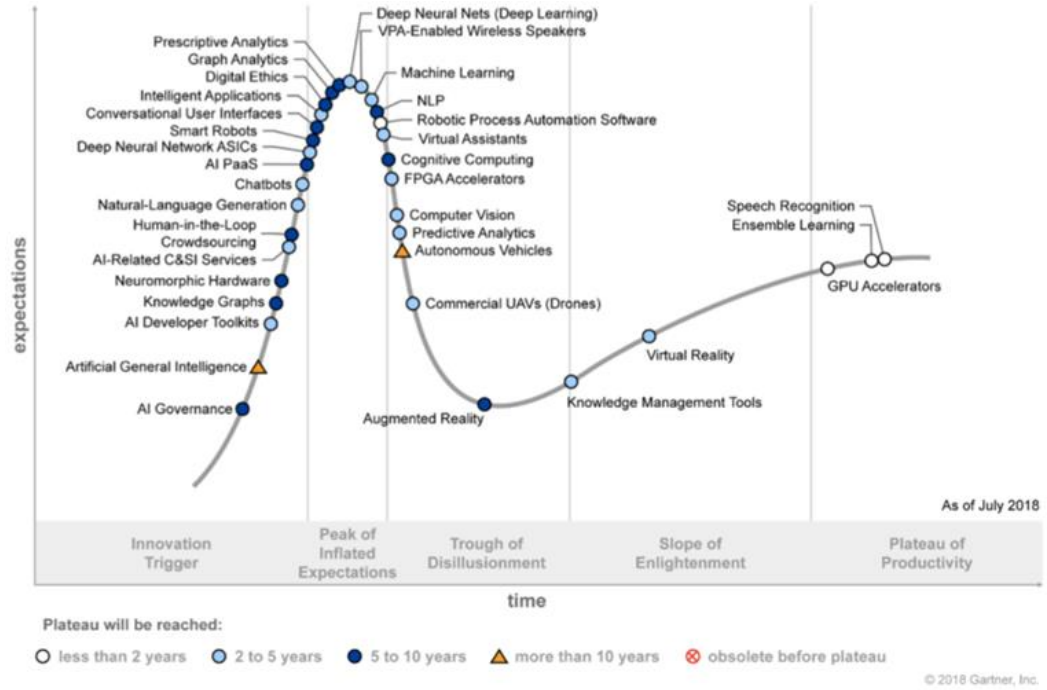

Figure 4. Hype Cycle for Artificial Intelligence, 2018

Source: Gartner, 2018

Since then, one of the main technologies that Gartner has identified as a key enabler of knowledge management is artificial intelligence. AI-powered tools, such as chatbots and virtual assistants, can help organisations to automate routine tasks, such as answering customer queries or categorizing and indexing large amounts of data. Additionally, AI can provide personalised recommendations to users, based on their past behaviour and preferences, making it easier for organisations to deliver the right information to the right people at the right time. Gartner predicts that AI will be increasingly used for knowledge management in the coming years, with the global AI market expected to reach $126 billion by 2025 (Gartner, 2021).

Another technology that Gartner highlights as a key enabler of knowledge management is the Internet of Things (IoT). IoT devices, such as sensors and smart appliances, can collect vast amounts of data about an organisation's operations, customers, and

environment. By analysing this data, organisations can gain valuable insights that can inform their knowledge management strategies. For example, a manufacturing company could use IoT sensors to monitor its production line and identify areas for improvement, while a retailer could use IoT data to better understand its customers' shopping habits. Gartner predicts that the global IoT market will reach $1.5 trillion by 2030, with knowledge management being one of the key use cases for IoT (Gartner, 2021).

In addition to AI and IoT, Gartner also highlights several other emerging technologies that are supporting knowledge management. These include:

Augmented reality (AR) and virtual reality (VR), which can provide immersive experiences that help users to learn and retain information more effectively.

Blockchain, which can be used to create secure and transparent systems for sharing and managing knowledge.

Edge computing, which can enable organisations to process and analyse data closer to the source, reducing latency and improving the speed of decision-making.

Gartner notes that while these technologies offer significant potential for knowledge management, organisations must carefully evaluate their needs and select the technologies that are most relevant to their specific context. Additionally, organisations must ensure that they have the necessary skills and infrastructure to effectively implement these technologies.

In conclusion, Gartner's latest studies demonstrate that emerging technologies are increasingly supporting knowledge management in organisations. AI, IoT, AR/VR, blockchain, and edge computing are all technologies that offer significant potential for knowledge management, enabling organisations to automate routine tasks, gain valuable insights from data, and create secure and transparent systems for sharing and managing knowledge. However, to effectively implement these technologies, organisations must carefully evaluate their needs, select the most relevant technologies, and ensure that they have the necessary skills and infrastructure.

Machine learning (ML) and artificial intelligence are having a significant impact on knowledge management.

Automated categorisation and indexing

ML algorithms can automatically categorise and index large amounts of data, making it easier for organisations to manage their knowledge assets.

Personalised recommendations

AI can provide personalised recommendations to users based on their past behaviour and preferences, allowing organisations to deliver the right information to the right people at the right time.

Predictive analytics

Predictive analytics can be used to identify patterns and trends in data, which can help organisations make informed decisions about their knowledge management strategy.

Chatbots and virtual assistants

AI-powered chatbots and virtual assistants can provide quick and efficient support to users, freeing up human resources for more complex tasks.

Natural language processing (NLP)

NLP algorithms can understand and analyse human language, making categorizing and searching for information within large datasets easier.

Content creation

AI can be used to automate the creation of content, such as articles, reports, and presentations, freeing up human resources for other tasks.

Overall, AI and ML are helping organisations to manage their knowledge assets more effectively and efficiently, by automating repetitive tasks, providing personalised recommendations, and making it easier to find the information they need.

As formulated by Véry (2021), tools by themselves simply symbolise potential; to fully utilise these devices, equipment, and technologies, one must be proficient in their exploitation as well as possess the capacity to do so. Utilising technology is another way to acquire information. It includes understanding how to make different kinds of objects and how to use, apply, and leverage them. Exploitation suggests a purpose-driven methodology. This type of information broadens the scope of what humans are capable of.

3.5. Hungary's digitalisation within the European Union

The European Commission has been monitoring EU Member States' digital progress through the **Digital Economy and Society Index (DESI)** reports since 2014. The DESI Index ranks Member States based on their level of digitalisation and examines their comparative advancement over the previous five years while taking into account their beginning point. While Hungary's industry's share of Gross Domestic Product (GDP) was at 23.2% in 2022, the DESI 2022 index shows that Hungary comes in at 22nd out of the 27 EU Members in integration of digital technologies into corporate activities. All technology metrics show poor performance for Hungarian businesses, and essential digital technologies (big data, AI, and cloud) are not widely used (European Commission, 2022).

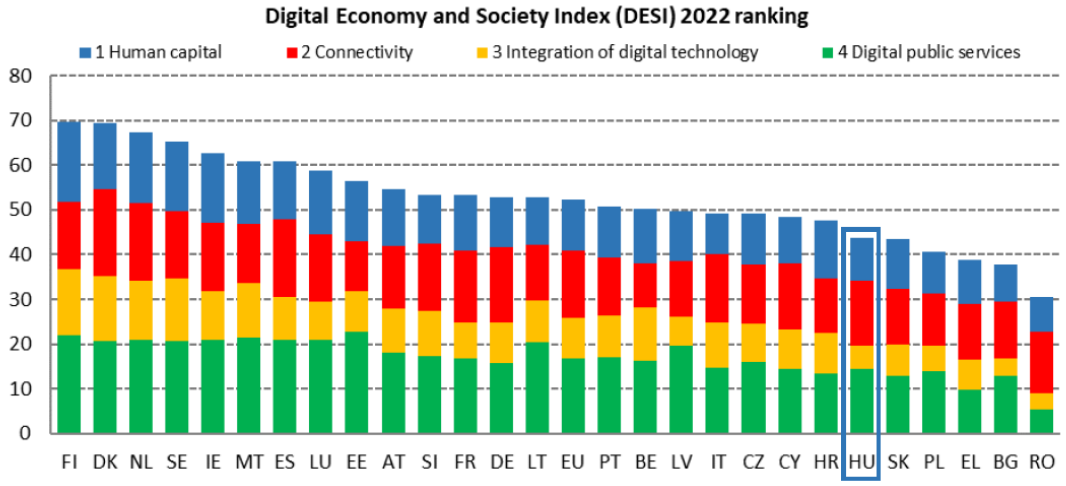

Figure 5. Use of advanced digital technologies

Source: DESI, 2022

Looking at the DESI reports over the last few years, it can be seen that Hungary progressed in line with the EU.

Considering digitalisation and adoption of emerging technologies, even though there was improvement in 2021 in the digitalisation of businesses, the majority of Hungarian businesses do not exploit the advantage of the possibilities provided by digital technologies. To exchange information electronically, 21% of the businesses use enterprise resource planning software (EU average: 38%), while 13% use social media (EU average: 29%2) or send e-invoices (EU average: 32%). Similar circumstances apply to cutting-edge technologies: on AI, cloud, and big data, Hungary also performs

significantly worse than the EU norm. Contrary to the Digital Decade goal of 75% by 2030, adoption of these services ranged between 3% and 21%. SMEs need a special policy focus because, compared to the EU average of 55% and the Digital Decade goal of at least 90%, only 34% of them have at least a basic level of digital intensity.

The EIB Group Survey on Investment and Investment Finance is a unique, annual survey based on interviews with 12 000 companies across the 27 European Union countries and a benchmark sample from the United States. The report confirms companies engaged in high-value-added tasks are more inclined to embrace digital technologies. A greater proportion of businesses within innovative domains, notably those within sectors characterised by high technological intensity in manufacturing and knowledge-intensive services, have adopted these technologies. On the **EIBIS Digitalisation Index**, Hungary is listed among the countries with the least extensive digital adoption. The majority of companies in Hungary have adopted at least one advanced digital technology, though their rate falls short of the EU average across all sectors (53% compared to 69%). Manufacturing firms (64%) and service providers (57%) are more inclined to use at least one form of digital technology compared to other industries. Large enterprises in Hungary are significantly more inclined to employ digital technologies than small and medium-sized enterprises (SMEs), with 64% of large firms utilising them as opposed to 39% of SMEs. Additionally, large firms are more prone to adopting a range of digital technologies, with 44% doing so, in contrast to just 13% of SMEs. Compared to the EU, Hungarian services and construction companies are more likely than other EU firms to have augmented or virtual reality implemented. In regards to other advanced technologies' implementations, like the Internet of Things, Big data/AI, 3D printing, digital platform technologies, and automation via robotics and drones, Hungarian firms did not reach the EU average (EIBIS, 2022).

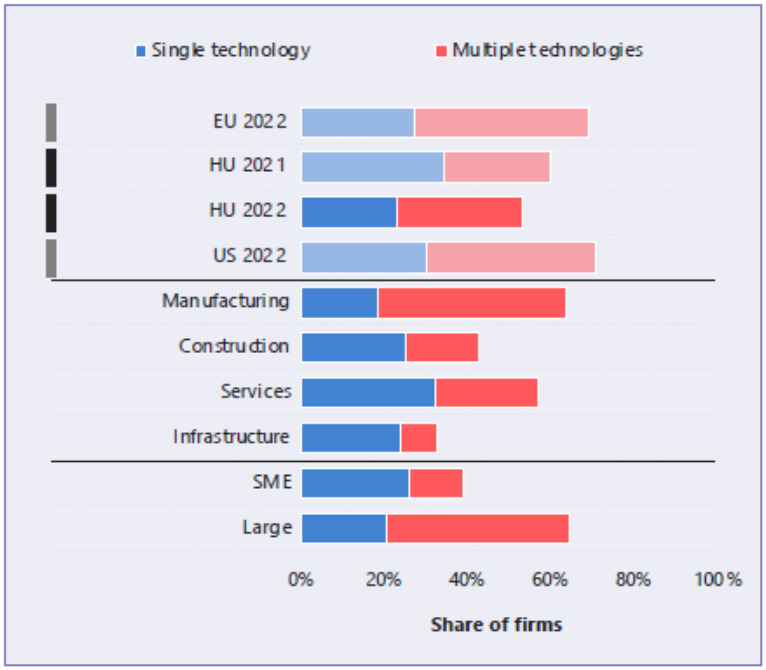

Figure 6. Use of advanced digital technologies

Source: EIBIS, 2022

By including the distinct view of businesses, the EIBIS Corporate Digitalisation Index completes the Digitalisation Economy and Society Index (DESI) index created by the European Commission. The two indices do, however, show a significant favourable correlation between nations. The key differences between the two indices are as follows:

- The EIBIS Corporate Digitalisation Index is structured around six elements derived from the same survey, focusing on companies' digitalisation assessments. This uniformity allows for straightforward international comparisons. In contrast, the DESI combines a variety of data from different sources, encompassing households, individuals, e-government services, and businesses, which makes its components more diverse.
- DESI does not include data from U.S. companies, which are pivotal for analysing the digital disparities or the extent of digitalisation between the European Union and the United States, a contrast to the EIBIS index.
- In terms of connectivity, DESI examines the household broadband market developments within the EU, reflecting the consumer side of connectivity. On the other hand, the EIBIS Index evaluates digital infrastructure from the perspective of businesses, particularly whether they view it as a hindrance to their investment activities.

- The EIBIS Corporate Digitalisation Index does not encompass digital public services, setting it apart from DESI. However, it does consider whether firms employ formal strategic business monitoring systems, an aspect indicative of their management practices. While DESI addresses the digital engagement of individuals, including internet usage and online transactions, EIBIS focuses exclusively on the business sector and does not cover these aspects (EIBIS, 2022).

After understanding these reports, it is assumed that there are sectoral differences in the integration of knowledge management in the context of technological capabilities and operational processes of organisations (see in chapter 4.3, as H1).

The European Commission has also defined its digital targets for 2030 within the guiding digital transformation program called '**Digital Compass – Europe's Digital Decade**', including skill-based individual targets alongside with business, public service and infrastructure related goals.

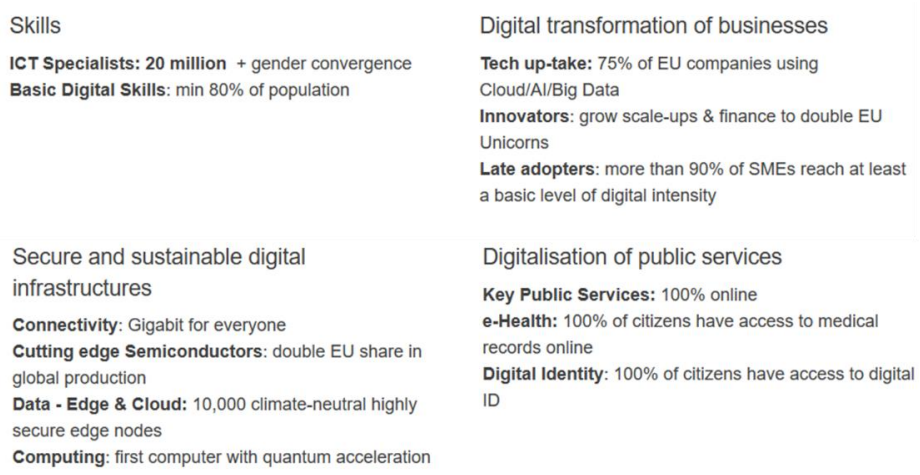

Figure 7. Europe's Digital Decade

Source: commission.europa.eu

The way I see it, in the methodologies of such rankings, the cultural and economic factors influencing the position of the countries are often disregarded. Regarding Hungary, and potential improvement on its standing, further strategic initiatives may support.

3.6. Previous research on digitalisation

As mentioned in previous sections, there are large body of research studies established on digitalisation. The following section discusses some of these previous research studies

to provide a holistic view on aspects that are regarded most influencing in the course of the research of this dissertation.

Studies conducted both domestically (Horváth - Szabó, 2019) and internationally (Li et al., 2019) have looked at the human-centric component of Industry 4.0. The motivations for and restrictions for implementing I4.0 are outlined in the latter paper. The competitiveness of the market, expectations from corporate management, productivity, and some aspects of efficiency have all been recognised as drivers.

However, there are also drawbacks, including organisational issues, the state of corporate capabilities, integration of technology and processes, and a lack of teamwork. While some financial and human resources serve as incentives, others serve as constraints. Furthermore, SMEs who possess the ability to adapt to changing circumstances might have a competitive advantage; nevertheless, the importance of certain motivations and constraints may vary depending on the size of the company (Horváth & Szabó, 2019).

Badawy et al. (2015) explores the debate between the benefits and drawbacks of technological advancements, specifically through the lens of IBM's Watson supercomputer. They examine how emerging technologies affect organisational knowledge management, focusing on the people, processes, and technological components within organisations. The study proposes a framework for managing knowledge workers and suggests a future digitised organisational structure, emphasizing the importance of adapting to technological changes for organisational efficiency and competitive advantage.

According to findings of research driven by Obermayer et al. (2021), efficiency is the main force behind digitalisation, according to the Hungarian industrial organisations studied. This was in line with the findings of Hofmann & Rüsch (2017) and Liao et al. (2017). Efficiency is quantified by speed, information flow, and precision. They have also found that the primary obstacles include the absence of technological compatibility (consistent with findings by Kiel et al., 2017b and Nagy, 2019), the challenges associated with the adaptation process, and concerns about and the lack of a workforce skilled in digital technologies from a human perspective (in accordance with some previous research such as Horváth & Szabó, 2019; Shamim et al., 2016; Müller et al., 2018; Kiel et al., 2017b).

In the digital transformation journey of businesses, several foundational elements are highlighted by Bochulia (2021). Initially, it is crucial to assess the potential risks and threats to revenue streams when transitioning from established models to digital innovations. Enhancing digital proficiency is also vital, requiring a comprehensive overhaul of employee training alongside software and hardware updates to ensure the workforce is digitally adept. Selecting the most suitable digital business model involves analysing various options to find one that balances risks and benefits effectively. Identifying the core digital capabilities essential for a company's growth and survival is another critical step. Additionally, evaluating the readiness for digital partnerships is important for fostering transparency and information exchange, which significantly changes traditional business interactions. Lastly, promoting a digital culture across the organisation is essential for a smooth transition to digital operations, emphasizing the importance of understanding its benefits at all management levels.

Obermayer et al. (2022) aimed to investigate Hungarian manufacturing businesses' view human resources and technology as both facilitators and obstacles for the implementation of I4.0. The writers developed a new definition of I4.0 that places a strong focus on human considerations. After pinpointing the motivating elements (efficiency along with speed, flow of information, and accuracy) and barriers (compatibility of technology, apprehensions among individuals, and shortage of digital proficiency) for embracing Industry 4.0, they formulated the 'DIGI-TEcH' dimensions for managing performance.

Csizmadia et al. (2022) investigated the impact of companies' general characteristics on Contactless Digital Technologies (CDTs) usage in Hungary, employee attitudes towards these technologies, and methods to enhance their acceptance. It found that company size and profile significantly influence CDT usage, employees generally view CDTs positively, and practical solutions are more effective than theoretical ones in increasing acceptance. The research highlights the importance of practical training and information for employee acceptance of CDTs, suggesting that companies, especially in Hungary, could benefit from further digital integration and employee training programs.

The current research thus, aims to investigate which characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes) influence the adoption of emerging technologies in organisations (see in chapter 4.1, as RQ5). Out of the previous findings it is expected that the adoption of

emerging technologies in organisations is influenced by organisational characteristics (see in chapter 4.3, as H5).

As concluded by Bencsik et al. (2023), the literature still mostly focuses on technology, despite the fact that there is a growing amount of study on the impact of human capital. In their research they aimed to investigate the managers' perspectives, readiness, skills, and dispositions about Industry 4.0. They also examined the impact of digital transformation on human labour demand, evaluated the digital aptitude of the existing workforce, assessed the difficulty in addressing any skills deficit, and explored the motivations and challenges encountered by managers. Their conclusion was that the human element is pivotal in both impeding and facilitating the deployment of digital tools for Industry 4.0, with the primary motivation being to replace human labour with Industry 4.0 tools. Also, their research emphasises the critical role of leadership in change processes, advocating for a style that maximally supports employees through decisions, interventions, and behaviours. While specific leadership styles for such scenarios have not been extensively studied by Bencsik et al., the theoretical analysis suggests transformational leadership as highly suitable. Past international studies align with their findings, highlighting the leadership's supportive role as vital in fostering digital trust. This supportive stance encompasses professional communication from leadership about the significance of embracing new technology, while valuing and integrating employees' input and innovative ideas. (Hunady et al., 2020, Rogers et al., 2016). Considering organisational characteristics, their finding was that the likelihood of adopting digital technology increases with a company's manufacturing profile characteristic and size, which is in line with others' results (Ardito et al., 2019, Rojko, 2017). The level of digital concern among employees diminishes with the smaller size of the company. A significant number of employees do not fear job loss resulting from the extensive utilisation of digital technologies, a finding that challenges the conclusions of several researchers (Rubin et al., 2009, Obermayer et al., 2022). They came to the conclusion that hands-on training has a higher chance of boosting digital technology adoption. The need for practical training is positively correlated with the size of the organisation (Bencsik, 2021).

Csizmadia et al. (2023) studied the impact of Industry 4.0 technologies on human resource and knowledge management within Hungarian small and medium-sized enterprises (SMEs) in the 'post-COVID' situation. They explored whether I4.0 facilitates knowledge sharing and storage in these firms. Data from 122 SME leaders were analysed using quantitative methods. The findings suggest that I4.0 technologies support human

resources in SMEs and are implemented for knowledge sharing, particularly through collaborative technologies and social media. However, knowledge storage is not a primary goal of I4.0 implementation in SMEs. The study contributes to understanding the role of I4.0 in enhancing human resources and knowledge management practices in Hungarian SMEs. Thus, the expectation of the current research is that the usage of emerging technologies increased due to COVID-19.

A BCG (2015) analysis indicated that the growth of Industry 4.0 is causing considerable changes in the kinds of work environments that industry workers need to have, the ways in which they operate, the emergence of new occupations, and the elimination of others.

According to a Massachusetts Institute of Technology (MIT) survey, teams made up of both humans and machines working together might be more productive than teams made up of just humans or just robots (Koleva, 2019).

In my opinion, the notion of AI's capability to truly replace human creativity seems still challenging, considering the implications for creative professions.

4. Research questions, hypotheses and applied research methods

In this chapter, research questions related to the empirical study are articulated and concepts considered having fundamental importance for understanding the research questions are introduced. Beyond formulating hypotheses for the research, a brief overview of the qualitative and quantitative methods used during the study is provided.

4.1. Research questions

Research questions serve the purpose of showcasing the key questions that arise in the researcher's mind. Answering them can help understanding the mechanisms in organisational knowledge management in firms operating in Hungary in the light of digitalisation.

After reviewing the conceptual background and theoretical literature and concluding missing pieces in currently available academic results, research questions are formulated in accordance to the research purpose with the intent to scientifically improve examined areas. Table 2. presents the research questions of this dissertation.

RQ1:	**How different sectors approach and integrate knowledge management in the context of their technological capabilities and operational processes?**
RQ1a:	Are there any sectoral differences with regards to technological intensity of products and processes?
RQ1b:	Are there any sectoral differences with regards to knowledge management strategy integration?
RQ1c:	Are there any sectoral differences with regards to knowledge management project?
RQ1d:	Are there any sectoral differences in the impediments faced during integration of knowledge management?
RQ2:	**How is the relationship between sectoral and ownership-related differences and the implementation of permitted knowledge management technologies?**
RQ3:	**How is the relationship between knowledge management strategies and information gathering by employees?**
RQ3a:	Is there a relationship between knowledge management strategies and information sources of employees?
RQ3b:	Is there a relationship between knowledge management strategies and the implementation of emerging technologies?
RQ4:	**How is the relationship between emerging technologies in use and knowledge management?**
RQ4a:	Is there a relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects?
RQ4b:	Is there a relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes?
RQ4c:	Is there a relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees?
RQ5:	**Which characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes) influence the adoption of emerging technologies in organisations?**

Table 2. Research questions

Source: own edition

4.2. Conceptual definition and operationalisation

To apply the right measures, a precise definition of the research variables is necessary. However, a number of theories were used and thoroughly discussed in the literature review section in order to construct the variables needed to validate the study hypotheses.

A variable is a trait or characteristic of an individual or organisation that can be quantified or noted, exhibiting variation across the subjects under investigation. Variables often

fluctuate across multiple categories or along a continuum of values and can be evaluated or measured on a scale (Creswell, 2009).

This section outlines the key variables that were employed in the study to support the research goals and answer the research questions. The task of conceptualisation is to provide a framework for the questions appearing in the research.

Sectors

The classification of economic activities into primary, secondary, and tertiary sectors is a conventional approach to categorising the different segments of an economy based on the nature of their activities.

The primary sector is the segment of the economy that extracts or harvests products from the earth. This sector includes activities like agriculture, fishing, forestry, and mining. It is the foundation of all other sectors as it provides the raw materials needed for manufacturing and production.

Primary sector includes branch A from NACE rev.2, which is 'agriculture, forestry and fishing' (Eurostat, 2023).

The secondary sector comprises activities that transform, process, or manufacture goods from raw materials into finished or semi-finished products. This includes industries like manufacturing, construction, and utilities. The goods produced in this sector serve as a base for the provision of services in the tertiary sector.

Secondary sector includes branches B-E + F from NACE rev.2 (Eurostat, 2023), which covers industry and construction, namely 'mining and quarrying' (B), 'manufacturing' (C), 'electricity, gas, steam and air conditioning supply' (D), 'Water supply; sewerage, waste management and remediation activities' (E), and 'construction' (F) (Eurostat, 2023).

The tertiary sector is the sector of the economy that concerns services. It is distinct from the secondary sector (manufacturing) and the primary sector (which concerns extraction such as mining, agriculture and fishing).

Tertiary sector covers branches G-I + J + K + L + M-N + O-Q + R-U from NACE rev 2 (Eurostat, 2023). These are 'wholesale and retail' (G), 'transportation and storage' (H), 'accommodation and food service activities' (I), 'information and communication' (J), 'financial and insurance activities' (K), 'real estate activities' (L), 'professional, scientific

and technical activities' (M), 'administrative and support service activities' (N), 'public administration and defence; compulsory social security' (O), 'education' (P), 'human health and social work activities' (Q), 'arts, sports and recreation' (R), 'other service activities' (S), 'activities of households as employers and undifferentiated goods - and service-producing activities of households for own use' (T), and 'activities of extraterritorial organisations and bodies' (U) (Eurostat, 2023).

Ownership of companies (foreign vs domestic)

A domestic corporation refers to a company that is incorporated in and conducts business affairs in its own country. A domestic corporation is often compared to a foreign corporation, which conducts business in a country other than the one where it originated or was incorporated. Foreign companies are enterprises that are ultimately majority controlled by a non-resident entity, either a natural or legal person (European Commission, 2001).

Company size

Micro enterprises are having fewer than 10 persons employed; small enterprises are having 10 to 49 persons employed; medium-sized enterprises are employing 50 to 249 persons; and large enterprises are having 250 or more persons employed (Eurostat, 2023).

Net income

Net income is the value for the fiscal year of sold (finished and semi-finished) products, materials, goods, and performed services, increased with surcharges and mark-ups, containing registration, excise, and energy taxes, reduced by discounts, and excluding value-added tax (VAT). This category also includes the invoiced, VAT-excluded value of product sales and services provided to a foreign-based company or another Hungarian branch of a foreign-based company (KSH, 2023).

Net income of Hungarian companies is a public data available at https://www.nemzeticegtar.hu.

Knowledge

Knowledge encompasses the information that individuals process, which includes ideas, facts, expertise, and judgments that are pertinent to the performance of individuals, teams, and organisations (Alavi & Leidner, 2001; Bartol & Srivastava, 2002).

Explicit knowledge is knowledge that can be articulated clearly and systematically using a set of symbols or a formal language (Nonaka, 1995).

Tacit knowledge is personal and inherent (Polanyi, 1962; Nonaka, 1995), which renders its codification and dissemination particularly challenging (Nonaka, 1995).

Knowledge management

'Knowledge management describes the process of acquiring, developing, sharing, exploiting and protecting organisational knowledge in order to improve the competitiveness of organisations' (Gaál et al., 2009).

Knowledge management strategy

The term 'knowledge management strategy' represents the set of objectives related to knowledge management within a company and the methods aimed at achieving them (Zack, 1999).

Knowledge management project

Knowledge management projects initiated within organisations have a key objective of capturing, recording, and sharing the knowledge residing in people's minds, transforming individual knowledge into organisational knowledge (KPMG, 2006, Obermayer-Kovacs, 2007).

Knowledge management practices

Knowledge management practices ensure that knowledge flows seamlessly across the organisation, fostering innovation, and driving competitive advantage.

Lloyd (1996) considers the knowledge value chain model, starting with ideas, know-how, and other intangible intellectual capital assets transformed into measurable, tangible intellectual assets as knowledge management practices.

Problem solving - Information source

During knowledge management, it is interesting to see whether the source of knowledge is originated from a person or from a technology-based solution, mainly a tool in case a problem needs to be solved. Therefore, as information source the following major knowledge management practices are considered during the research: turning to a colleague, turning to external sources (e.g. internet), and checking the organisational

database (training, document management system, groupware, intranet, etc.) (KPMG, 2014).

Emerging technologies

An emerging technology is ‘a relatively fast growing and radically novel technology characterised by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and the patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so the emergence phase is still somewhat uncertain and ambiguous’ (Rotolo et al., 2015).

Technological intensity

Technological intensity refers to the extent to which machines and technology in general support autonomous human action during work processes.

Technological intensity refers to the extent of knowledge embedded in the products of companies across various industrial sectors. This metric is commonly calculated by dividing a firm's average research and development (R&D) expenditure by its revenue. The Organisation for Economic Cooperation and Development (OECD) oversees the categorisation of industrial sectors based on their technological intensity levels (OECD, 2003, 2007).

Digital transformation

Digital transformation is ‘a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies’ (Vial, 2019).

Industry 4.0

‘Industry 4.0 covers the digitalisation and automation of the manufacturing environment, and also the creation of digital value chains for the purposes production, environment and communication between business partners’ (Lasi et al., 2014).

Industry 5.0

Industry 5.0 emphasizes a human-centered approach where collaborative robots (cobots) and humans work together to achieve personalized autonomous manufacturing facilitated

by enterprise social networks. This collaboration allows humans and machines to complement each other's capabilities. Unlike traditional programmable machines, cobots are designed to sense and interact with human presence safely. In this setting, cobots are deployed for repetitive and labor-intensive tasks, while humans focus on customisation, critical thinking, and creative problem-solving (Maddikunta et al., 2021).

Following the conceptualisation, measurements of research concepts are described in depth since operationalisation is the process of turning concepts into measurable variables. Operationalisation is a method used to arrange how data required is collected based on certain variables (Creswell, 2009).

The next table summarises the conceptualisation and operationalisation of company-characteristic-related variables.

Research variable	Content	Definition	Source	Measurement
Sector	Primary	The sector of the economy that extracts or harvests products from the earth. This sector includes activities like agriculture, fishing, forestry, and mining. It is the foundation of all other sectors as it provides the raw materials needed for manufacturing and production.	Eurostat, 2023	Nominal
	Secondary	Comprises activities that transform, process, or manufacture goods from raw materials into finished or semi-finished products. This includes industries like manufacturing, construction, and utilities. The goods produced in this sector serve as a base for the provision of services in the tertiary sector.		
	Tertiary	The sector of the economy that concerns services. It is distinct from the secondary sector (manufacturing) and the primary sector (which pertains extraction such as mining, agriculture and fishing).		
Ownership	Foreign	Enterprises that are ultimately majority controlled by a non-resident entity, either a natural or legal person.	European Commission, 2001	Nominal
	Domestic	Enterprises that are incorporated in and conduct business affairs in its own country.		
Company size	Micro	Micro enterprises are having fewer than 10 persons employed.	Eurostat, 2023	Ordinal
	Small	Small enterprises are having 10 to 49 persons employed.		
	Medium	Medium-sized enterprises are employing 50 to 249 persons.		
	Large	Large enterprises are having 250 or more persons employed.		
Net income	Net income of companies (public data)	The value for the fiscal year of sold (finished and semi-finished) products, materials, goods, and performed services, increased with surcharges and mark-ups, containing registration, excise, and energy taxes, reduced by discounts, and excluding value-added tax (VAT). This category also includes the invoiced, VAT-excluded value of product sales and services provided to a foreign-based company or another Hungarian branch of a foreign-based company.	KSH, 2023; nemzeticegtar.hu	Interval
Technological intensity	Technological intensity of products and services	The extent to which machines and technology in general support autonomous human action during work processes. Technological intensity refers to the degree of knowledge embedded in the products of companies across various industrial sectors. This indicator is often quantified by dividing the firm's average R&D expenditure by its revenue.	OECD, 2003, 2007	Ordinal, Likert-scale (1-4)
	Technological intensity of company operational processes			

Table 3. Conceptualisation and operationalisation summary – company characteristics

Source: own edition

It lists the variables, their content, a definition considered during the course of the study, the related source(s) and the measurement. In addition to the table it is important to note that all the following primary data will be collected by quantitative method.

The next table, based on the same structure like the previous table presents the conceptualisation and operationalisation of characteristics related to technological intensity, knowledge management and emerging technologies related variables that will be collected during the empirical research. These data will be collected primarily by quantitative then by post-qualitative methods.

Research variable	Content	Definition	Source	Measurement
Knowledge management	Knowledge management strategy	Represents the set of objectives related to knowledge management within a company and the methods aimed at achieving them. Including: Knowledge management strategy is part of the corporate strategy; sub-strategy of an independent area; or not existent.	Zack, 1999	Ordinal
	Knowledge management project	Knowledge management projects initiated within organisations have a key objective of capturing, recording, and sharing the knowledge residing in people's minds, transforming individual knowledge into organisational knowledge. Including: there is no information about knowledge management projects; the assessment is in progress currently whether there is a need for such a project; have a knowledge management project; do not have a knowledge management project and do not plan to introduce one; knowledge management project is being developed; thought about introducing a project but rejected it.	KPMG, 2006, Obermayer-Kovacs, 2007	Ordinal
	Knowledge management practice	Knowledge management practices ensure that knowledge flows seamlessly across the organisation, fostering innovation, and driving competitive advantage. The knowledge value chain model, starting with ideas, know-how, and other intangible intellectual capital assets transformed into measurable, tangible intellectual assets. Including: Document management and knowledge base system; Communities of Practice; Knowledge map; Intra-organisational social technologies; Internal blogs; Information sharing; Enterprise social network; Corporate instant messaging; Participation in professional communities; Trainings.	KPMG, 2014; Lloyd, 1996	Nominal
Emerging technologies	Business intelligence software	A rapidly evolving and fundamentally innovative technology is characterised by a consistent level of coherence over time and possesses the potential to significantly influence socio-economic domains. This influence is noticeable in the changing composition of actors and institutions, as well as in the interaction patterns among them, coupled with the processes of knowledge creation. However, the most significant impact of such technology is anticipated in the future, making the initial phase of emergence somewhat uncertain and ambiguous.	Rotolo et al., 2015	Nominal
	Ticket management system			
	Chatbot			
	E-HR			
	Biometric authentication			
	VR technologies			
	3D printing			
	Management Information System (MIS)			
	Collaborative technologies			
	Artificial intelligence			
	Fraud detection software			
	Content-based recommendation system			
	Virtual assistant			
	Robotic process automation			
	Customer relationship management			
	Drones			
	Internet of Things (IoT)			
	Big data, data mining			

Table 4. Conceptualisation and operationalisation summary – KM, emerging technologies

Source: own edition

4.3. Hypotheses

Hypotheses built on the research questions are presented in the following table.

	Hypotheses
H1: There are sectoral differences in the integration of knowledge management in the context of technological capabilities and operational processes of organisations.	
H1a:	Technological intensity of products and processes is the highest within the secondary (manufacturing) sector.
H1b:	Knowledge management strategy is implemented within the tertiary (services) sector to a greater extent than within the other sectors.
H1c:	Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.
H1d:	Impediments due to the lack of knowledge management strategy or project are different depending on sectors.
H2: Sectoral and ownership-related differences have relationship with permitted and used knowledge management practices.	
H2a:	Knowledge management practices are permitted and used to a greater extent within the tertiary sector.
H2b:	Knowledge management practices are permitted and used to a greater extent by subsidiaries of foreign companies.
H3: The integration of knowledge management strategies has relationship with the information sources employees using to solve problems.	
H3a:	The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.
H3b:	The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.
H4: There is relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes.	
H4a:	There is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects.
H4b:	There is relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes.
H4c:	There is relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees.
H5: The adoption of emerging technologies in organisations is influenced by organisational characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes).	

Table 5. Research hypotheses

Source: own edition

4.4. Research method

The implementation of empirical research is influenced by several factors, among which the role of research questions and the empirical substantiation of hypotheses are prominent, as these determine the applicable research approaches.

Quantitative research provides information about the existence and strength of causal relationships between variables, while qualitative research can be successfully applied when we do not know the triggering causes and mechanisms of action (Babbie, 1996).

A common tool is the use of methodological triangulation, which allows for the application of various methods within quantitative approaches, within qualitative approaches, and also the combination of both quantitative and qualitative methods is possible (Balaton & Dobák, 1991).

A strategy of investigation known as 'mixed methods research' associates or integrates both qualitative and quantitative elements. It entails making philosophical assumptions, applying both qualitative and quantitative methods, and combining the two methods in one study. Accordingly, it entails more than just gathering and evaluating both types of data; it also entails utilising both methodologies simultaneously such that a study's total strength surpasses that of either qualitative research or quantitative research (Creswell, 2009).

This research applies a mixed method (also called as hybrid or integrating method) including quantitative and qualitative research in order to provide in-depth understanding and validation of the studied phenomenon. As it has been mentioned in the beginning of the dissertation (Figure 1), first, the quantitative study was conducted based on prior analysis of literature and related research. As a second step, the qualitative study was realised building on the previous information that served as a baseline for the quantitative part and based on the results of the quantitative research. Thus, the qualitative part of the study could be also called as a post-qualitative investigation.

In the following sections further details on the quantitative and qualitative methods of the research are described.

4.4.1. The quantitative method of research

In the quantitative part of the research, the a large-scale online survey has been created based on previous research and literature review, that has been sent out to a database with

global contacts including more than 200.000 companies from Hungary where participation in the survey is voluntary. With quantitative research, findings may be extrapolated from a sample group to the total population. Quantitative research provides the ability to draw conclusions and practical implications since it is structured and statistically sound.

The result of the questionnaire was analysed using econometric methods using IBM SPSS 22.0 and Smart-PLS 4 statistical analysis softwares. The econometric methods used are detailed as follows.

Descriptive statistics

The purpose of descriptive statistics is to provide information that summarises the phenomenon described by our existing data. This provides a primary picture of our sample, and allows to graphically represent the incidence rates (Jánosa, 2011). From the perspective of the research, it is fundamental that the researcher is aware of the nature and structure of the data when doing multivariate analysis. The descriptive procedure involves presenting univariate summary statistics for multiple variables within a single table and calculates standardised values, known as ‘z scores’ (IBM, 2023). To construct descriptive statistics, IBM SPSS 22.0 software has been used.

Crosstab and its checks: Cramer’s V, Pearson’s Chi-Square

In order to reveal the association between two categorical variables Crosstab statistics and measurement checks (Cramer’s V and Pearson’s Chi-Square) were applied. The Crosstabs procedure generates two-way and multiway tables and offers an array of tests and association for two-way tables. The table’s structure and whether categories are sorted determine what test or measure to use (IBM, 2023).

Cramer’s V was used in order to measure the strength of the association between categorical variables ($0<V\leq0.2$ weak, $0.2<V\leq0.7$ moderate, $0.7<V<1$ strong association) (Sajtos & Mitev 2007). The relationship is significant, if the p-value of Cramer’s V is less than 0.05. Pearson's Chi-Square test is a statistical method used to evaluate the presence of a significant relationship between nominal and ordinal variables displayed in a bivariate table. Utilising this test allows for the acceptance or rejection of the null hypothesis, thereby determining if there is a connection between the two variables in question (Malhotra, 2008).

IBM SPSS 22.0 software has been used to investigate Crosstab and its checks.

T-test: Levene statistics, Tamhane

T-test is used to compare the means of two groups, it is used in hypothesis testing to determine whether a process or treatment actually has an effect on the population of interest, or whether two groups are different from one another. Levene's test is used to test the null hypothesis that the two population variances are equal and Tamhane's T2 when the variances are unequal (Sajtos & Mitev, 2007).

T-tests has been conducted using IBM SPSS 22.0 software.

One-way ANOVA

The one-way ANOVA (analysis of variance) procedure conducts a one-way analysis for a quantitative dependent variable influenced by a single factor (independent) variable. This statistical method is employed to assess the hypothesis that multiple group means are identical, extending the capabilities of the two-sample t-test.

To assess the presence of differences among group means, two categories of tests are utilised: a priori contrasts and post hoc tests. A priori contrasts are planned comparisons established before conducting the experiment, designed to test specific hypotheses about the means. Post hoc tests, on the other hand, are conducted after the experiment has concluded and are used to explore and identify where differences between group means lie, especially when no specific hypotheses were stated in advance. Testing for patterns across categories is another option (IBM, 2023).

The one-way ANOVA is often used to analyse data from the types of studies like field studies, experiments, or quasi-experiments. The one-way ANOVA is commonly used to test the statistical differences among the means of two or more groups, statistical differences among the means of two or more interventions, or statistical differences among the means of two or more change scores.

The test statistic for a one-way ANOVA is denoted as F indicating the significance level. The F-test of ANOVA shows whether there is a significant difference between groups, significance is proved when its level is <0.05 (Sajtos & Mitev, 2007).

One-way ANOVA analyses have been examined using IBM SPSS 22.0 software.

Pearson correlation

The Pearson correlation coefficient is a statistical metric that quantifies the degree of association between two continuous variables. It is regarded as the most effective method for assessing the relationship between variables of interest due to its foundation in covariance analysis. This coefficient provides insights into both the strength and the direction of the association, indicating how closely the variables are related and whether they move together in the same or opposite directions (Statistics Solutions, 2023).

To study Pearson correlation, IBM SPSS 22.0 software has been used.

Partial Least Squares (PLS)

To investigate relationship between latent variables and manifest variables, the Structural Equation Model (SEM) were used. SEM allows simultaneous factor and regression analysis. The Partial Least Squares (PLS) method was chosen due to the model's complexity, the ordinal scales, and the amount of items in our sample (Haenlein and Kaplan 2004; Hair et al. 2011; Kazár 2014). PLS path analysis is a variance-based method where the full explained variance of the dependent latent variables is maximised (Kazár 2014). The method is favoured for the reason that it enables the estimation of complex models on small samples without setting distributional limitations on data (Hargitai & Bencsik 2023).

The model and calculations were created with Smart PLS 4 software was used to build the model and perform the calculations. The normal distribution of variables is not a prerequisite for PLS-SEM, the analysis can be performed as an exploratory research using parameter estimation to identify the effects (Ringle et al. 2015).

An external and internal model must be divided during modelling. Links between manifest and latent variables are described by the external model. Latent variable causality is determined by the internal model. However, the estimates for the two models are generated simultaneously rather than separately.

Independent variables are factors believed to cause, influence, or affect outcomes and are alternatively known as treatment, manipulated, antecedent, or predictor variables. They represent the inputs or causes in a study. Dependent variables, on the other hand, are influenced by the independent variables and represent the outcomes or effects in a research context. These variables are also referred to as criterion, outcome, or effect variables. In quantitative research, control variables are also crucial; they are a specific

kind of independent variable that are not manipulated but measured because of their potential impact on the dependent variable. Control variables are included in analyses to ensure that the observed effects can be attributed more confidently to the independent variables under investigation, rather than to extraneous factors (Creswell, 2009).

The following table presents the connection between hypotheses and analyses methods that have been applied.

	Hypotheses	Methods
H1: There are sectoral differences in the integration of knowledge management in the context of their technological capabilities and operational processes.		Crosstab, Pearson's Chi-Square, Cramer's V
H1a:	Technological intensity of products and processes is the highest within the secondary (manufacturing) sector.	Crosstab, Pearson's Chi-Square, Cramer's V
H1b:	Knowledge management strategy is implemented within the tertiary (services) sector to a greater extent than within the other sectors.	Crosstab, Pearson's Chi-Square
H1c:	Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.	Crosstab, Pearson's Chi-Square
H1d:	Impediments due to the lack of knowledge management strategy or project are different depending on sectors.	Crosstab, Pearson's Chi-Square, Cramer's V
H2: Sectoral and ownership-related differences have relationship with permitted and used knowledge management practices.		Crosstab, Pearson's Chi-Square, Cramer's V
H2a:	Knowledge management practices are permitted and used to a greater extent within the tertiary sector.	Crosstab, Pearson's Chi-Square, Cramer's V
H2b:	Knowledge management practices are permitted and used to a greater extent by subsidiaries of foreign companies.	Crosstab, Pearson's Chi-Square, Cramer's V
H3: The integration of knowledge management strategies has relationship with the information sources employees using to solve problems.		One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe
H3a:	The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.	One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe
H3b:	The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.	One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe
H4: There is relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes.		Crosstab, Pearson's Chi-Square, Cramer's V, Pearson correlation
H4a:	There is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects.	Pearson correlation
H4b:	There is relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes.	Pearson correlation
H4c:	There is relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees.	Pearson correlation
H5: The adoption of emerging technologies in organisations is influenced by organisational characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes).		PLS, Durbin-Watson test, VIF

Table 6. Econometric methods applied connected to hypotheses

Source: own edition

In the following section, the model of the quantitative research is presented that is shown in the next figure.

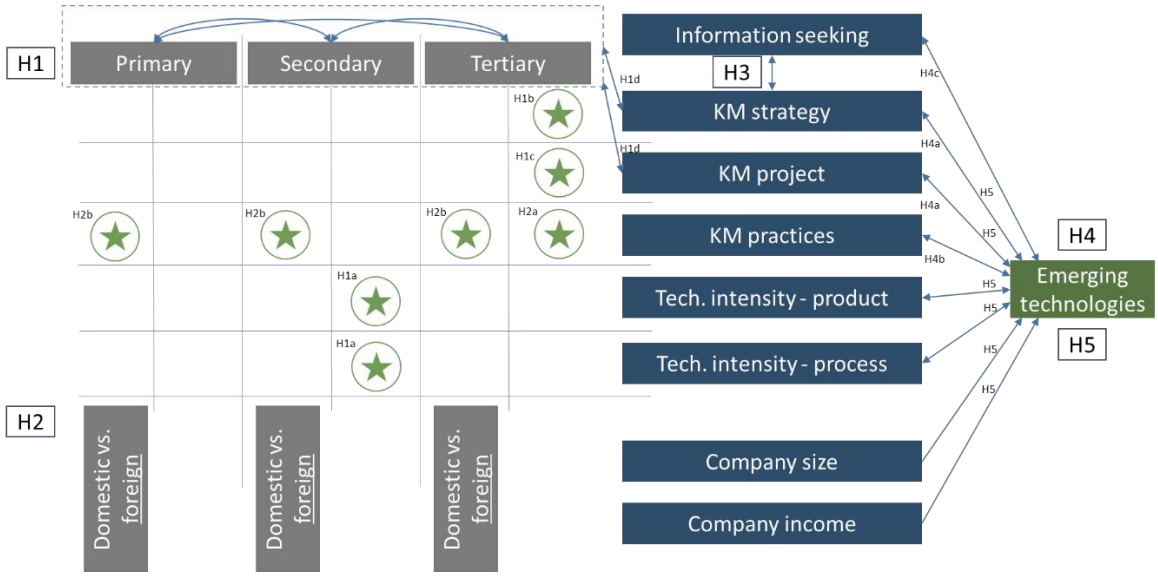

Figure 8. Research model - quantitative study

Source: own edition

The research model above aims to represent the analyses based on the formulated hypotheses. The presence of stars in the model designates the anticipated significant differences. Bi-directional arrows indicate that there is mutual influence or relationship where changes in one factor might be associated with changes in another. Unidirectional arrows illustrate regression analyses, where one factor could be a predictor of another, often implying a causative relationship. Hypotheses are marked in the model by 'H'. The model intends to be multi-dimensional (3D), incorporating sectoral and ownership-related investigations with knowledge management practices, organisational characteristics and emerging technologies.

The first (upper left) part represents the assumed sector-based differences regarding integration or impediments of knowledge management in the context of technological capabilities and operational processes of organisations (H1; H1a; H1b; H1c; H1d). The lower left part depicts sectoral and ownership-related differences with knowledge management practices (H2; H2a; H2b). In these parts, Crosstab and its checks (Pearson's Chi-Square, Cramer's V) are used.

The second part, which focuses on knowledge management-related and organisational characteristics is situated in the middle of the model. Here, H3 and its sub-hypotheses

(H3a; H3b) are symbolised. These are investigated with the analysis of variances (ANOVA) and its tests (Levene statistic, Tamhane post-hoc test, Scheffe).

The third, righter-side of the model portrays H4, H5 and their sub-hypotheses.

To investigate H4, Crosstab and its checks (Pearson's Chi-Square, Cramer's V, Pearson correlation) are used to test relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes. These are illustrated with the two-way arrows.

The regression model (related to H5) is also represented in this part of the model, where PLS, Durbin-Watson test, and VIF are used to investigate the potential influence of organisational characteristics (company size, net income, knowledge management strategy level, knowledge management project implementation, technological intensity of products and services, and technological intensity of corporate operational processes) to the volume of emerging technologies in use. Regression tests are indicated with one-way arrows and 'H5' is added wherever regression is tested.

This research model intends to provide a comprehensive structure for the investigation of interrelationships between sectoral and ownership-related differences, knowledge management practices, and emerging technologies within organisations.

Further details and results of analyses are discussed in chapter 5.1.

4.4.2. The qualitative method of research

In the qualitative part of the research, the aim is to gather comprehensive investigation and validation of the results from the quantitative research. During exploratory qualitative research the researcher gets a more subjective description and gives the opportunity to get a deeper understanding of the phenomenon sought to be described (Lund & Haugen, 2006). It seeks to explain the social environment in which we live and the reasons behind (Polkinghorne, 2005).

Therefore, data gathering techniques are interviews and case studies created based on the interviews.

Qualitative research interviews can be structured, semi-structured or unstructured. In this research, semi-structured type interviews will be applied. Using semi-structured interview technique, the researcher can investigate a certain topic with support of

numerous prepared questions and questions formulated during the interviews. The flexibility of this approach guarantees that the interview reflects the depth, complexity, and richness of the participants' experiences and perspectives.

This primary data collection is chosen to explore the most important information and trends in the focus area by interviewing subject matter experts, since no such previous research has been published yet in the aimed research area. Further details regarding data collection, sampling and analysis of results are included in the next chapter.

During the qualitative part of the research, the case study method was chosen, as it supported to gain overall information and knowledge of the impact of emerging technologies on knowledge management in Hungary. The qualitative case study approach focuses on understanding the complex phenomenon within a specific context (Baxter & Jack, 2008). It enables using open-ended questions to examine situations in-depth and explore complex questions (Birkinshaw et al., 2011). It is carried out through a variety of sources such as questionnaires, interviews, observations, written narratives, and audio-visual materials (Creswell, 2009).

A research model (Figure 9) has been created to show the main steps of the qualitative part of the research.

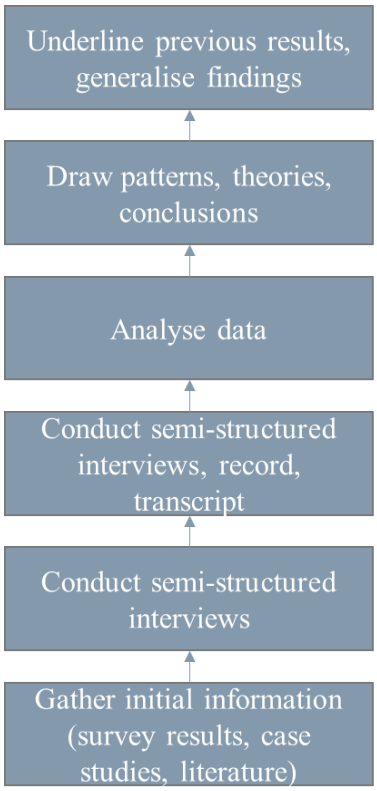

Figure 9. Research model - qualitative study

Source: own edition

As demonstrated by the qualitative research model, the first phase involved gathering preliminary data based on available case studies and the findings of the quantitative investigation. Based on initial information collected, semi-structured interviews were prepared, planned, organised and carried out with participants. Answers and feedback during the interviews were recorded and transcription of the interviews was created in order to be able to analyse them, identify trends and build case studies with conclusions. In the final phase of the qualitative study, findings were used to draw overall conclusions to confirm earlier results and make generalisations, triangulate findings.

Further details and results of analyses are discussed in chapter 5.3.

5. Empirical research

The current chapter addresses the empirical research analysis methods and results based on the collected quantitative and qualitative data.

As described earlier in the dissertation, during empirical research a mixed-method is used.

The core of the study is built on a quantitative method, followed by a qualitative method involving detailed exploration with a few cases to better understand, explain and build on the results from the quantitative approach. Thus, it is more than just gathering and evaluating both types of data; it also entails utilising both strategies simultaneously to make a study's overall strength greater to that of either qualitative or quantitative research.

However, there are challenges that this type of study presents to the researcher. These include the necessity of gathering a lot of data, the time-consuming nature of interpreting textual and numerical data, and the need for the researcher to be knowledgeable about both qualitative and quantitative research methods.

Despite the challenges faced, there is a growing interest in mixed methods research, as evidenced by the publication of books, journal articles, the attention it receives across various disciplines, and the support it obtains through funded projects (Creswell, 2009).

5.1. Quantitative analysis

The core of my research is a questionnaire-based quantitative survey (see 217 – Survey questionnaire). The centre of the questionnaire is knowledge management, with individual topics logically connected in sequence. The subtopics build on each other in terms of content, and within each topic area, all essential information is collected through specific questions to identify, describe and explore the potential relationship between industrial and organisational characteristics, knowledge management and emerging technologies. The uniqueness of the quantitative method lies in the fact that, due to the size of the sample and the method of sampling, it is suitable for measuring the results using statistical methods. Further details on the quantitative data collection is described in the following part.

5.1.1. Data collection

A large-scale quantitative survey was developed and carried out online via LimeSurvey web application between September – December 2021. More than 200.000 contacts from

various companies from the Orbis (Bureau van Dijk Editions) global database were addressed and invited via e-mail to participate and fill-in the questionnaire. Participation in the study was voluntary, responses are anonymous. The questionnaire fill-in was advised as approx. 10 minutes.

The survey questionnaire composed of three main parts has been applied: information about the organisation, knowledge management and emerging technologies within the organisation and general information on the respondent.

Company characteristics	Industry, Subsidiary, Company size, Net income, Technological intensity – products & services, Technological intensity – operational processes
Knowledge management and Emerging technologies	Knowledge management strategy, knowledge management project (main initiator, impediments), Problem solving –sources, knowledge management technologies (permitted / used, impediments), Emerging technologies (permitted / used, impediments), Covid-19's effect on usage of emerging technologies
Respondent information	Generation, Education level, Position, Role / area, Gender

Table 7. Structure of the survey questionnaire

Source: own edition

The questionnaire contained list (drop-down and radio), multiple-choice, yes-no and array (Likert-scale) type of questions. The full questionnaire is shown in the Appendix – Survey questionnaire.

In the course of the survey, 2703 (n=2703) full responses were included in the database. It was completed mainly by managers and white-collar workers (99% of total) representing organisations operating in Hungary. Such sample size with 2703 full responses in a survey typically allows for more accurate and reliable results. A substantial sample size can reduce the margin of error and increase the confidence level of the findings, which means the results are likely to be closer to the true values for the entire population. In addition, when the majority of respondents are managers and white-collar workers, the data can provide targeted insights into organisational behaviors and attitudes, which is valuable for understanding business trends and dynamics in Hungary. The diversity and representativeness within a large sample size can also enhance the

generalisability of the findings, making it possible to apply the conclusions to a broader context within the sector or industry being studied.

In preparation and validation of the survey structure, in 2019, a research has been conducted by an international Hungarian-Finnish researchers' group (Saukkonen et al., 2019) to explore levels of adoption of emerging technologies in the human resource management field that serves as preparation for the current research by piloting a set of questions via an online survey conducted in Finland between April-May 2019.

5.1.2. Sample description

As mentioned above, in the course of the survey, 2703 (n=2703) full responses were received and included in the database.

Regarding position of participants, a notable majority, 71% were top managers, further underlining the authoritative quality of the insights. 14% represented the middle managerial cadre while an equal percentage comprised of non-managerial white-collar professionals.

More than half (51%) of the respondents were owners (managing director). The other half consisted of management (21%), consultants (6%), finance professionals (6%), and others (16%) representing a range of roles from strategic planning, procurement and logistics, to human resources and knowledge management.

Education of respondents were mainly college/university master's degree (MSc / MBA) with 45%, followed by college/university bachelor degree (BA / BSc) with 34%. 9% had higher level vocational training, 6% with having PhD degree and 6% with graduation.

The generational distribution provided a balanced view of various age groups: 52% of the participants were from generation X (born between 1965-1979), 32% were from the 'big generation' (born between 1946-1964), 15% were from generation Y (born between 1980-1994) and only 1% from generation Z (born between 1995-2009).

A massive 90% of the represented companies were small and medium-sized enterprises (SMEs), having between 0-249 employees.

Employees in sample	% of total
0-49 employees	80%
50-99 employees	5%
100-249 employees	5%
250-500 employees	2%
500+ employees	8%

Table 8. Company size

Source: own edition

According to the Hungarian Central Statistical office, in 2022 companies with 0-249 employees are 99% of all working companies (KSH, 2023a). Due to predominance of SMEs, the sample was representative of the Hungarian corporate sector as a whole.

Looking at the net income of companies represented by respondents reveals that 78% of them have a yearly income up to 2 million euros (Nemzeti cégtár, 2023). The remaining income brackets, ranging from 2 million to over 50 million euros, collectively account for 22% of the companies.

Net income	% of total
up to 2 million euros (720 million forints)	78%
between EUR 2 million - EUR 10 million (HUF 720 million - HUF 3,600 million)	10%
between EUR 10 million - EUR 50 million (HUF 3,600 million - HUF 18,000 million)	6%
over 50 million euros (18,000 million forints)	6%

Table 9. Net income

Source: own edition

Based on the given TEAOR structure of industries (KSH, 2023a), distribution of companies are summarised in the following tables. Table 10. Shows the industrial distribution of represented companies.

Industry	% of total
Professional, scientific and technical activities	15.2%
Information and communication	14.9%
Other service activities	11.5%
Construction	8.8%
Financial and insurance activities	8.2%
Human health and social work activities	7.9%
Administrative and support service activities	5.5%
Education	4.7%
Manufacturing	4.5%
Other	18.9%

Table 10. Company distribution by industry

Source: own edition

The survey encompassed a diverse array of industries: leading sectors are professional, scientific and technical activities (15.2%) and information and communication (14.9%). They are followed by service sectors (11.5%), construction (8.8%), and finance and insurance (8.2%). Other key sectors included health and social work (7.9%), administration and support (5.5%), education (4.7%), and manufacturing (4.5%). The category labeled 'Other' encompasses 18.9%, which may represent a myriad of niche sectors.

The next table illustrates the distribution of companies across various sectors, showcasing a predominant concentration in the tertiary sector with 81.0% of the total. The secondary sector follows with a significant 16.5% share, while the primary sector encompasses the smallest portion at 2.5%. This data, sourced from the author's own edition, highlights the diverse landscape of company distributions within these sectors. The table effectively provides a clear overview of the sector-wise breakdown of companies, emphasizing the dominance of service-oriented (tertiary) industries.

Sector	% of total
Primary	2.5%
Secondary	16.5%
Tertiary	81.0%

Table 11. Company distribution by sectors

Source: own edition

Regarding sectoral distribution, there is a distinct variance between the sample and companies across sectors within Hungary (KSH, 2023b). In 2022, based on KSH data, sectoral distribution was the following: primary sector 25%, secondary 12%, and tertiary sector 63%. Thus, it can be concluded in both distributions, tertiary sector dominates overwhelmingly, with 81.0% of companies falling under this category, which is a higher proportion than the 63% reflected in the national data. Conversely, the primary sector is significantly underrepresented in the sample, showing only 2.5% compared to 25% in the national distribution. The secondary sector shows an overrepresentation in the sample at 16.5%, in contrast to the 12% national figure. Thus, regarding sectoral distribution, although sample approaches the national data, it is not representative.

In summary, the survey included professionals from varying backgrounds, sectors, and designations, thus promising a holistic view of the subject under study.

In the following section, technological intensity of organisations will be analysed based on the feedback of survey participants.

A minority, 12% of companies are described as having ‘very low technological intensity’ in terms of their technological intensity need regarding their products and services. This indicates that these companies either rely heavily on manual processes or traditional methods with limited technological integration. 21% of companies fall under the ‘rather not technology-intensive’ category, suggesting that while they might utilise some forms of technology, it's not at the core of their product or service offerings. A considerable 31% of companies are ‘rather technology-intensive’. This indicates that a significant number of Hungarian companies are making substantial use of technology, though not at the highest levels. The leading category, with 33% of companies, is those with ‘very high technological intensity’. This signifies that a third of companies are at the forefront of technological adoption, heavily incorporating advanced technologies into their products and services. There is a small percentage (3%) of representatives who were uncertain about the technological intensity of their company's offerings. This could point to a lack of clarity or understanding about the technological aspects within their organisation.

Technological intensity - products & services	
1- very low technological intensity	12%
2- rather not technology-intensive	21%
3- rather technology-intensive	31%
4- very high technological intensity	33%
I do not know	3%

Table 12. Technological intensity of products and services

Source: own edition

In summary, the majority (64%) of respondents, either have 'rather technology-intensive' or 'very high technological intensity' products and services. This underscores the significant role technology plays in the Hungarian business landscape.

The following table sheds light on the technological intensity of companies as gauged by their operational processes.

Technological intensity - operational processes	
1- very low technological intensity	15%
2- rather not technology-intensive	26%
3- rather technology-intensive	35%
4- very high technological intensity	20%
I do not know	3%

Table 13. Technological intensity of operational processes

Source: own edition

15% of companies are characterised as having 'very low technological intensity' concerning their operational processes. This suggests that these businesses might be predominantly relying on traditional or manual methods for their day-to-day operations. A quarter of the companies, specifically 26%, fall under the 'rather not technology-intensive' bracket. This indicates that while these businesses do utilise technology, it is not deeply embedded or central to their operations. The most prominent category, capturing 35% of the companies, is 'rather technology-intensive'. This signifies that a significant portion of Hungarian businesses have incorporated technology into their operations to a notable extent, though not at the most advanced levels. Only 20% of companies are categorised under 'very high technological intensity' for operational processes. This indicates that a fifth of the businesses are heavily reliant on state-of-the-art technologies, making them likely pioneers in optimizing their operations through

technology. Again, a small fraction, 3%, of respondents were uncertain about the technological intensity of their company's operational processes, which may suggest some ambiguity or a lack of insight regarding the technological aspects of their own companies.

In essence, the data reflects that a combined 55% of Hungarian companies, based on the questionnaire's responses, incorporate technology into their operational processes to a significant degree (‘rather technology-intensive’ and ‘very high technological intensity’). However, there is a clear indication that fewer companies reach the peak of technological adoption in their operational processes compared to their product or service offerings, as evident from the previous table.

In the questionnaire, there were questions about existence and level of implementation of knowledge management strategy and project within the organisations.

With regards to overall knowledge management strategy, it has been asked whether the organisation is having knowledge management strategy in place at all, and if so, then having it as part of the corporate strategy, or as a sub-strategy of an independent area.

Knowledge management strategy	
No	61%
Yes, it is part of the corporate strategy	24%
Yes, a sub-strategy of an independent area	9%
I do not know	6%

Table 14. Implementation of knowledge management strategies

Source: own edition

It can be seen that a significant majority, 61%, of the organisations reported not having a knowledge management strategy in place. This suggests that over half of the organisations surveyed do not prioritise or see the need for formalizing their approach to knowledge management. 24% of organisations have incorporated knowledge management as part of their corporate strategy. This indicates that nearly a quarter of the surveyed organisations recognise the importance of knowledge management at the highest strategic level, aligning knowledge management objectives and practices with their broader corporate goals. A smaller proportion, 9%, reported having knowledge management as a sub-strategy of an independent area. This suggests that while these organisations do prioritise knowledge management, they have opted to treat it as a

specialised segment under a broader area or function rather than integrate it into their primary corporate strategy. Lastly, 6% of the respondents were unsure about the status of knowledge management strategy in their organisation. This could point to either a lack of awareness about strategic decisions at the top management level or ambiguity in the way knowledge management is approached within their organisation. In summary, while the majority of the surveyed organisations do not have a formal knowledge management strategy in place, there is a significant combined proportion (33%) that recognises the value of knowledge management, either integrating it into their overarching corporate strategy or treating it as a specialised sub-strategy.

Considering knowledge management projects, the following table show answers of respondents regarding implementation of knowledge management projects in their organisations.

Knowledge management project	
I have no information about knowledge management projects	34%
We do not have knowledge management project and do not plan to introduce one	25%
We have knowledge management project	21%
Knowledge management project is being developed	9%
I do not know	5%
Assessment is in progress currently whether there is a need for such a project	4%
We thought about introducing a knowledge management project, but rejected it	2%

Table 15. Implementation of knowledge management projects

Source: own edition

34% of respondents claimed they have no information about knowledge management projects in their organisation. This suggests a potential gap in communication or awareness within these companies regarding knowledge management strategy initiatives. A quarter of the organisations, 25% explicitly stated that they do not have a knowledge management project and have no plans to introduce one. This indicates a deliberate decision not to pursue formal knowledge management projects, either due to perceived lack of benefit, resource constraints, or other reasons. 21% of respondents reported that their organisation already has a knowledge management project in place, signifying a proactive approach to managing and leveraging organisational knowledge. 9% indicated that a knowledge management project is currently being developed. These organisations

are in the process of recognizing and acting upon the benefits of structured knowledge management. A small percentage, 5%, of respondents were unsure about the status of knowledge management projects in their organisation. This might point to a lack of visibility or awareness of such strategic initiatives among certain employees or departments. Another 4% mentioned that an assessment is currently in progress to determine the need for a knowledge management project. These organisations are in the preliminary stages, evaluating the potential advantages and requirements of implementing a knowledge management initiative. Finally, 2% of respondents indicated that their organisation considered introducing a knowledge management project but ultimately decided against it. Reasons could vary from resource constraints, perceived lack of benefits, or changes in organisational priorities.

In summary, while a significant proportion of companies either lacks awareness or has chosen not to implement knowledge management projects, there is a combined 34% that has either already implemented, is developing, or is assessing the need for knowledge management projects. This reflects the varying degrees of emphasis placed on structured knowledge management across different organisations in Hungary.

The following table provides insights into the main initiators of knowledge management projects within organisations based on respondents' feedback.

Knowledge management project - main initiator	
Top Management	43%
No such project	35%
Middle management	10%
Colleagues	9%
Parent company	2%

Table 16. Initiators of knowledge management projects

Source: own edition

Top management emerges as the leading initiator, with 43% of respondents indicating that senior leadership takes the helm in starting knowledge management projects. This underscores the strategic importance of knowledge management, as top-level executives often prioritise initiatives that align with the organisation's overarching goals and vision. 35% of respondents stated that there is no such knowledge management project within their organisation. This group might correspond to the earlier mentioned organisations that either do not see the need for or have chosen not to pursue knowledge management

projects. Middle management is credited as the main initiator by 10% of respondents. This suggests that in some organisations, the drive for structured knowledge management comes from middle-tier managers who directly oversee operational processes and see the immediate need and benefits of managing knowledge effectively. Colleagues are responsible for initiating knowledge management projects in 9% of the cases. It's intriguing to see that in some instances, the push for knowledge management comes from the ground up, possibly driven by team members who feel the direct impact of knowledge gaps or see opportunities for efficiency and improvement. Finally, 2% of respondents indicated that the parent company is the main initiator. This implies that in organisations that are part of larger corporate structures, directives to implement knowledge management projects sometimes come from the overarching parent entity, likely as part of broader corporate strategies or best practice implementations.

In summary, while the main drive for knowledge management projects in many organisations comes from the top, there is evident involvement and initiative from all levels of the organisation, from non-manager graded colleagues to middle management. This diversity of initiators reflects the universal relevance and potential impact of effective knowledge management across different layers of an organisation.

5.2. Findings of the quantitative research

Technological intensity-related questions were twofold, one question was asking about the technological intensity of products and services, another one was about technological intensity of operational processes within the firms. Answers were possible to be given on an interval scale from one to four, where one meant very low technological intensity and 4 meant very high technological intensity. Additionally, it was allowed to respond with ‘I do not know’.

Technological intensity in sectoral approach

Crosstab						
			sectoral			Total
			primary	secondary	tertiary	
Technological intensity of products and services	very low	Count	10	51	262	323
		% within sectoral	15.4%	11.6%	12.5%	12.4%
	rather not technology-intensive	Count	12	71	476	559
		% within sectoral	18.5%	16.1%	22.7%	21.5%
	rather technology-intensive	Count	27	185	627	839
		% within sectoral	41.5%	42.0%	29.8%	32.2%
	very high technological intensity	Count	16	133	736	885
		% within sectoral	24.6%	30.2%	**35.0%**	34.0%
Total		Count	65	440	2101	2606
		% within sectoral	100.0%	100.0%	100.0%	100.0%

Table 17. Technological intensity of products and services

Source: own edition

As it can be seen from the table, in terms of proportions according to the sectoral approach, the services sector has the highest technological intensity of products and services (Chi-square=31.014 df=6 sign.=0.000) and secondary (manufacturing) sector comes after to as second, meaning that the sector a firm belongs to is likely to influence its products and services' technological intensity. However, correlation is rather weak (Cramer V: 0.077 sign.= 0.000). This could be attributed to the increasing incorporation of IT and digital technologies in service offerings and the innovation-driven nature of many service industries.

Crosstab						
			sectoral			Total
			primary	secondary	tertiary	
Technological intensity of corporate operational processes	very low	Count	10	79	304	393
		% within sectoral	15.9%	18.1%	14.6%	15.2%
	rather not technology-intensive	Count	14	108	584	706
		% within sectoral	22.2%	24.7%	28.0%	27.3%
	rather technology-intensive	Count	31	180	736	947
		% within sectoral	49.2%	41.2%	35.3%	36.6%
	very high technological intensity	Count	8	70	461	539
		% within sectoral	12.7%	16.0%	**22.1%**	20.9%
Total		Count	63	437	2085	2585
		% within sectoral	100.0%	100.0%	100.0%	100.0%

Table 18. Technological intensity operational processes

Source: own edition

In terms of corporate processes, the same conclusion can be drawn as in the previous finding, the services sector has the highest technological intensity of corporate operational processes (Chi square=19.671 df=6 sign.=0.003; Cramer's V= 0.062 sign.=0.03) and similarly, followed by the secondary then the primary sectors. Again, the relationship is rather weak.

These results can be compared to the EIBIS 2022 EU overview on use of advanced digital technologies. According to the report, firms in manufacturing and infrastructure sectors are most likely to adopt digital technologies and companies in services sector are only the 3rd out of the 4 sectors where construction comes as last. Similar results reported in EIBIS 2022 Hungary overview, where Hungary's manufacturing sector has the highest proportion of innovating firms (32%), while services (18%) and construction (21%) has the lowest.

Thus, it can be concluded, that these results are not fully in line with the EIBIS findings.

Overall knowledge management strategy in sectoral approach

Analysing possible differences based on having an overall knowledge management strategy in place at companies (N=2511), results showed that there is no difference in the level of integration of the knowledge management strategy (knowledge management strategy as a sub-strategy of an independent area or knowledge management strategy as part of the corporate strategy) by sector.

		Having an overall knowledge management strategy	Number of emerging technologies used
Having an overall knowledge management strategy	Correlation Coefficient	1.000	0.423
	Sig. (2-tailed)		.000
	N	2542	2542

Table 19. Knowledge management strategy supported by technology

Source: own edition

The table presents a relationship analysis between 'having an overall knowledge management strategy' and the 'number of emerging technologies used'. This suggests that organisations with a comprehensive knowledge management strategy tend to utilise more emerging technologies (r = 0.423 indicates a moderate positive relationship between the two variables). The significance level (Sig. 2-tailed) is 0.000, indicating that the correlation is statistically significant.

Sectoral distribution is shown by the following table.

	Primary	Secondary	Tertiary
Having an overall knowledge management strategy	0.485	0.481	0.411
	N= 64	N= 418	N= 2029

Table 20. Knowledge management strategy in place by sectors

Source: own edition

The table displays the sectoral distribution of overall knowledge management strategy implemented across three sectors: primary, secondary, and tertiary. For the primary sector, the correlation coefficient is 0.485, with a sample size of 64. The secondary sector has a correlation coefficient of 0.481 with a larger sample size of 418. The tertiary sector, with the largest sample size of 2,029, has a correlation coefficient of 0.411. This lower correlation compared to the sample size could be due to the diverse nature of the tertiary sector, which encompasses a wide range of services with varying levels of technology integration. All these relationships are statistically significant. This suggests that the presence of a knowledge management strategy has varying degrees of correlation across these three sectors, with the highest volume in the tertiary sector.

The next table is a crosstab that displays the distribution of organisations based on their adoption of a knowledge management strategy across three sectors.

Crosstab						
			Having an overall knowledge management strategy			Total
			No	Yes, a sub-strategy of an independent area	Yes, part of the corporate strategy	
sectoral	primary	Count	44	6	14	64
		% within sectoral	68.8%	9.4%	21.9%	100.0%
	secondary	Count	287	40	91	418
		% within sectoral	68.7%	9.6%	21.8%	100.0%
	tertiary	Count	1313	190	526	2029
		% within sectoral	64.7%	9.4%	25.9%	100.0%
Total		Count	1644	236	631	2511
		% within sectoral	**65.5%**	9.4%	25.1%	100.0%

Table 21. Knowledge management strategy overview (sectoral)

Source: own edition

Table 21 clearly shows that there are no sectoral differences. Overall, about 65% of organisations across all sectors do not have a formal knowledge management strategy. Among those that do, about 25% have integrated it as part of their corporate strategy, while around 9.4% treat it as a sub-strategy of an independent area.

In the primary sector, out of 64 organisations, 44 (68.8%) do not have a knowledge management strategy, 6 (9.4%) have a sub-strategy of an independent area, and 14 (21.9%) consider it as part of the corporate strategy. Similarly, in the secondary sector, 68.7% have no strategy, 9.6% have a sub-strategy, and 21.8% include it in the corporate strategy. The tertiary sector shows 64.7% without a strategy, 9.4% with a sub-strategy, and 25.9% incorporating it into the corporate strategy. Overall, 65.5% of the total 2511 organisations across all sectors do not have a knowledge management strategy, 9.4% have a sub-strategy, and 25.1% consider it a part of their corporate strategy.

Thus, it can be concluded that the large majority of respondents (approx. 65%) do not have a knowledge management strategy. The absence of differences is also proven by the Chi-square statistic (3.605 df=4 sign.=0.462). It is therefore unnecessary to examine the strength of the relationship.

Knowledge management project in sectoral approach

Crosstab								
			Having a knowledge management project					Total
			We do not have a knowledge management project and do not plan to introduce one	Assessment is in progress currently whether there is a need for such a project	We thought about introducing a knowledge management project, but rejected it	Knowledge management project is being developed	We have knowledge management project	
sectoral	primary	Count	15	1	0	5	17	38
		% within sectoral	39.5%	2.6%	0.0%	13.2%	**44.7%**	100.0%
	secondary	Count	120	23	11	37	76	267
		% within sectoral	44.9%	8.6%	4.1%	13.9%	28.5%	100.0%
	tertiary	Count	539	82	43	195	474	1333
		% within sectoral	40.4%	6.2%	3.2%	14.6%	35.6%	100.0%
Total		Count	674	106	54	237	567	1638
		% within sectoral	**41.1%**	6.5%	3.3%	14.5%	34.6%	100.0%

Table 22. Knowledge management project overview (sectoral)

Source: own edition

Regarding sectoral approach, it can be stated that close to half (41%) of the companies across all areas do not have a knowledge management project and do not plan to introduce one either. This can be due to the fact that in the sample of the research, mostly SMEs are represented from Hungary, there could be no need for formal knowledge management as information and knowledge flows are anyways happening and with such number of employees, there is no necessity for having knowledge management project as such implemented formally.

However, 35% of respondents answered positively and confirmed that their firm is having knowledge management project in place. Out of this ratio, it is also clear that primary sector comes first with (45%) having knowledge management project, this proportion is the smallest in the industrial sector (28, 5%). There is no significant difference between industries (Chi square= 10.442 df=8 sign.=0.235). The slight variation in KM project adoption across sectors suggests the need for sector-specific KM solutions. For example, in the primary sector, KM could focus on sustainable practices and environmental knowledge, while in the manufacturing sector, it might concentrate on process optimisation and innovation.

Impediments due to missing knowledge management in sectoral approach

During the course of the survey it was asked that in case of having no knowledge management strategy or project in place, what the main impediments are. There were 5 main possible reasons listed: knowledge management is not part of the daily work; lack of knowledge sharing culture; lack of time, wrong priorities; and top management is not being aware of the importance of knowledge management. Additionally, it was allowed to respond with 'I do not know'. Respondents needed to provide their feedback on an interval scale from one to four, where one meant that the listed reason is not an impediment at all, four meant that the reason is an impediment to a great extent.

There was no sectoral difference with regards to the impediment that knowledge management is not part of the daily work (Pearson Chi-Square =10.399 df=6 sign.=0.109). This suggests that across sectors, the integration of KM into daily operations is equally challenging or overlooked.

Crosstab							
			Lack of knowledge sharing culture				Total
			not an impediment at all	impediment to a small extent	somewhat an impediment	impediment to a great extent	
sectoral	primary	Count	20	19	11	2	52
		% within sectoral	38.5%	36.5%	21.2%	3.8%	100.0%
	secondary	Count	142	123	89	25	379
		% within sectoral	37.5%	32.5%	23.5%	6.6%	100.0%
	tertiary	Count	837	495	324	123	1779
		% within sectoral	**47.0%**	27.8%	18.2%	6.9%	100.0%
Total		Count	999	637	424	150	2210
		% within sectoral	45.2%	28.8%	19.2%	6.8%	100.0%

Table 23. Lack of knowledge sharing culture (sectoral)

Source: own edition

Regarding the reason 'lack of knowledge sharing culture', it is the tertiary sector where it is less likely to be considered as impediment compared to the primary and secondary sectors (Pearson Chi-Square=15.660 df=6 sign.=0.016). The strength of the relationship is rather weak (Cramer's V=0.060 sign.=0.016).

This could indicate that the nature of service-oriented work, which often relies on interpersonal communication and collaboration, may naturally foster a more favourable environment for knowledge sharing.

Other possible reasons as impediments

Regarding 'lack of time, wrong priorities' (Pearson Chi-Square=7.758 df=6 sign.=0.256), 'knowledge management is not integrated into business processes' (Pearson Chi-Square=6.955 df=6 sign.=0.325), and 'top management is not aware of the importance of knowledge management' (Pearson Chi-Square=9.010 df=6 sign.=0.173), asked as probable impediments, there were no significant difference between sectors. These aspects are mostly not considered as impediment in the services sector. Overall it can be stated that respondents belong to the services sector reported mostly about having the least impediments realised.

In summary, there are no significant difference found between sectors regarding impediments due to the lack of knowledge management strategy or project. This uniformity across sectors suggests common challenges in prioritising and integrating KM initiatives within organisational processes and strategies.

Permitted knowledge management practices

Respondent were asked about knowledge management-related practices (also referred as knowledge management technologies) that are permitted and used in their organisation. The following practices has been listed: external professional communities (e.g. meetup, webinar); social networking services (e.g. Facebook, LinkedIn); external messaging network (e.g. Skype, Viber, Messenger); external video sharing tools (e.g. YouTube); groupware tools (e.g. Google Docs, GoogleDrive, Planner, OneDrive, OneNote, Teams); professional blogs (e.g. Blogger) and microblogs (e.g. Twitter); external presentation sharing tools (e.g. Slideshare); cloud based company-owned network storage (intranet); and company-owned offline storage (intranet). It was a multiple choice question where participants were asked to choose the appropriate technologies or practices existing at their companies.

According to the investigation, significant relationship could be found between some of the examined knowledge management technologies and the sectoral approach (see details in 9.3 Appendix). It can be stated that external professional communities are used to a significantly greater extent in the tertiary sector (72.4%), while in the primary (65.6%)

and secondary (65.9%) it is almost the same. Tertiary sector also stands out in use of social networking services (69.4%) compared to the other two sectors (primary: 61.3%, secondary: 52.3%). External messaging network is used to a greater extent by the primary (78.8%) and tertiary (80.2%) sectors compared to the secondary (73.0%). External video sharing tools are mostly not in use within the primary (55.4%) and secondary (57.3%) sectors and only slightly more used within the tertiary (54.9%) sector. Groupware tools are more in use, mainly within the tertiary (75.3%) and secondary (73.7%) sectors, but also within the primary (60.7%) it is used to a great extent. Regarding professional blogs and microblogs it can be seen that these technologies are mostly not used, usage appears more dominantly in the tertiary (37.9%) sector. External presentation sharing tools show similarities to them, mainly not applied but it is the tertiary sector (26.9%) where their usage appear the most. Cloud based company-owned network storage (intranet) is used most dominantly within the tertiary (66.8%) sector, compared to primary (50.0%) and secondary (58.8%). Overall, it can be seen that most of the found significant relationships between knowledge management practices and sectors are strengthening the tertiary sector (in 7 out of 8 cases).

Moreover, analysis resulted in significant relationship between usage of knowledge management practices and ownership type of the companies (subsidiary of a foreign company or domestic company). External professional communities are used to a significantly greater extent by foreign companies' subsidiaries. However, there was no significant difference considering social networking services in the ownership approach. External messaging network technologies are used significantly greater extent by purely domestic companies.

Overall finding is that not all the examined knowledge management practices showed significant relationship with sectors.

Focus on emerging technologies

Based on rank correlation calculation regarding technology intensity of products and services and technological intensity of corporate operational processes, supplementing with the number of emerging technologies used, it can be stated that these factors are most closely related in the tertiary sector. This suggests that companies in this sector (services) heavily integrate various technologies both in their offerings and in their internal processes.

The diversified portfolio of technologies is more closely related to the number of technologies used in the primary sector. This could be due to the nature of the primary sector where a broader range of technologies might be employed for different tasks, but each technology's impact on product or process intensity might not be as significant.

Calculating Cramer's V, it has been investigated which emerging technology has a greater impact on the technological intensity of the products and processes.

	Products / Services				Corporate processes			
	Chi-square	df (degrees of freedom)	sign.	Cramer V	Chi-square	df (degrees of freedom)	sign.	Cramer V
Business intelligence application	136.679	3	0.000	**0.228 (0.000)**				
Ticket management system	260.589	3	0.000	**0.314 (0.000)**	306.055	3	0.000	**0.342 (0.000)**
Chatbot	49.247	3	0.000	0.137 (0.000)	97.955	3	0.000	0.194 (0.000)
E-HR	29.663	3	0.000	0.106 (0.000)	59.31	3	0.000	0.151 (0.000)
Biometric authentication	30.157	3	0.000	0.107 (0.000)	18.359	3	0.000	0.084 (0.000)
VR technologies	68.224	3	0.000	0.161 (0.000)	57.582	3	0.000	0.149 (0.000)
3D printing	80.02	3	0.000	0.174 (0.000)	41.963	3	0.000	0.127 (0.000)
Management Information System	70.432	3	0.000	0.163 (0.000)	108.016	3	0.000	0.203 (0.000)
Collaborative technologies	191.064	3	0.000	**0.269 (0.000)**	190.221	3	0.000	**0.270 (0.000)**
Artificial intelligence	86.229	3	0.000	0.181 (0.000)	98.767	3	0.000	0.194 (0.000)
Fraud detection software	47.803	3	0.000	0.135 (0.000)	73.235	3	0.000	0.167 (0.000)
Content-based recommendation system	10.417	3	0.015	0.063 (0.015)	16.717	3	0.001	0.080 (0.001)
Virtual assistant	16.911	3	0.001	0.080 (0.01)	22.686	3	0.000	0.093 (0.000)
Robotic process automation	91.369	3	0.000	0.186 (0.000)	134.959	3	0.000	0.227 (0.000)
Customer relationship management	28.697	3	0.000	0.104 (0.000)	47.116	3	0.000	0.134 (0.000)
Drones	27.188	3	0.000	0.102 (0.000)	6.831	3	0.077	
Internet of Things	101.369	3	0.000	0.196 (0.000)	84.005	3	0.000	0.179 (0.000)
Big data, data mining	148.803	3	0.000	**0.238 (0.000)**	173.946	3	0.000	**0.258 (0.000)**
None of the listed	373.522	3	0.000	0.376 (0.000)	348.357	3	0.000	0.365 (0.000)

Table 24. Emerging technologies, technological intensity by sector

Source: own edition

It can be found that business intelligence, ticket management systems, collaborative technologies, as well as big data & data mining stand out from the others and have the greatest effect on technological intensity. A possible reason for having these technologies the most influence is because these are the most essential technologies that could be implemented not especially for the sake of supporting technological intensity of products and processes but these are essential nowadays to support core businesses in their daily operations in enhancing both the offerings to the customers and the efficiency of internal operations, too. Big data and data mining also show a strong association with technological intensity, highlighting the importance of data-driven decision-making in modern businesses. Technologies like 3D printing and VR show moderate associations, indicating their selective impact on certain industries or sectors. Content-based recommendation systems and drones have lower Cramer's V values, suggesting a more niche application or a lesser overall impact on technological intensity compared to other technologies listed.

The findings highlight the importance of aligning technology adoption with sector-specific needs and the potential of certain technologies to significantly influence the technological intensity of products and processes.

Emerging technologies in use in sectoral approach

Considering emerging technologies, survey participants got the question to choose emerging technologies being used or being implemented from a list of 18 listed technologies, which were the following: business intelligence application (e.g. PowerBI, SAP Analytics Cloud, etc.); ticket management system (e.g. JIRA, SPC, ServiceNow, etc.); chatbot; E-HR; biometric authentication; VR technologies; 3D printing; Management Information System (MIS); collaborative technologies (e.g. Slack); AI (e.g. TensorFlow, IBM Watson); fraud detection software; content-based recommendation system; virtual assistant; robotic process automation (RPA) (e.g. Power Automate); customer relationship management (CRM) (e.g. Aaron, Presence AI, Spin); drones; Internet of Things (IoT); and big data, data mining.

Answers to this question then was connected to industries. The table, which due to its size, can be found in the Appendix 9.4 as Table 86. However, to provide a more comprehensive overview, the following summary table has been created that clearly shows the proportion of users per industries. The minority of the users (that were under 19%) are excluded from the table.

Industry (N=number of respondents)	Emerging technology in use
Agriculture, forestry and fishing (N=68)	Drones
Mining and quarrying (N=3)	Business intelligence application, Ticket management system, Biometric authentication, VR, 3D printing, Management Information System (MIS), RPA, Drones, Big data, data mining
Manufacturing (N=122)	Business intelligence application, 3D printing, Management Information System (MIS)
Electricity, gas, steam and air conditioning supply (N=59)	Business intelligence application, Management Information System (MIS)
Water supply; sewerage, waste management and remediation activities (N=25)	Management Information System (MIS)
Construction (N=240)	none
Wholesale and retail trade; repair of motor vehicles and motorcycles (N=96)	Business intelligence application
Transportation and storage (N=30)	
Accommodation and food service activities (N=31)	Business intelligence application, E-HR, Management Information System (MIS)
Information and communication (**N=402**)	Business intelligence application, Ticket management system, Management Information System (MIS), Collaborative technologies, Big data, data mining, IoT (18,9%)
Financial and insurance activities (N=223)	none
Real estate activities (N=36)	none
Professional, scientific and technical activities **(N=413)**	3D printing, Collaborative technologies
Administrative and support service activities (N=143)	none
Public administration and defence; compulsory social security (N=31)	Management Information System (MIS)
Education (N=127)	Management Information System (MIS)
Human health and social work activities (N=213)	none
Arts, entertainment and recreation (N=98)	Collaborative technologies
Other service activities (N=312)	none
Activities of extraterritorial organisations and bodies (N=31)	Business intelligence application, 3D printing, Management Information System (MIS), Collaborative technologies, Big data, data mining

Table 25. Proportion of users within the industry

Source: own edition

This analysis resulted that number of emerging technologies are in use the most within the professional, scientific and technical activities and within information and communication industries.

Certain technologies have found significant adoption in specific industries, reflecting the unique needs and operational characteristics of these sectors. For example, drones are notably prevalent in agriculture, forestry, and fishing, where they are likely used for monitoring crops and gathering data over large areas.

Technologies such as business intelligence applications and management information systems are widely adopted across several industries, including mining and quarrying, manufacturing, electricity, gas, steam, and air conditioning supply, among others. This indicates these technologies' versatility and foundational role in modern business operations, providing analytics, insights, and operational support.

The information and communication sector, as well as professional, scientific, and technical activities, show a diverse adoption of emerging technologies like Business intelligence applications, ticket management systems, MIS, collaborative technologies, big data, and IoT. This suggests that these sectors are at the forefront of technological integration, leveraging multiple advanced technologies to enhance their operations, communication, and data management capabilities.

Some industries, such as construction, financial and insurance activities, and human health and social work activities, show no significant adoption (>19%) of any listed technologies. This could be due to various factors, including regulatory constraints, the nature of work, or the current stage of technological integration within these sectors.

Technologies like 3D printing and collaborative technologies have found significant use in sectors like professional, scientific and technical activities, and arts, entertainment, and recreation. This indicates that while some technologies may not have broad applicability across all industries, they can be crucial in specific sectors.

The analysis illustrates the diverse landscape of emerging technology adoption across industries, reflecting each sector's unique characteristics and needs. Companies can leverage these insights to make informed decisions about technology investments, ensuring they align with industry trends and contribute to operational effectiveness and competitive positioning.

Emerging technologies in use by sectors

Use of emerging technologies in sectoral approach were investigated, Chi-square (examines the existence of the relationship) and Cramer’s V (examines the strength of the relationship) show whether there is a significant difference between sectors regarding the

use of the given emerging technologies. Based on the number of used emerging technologies, services sector is the strongest. The following table shows significant results, the full table can be found in the Appendix as Table 87.

	primary	secondary	tertiary	Chi-square	Cramer's V
	N=71	N=446	N=2162		
Ticket management system	1	19	361	56.734 (0.000)	0.146
proportion of users within the industry	1.41%	4.26%	16.70%		
Chatbot	4	12	160	14.481(0.0001)	0.071
proportion of users within the industry	5.63%	2.69%	7.40%		
3D printing	2	65	209	14.038 (0.001)	0.072
proportion of users within the industry	2.82%	14.57%	9.67%		
Artificial intelligence	0	6	87	10.549 (0.005)	0.063
proportion of users within the industry	0.00%	1.35%	4.02%		
Content-based recommendation system	2	9	104	7.413 (0.025)	0.053
proportion of users within the industry	2.82%	2.02%	4.81%		
Customer relationship management	1	14	116	6.415 (0.040)	0.049
proportion of users within the industry	1.41%	3.14%	5.37%		
Drones	21	47	123	68.538 (0.000)	0.16
proportion of users within the industry	29.58%	10.54%	5.69%		
Big data, data mining	5	30	276	14.648 (0.001)	0.074
proportion of users within the industry	7.04%	6.73%	12.77%		
None of the listed	36	237	982	9.228 (0.010)	0.059
proportion of users within the industry	50.70%	53.14%	45.42%		

Table 26. Emerging technologies in use by sectors

Source: own edition

According to the result of the analysis, the following technologies showed relationship, however, relationship is weak in each cases: ticket management system; chatbot; 3D printing; AI; content-based recommendation system; CRM; drones; big data, data mining. Cramer's V values, which measure the strength of relationship, suggest that the relationships are generally weak to moderate. For instance, drones have the highest Cramer's V value of 0.16, indicating a relatively stronger association with sectoral distribution than other technologies. The tertiary sector (services) demonstrates the most extensive use of emerging technologies overall, with significant adoption rates for technologies like ticket management systems, chatbots, 3D printing, artificial intelligence, content-based recommendation systems, customer relationship management, drones, and big data/data mining.

The proportion of users within the industry varies, with drones being notably prevalent in the primary sector at 29.58%. This high rate suggests drones' significant utility in these industries for tasks like monitoring, mapping, and surveying large areas of land.

Big data and data mining are most used in the tertiary sector at 12.77%, underscoring the importance of data analytics in service-oriented industries for customer insights, market trends analysis, and decision-making processes.

Emerging technologies by company ownership

Using Chi-square and Cramer's V statistics, differences regarding ownership of organisations were found between organisations that are subsidiaries of a foreign company and domestic companies. Multinational corporations and their subsidiaries may need to consider how global technology strategies can be adapted to local contexts, ensuring that the technologies they deploy are relevant and effective within the specific operational environments of their foreign subsidiaries. Also, these could have the advantage of accessing cutting-edge technologies and practices from their parent companies. They should leverage this by adopting and adapting these technologies to improve their competitive edge in local markets.

	Foreign company (subsidiary) (N=288)	Foreign user	Hungarian (N=2390)	Hungarian user	Chi-square	Cramer V
Business intelligence application	121	42.014%	286	11.97%	180.054 (0.000)	**0.259**
Ticket management system	91	31.597%	290	12.13%	79.79 (0.000)	**0.173**
Chatbot	55	19.097%	121	5.06%	82.450 (0.000)	**0.175**
E-HR	63	21.875%	156	6.53%	80.629 (0.0000)	**0.174**
Biometric authentication	23	7.986%	96	4.02%	9.537 (0.002)	0.06
VR technologies	30	10.417%	93	3.89%	24.976 (0.000)	0.097
3D printing	43	14.931%	245	10.25%	7.465 (0.009)	0.053
Management Information System	91	31.597%	316	13.22%	67.339 (0.0000)	**0.159**
Collaborative technologies	64	22.222%	393	16.44%	6.065 (0.014)	0.048
Artificial intelligence	23	7.986%	70	2.93%	19.61 (0.000)	0.086
Fraud detection software	49	17.014%	66	2.76%	127.037 (0.000)	**0.218**
Content-based recommendation system	15	5.208%	100	4.18%		
Virtual assistant	22	7.639%	97	4.06%	7.759 (0.05)	0.054
Robotic process automation	52	18.056%	136	5.69%	60.207 (0.000)	**0.15**
Customer relationship management	29	10.069%	87	3.64%	25.638 (0.000)	0.098
Drones	22	7.639%	169	7.07%		
Internet of Things	44	15.278%	171	7.15%	22.968 (0.000)	0.093
Big data, data mining	75	26.042%	236	9.87%	65.450 (0.000)	**0.156**
None of the listed	76	26.389%	1179	49.33%	54.734 (0.000)	0.142

Table 27. Emerging technologies by company ownership

Source: own edition

There was strong relationship found considering ownership related to business intelligence application, ticket management system, chatbot, E-HR and management information system, fraud detection software, RPA and big data, data mining. Also, there are weak relationship with the usage of other listed emerging technologies except content-based recommendation systems and drones where there were no significant relationship found. Users of companies that are subsidiaries of a foreign company are about 10% of all users, the most frequently used technologies are business intelligence application, ticket management system, MIS and big data and data mining. Users from domestic companies are using collaborative technologies, MIS, ticket management system and business intelligence application technologies the most. Therefore, it can be seen that

considering the most frequently used technologies there is a major overlap regarding the ownership of the companies.

Change in emerging technologies by sectors

As additional research connected to the latest pandemic, relationship between change in emerging technologies' use based on Covid-19 and sectors were analysed. As result of the analysis it has been found that the pandemic has evidently accelerated the use of certain technologies, with variations in adoption rates based on sector and ownership. Relationship was found with some of the pre-listed emerging technologies, namely with ticket management system, chatbot, E-HR, collaborative technologies, content-based recommendation system, virtual assistant, RPA, CRM, drones, and big data, data mining.

The top technologies that showed growth due to the pandemic are collaborative technologies, business intelligence application, MIS, big data, data mining, IoT and chatbots, regardless of sectors (see in Appendix 9.2, Table 88).

Drones showed a 19% growth in the primary sector, which is significant compared to their 2% and 3% growth in the secondary and tertiary sectors, respectively. Technologies like business intelligence applications and ticket management systems showed some level of growth across all sectors.

Change in emerging technologies by sectors and owners (3D crosstab)

The 3D crosstab table compares the adoption of emerging technologies across sectors and ownership (Foreign company subsidiaries – F vs. domestic companies - D).

	Primary		Secondary		Tertiary		Primary		Secondary		Tertiary	
	F N=8	D N=50	F N=57	D N=348	F N=161	D N=1748	F N=8	D N=50	F N=57	D N=348	F N=161	D N=1748
Business intelligence application	2	8	19	29	54	188	25.00%	16.00%	**33.33%**	**8.33%**	**33.54%**	**10.76%**
Ticket management system	0	0	3	6	31	114	0.00%	0.00%	**5.26%**	**1.72%**	**19.25%**	**6.52%**
Chatbot	2	4	5	11	31	85	25.00%	8.00%	8.77%	3.16%	**19.25%**	**4.86%**
E-HR	0	2	5	8	28	76	0.00%	4.00%	**8.77%**	**2.30%**	**17.39%**	**4.35%**
Biometric authentication	0	1	1	8	13	39	0.00%	2.00%	1.75%	2.30%	**8.07%**	**2.23%**
VR technologies	0	2	4	5	10	56	0.00%	4.00%	**7.02%**	**1.44%**	6.21%	3.20%
3D printing	0	1	5	12	11	69	0.00%	2.00%	**8.77%**	**3.45%**	6.83%	3.95%
Management Information System	1	6	11	23	26	146	12.50%	12.00%	**19.30%**	**6.61%**	**16.15%**	**8.35%**
Collaborative technologies	3	6	5	22	55	261	37.50%	12.00%	8.77%	6.32%	**34.16%**	**14.93%**
Artificial intelligence	1	0	3	3	13	41	**12.50%**	**0.00%**	**5.26%**	**0.86%**	**8.07%**	**2.35%**
Fraud detection software	0	0	3	5	17	31	0.00%	0.00%	**5.26%**	**1.44%**	**10.56%**	**1.77%**
Content-based recommendation system	0	4	0	6	13	90	0.00%	8.00%	0.00%	1.72%	8.07%	5.15%
Virtual assistant	0	4	2	5	11	78	0.00%	8.00%	3.51%	1.44%	6.83%	4.46%
Robotic process automation	0	2	4	3	22	83	0.00%	4.00%	**7.02%**	**0.86%**	**13.66%**	**4.75%**
Customer relationship management	0	1	2	4	15	65	0.00%	2.00%	3.51%	1.15%	**9.32%**	**3.72%**
Drones	3	8	1	9	4	51	37.50%	16.00%	1.75%	2.59%	2.48%	2.92%
Internet of Things	1	4	3	12	23	99	12.50%	8.00%	5.26%	3.45%	**14.29%**	**5.66%**
Big data, data mining	0	5	6	11	34	128	0.00%	10.00%	**10.53%**	**3.16%**	**21.12%**	**7.32%**

Table 28. Change in emerging technologies – by sectors and owners (3D crosstab)

Source: own edition

In the primary sector, collaborative technologies and drones show the highest adoption rates among foreign subsidiaries at 37.50%, while management information systems and business intelligence applications are more prevalent among domestic companies. In the secondary sector, business intelligence applications have a higher adoption rate among foreign subsidiaries (33.33%) compared to domestic companies (8.33%). The tertiary sector shows a significant adoption of collaborative technologies by foreign subsidiaries

(34.16%) compared to domestic companies (14.93%). The use of big data and data mining is notably higher in the tertiary sector among foreign subsidiaries (21.12%) than domestic companies (7.32%).

Overall, foreign subsidiaries tend to have higher percentages of technology adoption across most categories compared to domestic companies. The table also indicates that certain technologies, such as ticket management systems and chatbots, have low adoption rates across all sectors and ownership types.

In the services sector, there were significant change due to the pandemic within the most technologies in use, 13 out of 18. The following table shows the affected technologies and the magnitude of the increase.

	Tertiary	
	Foreign company (subsidiary) (N=161)	Hungarian (N=1748)
Collaborative technologies	34.16%	14.93%
Business intelligence application	33.54%	10.76%
Big data, data mining	21.12%	7.32%
Ticket management system	19.25%	6.52%
Chatbot	19.25%	4.86%
E-HR	17.39%	4.35%
Management Information System	16.15%	8.35%
Internet of Things	14.29%	5.66%
Robotic process automation	13.66%	4.75%
Fraud detection software	10.56%	1.77%
Customer relationship management	9.32%	3.72%
Artificial intelligence	8.07%	2.35%
Biometric authentication	8.07%	2.23%

Table 29. Increase in usage of emerging technologies due to COVID-19

Source: own edition

Applying the same analysis, results showed that in the industry sector, however, only one significant change was found in the subsidiaries of foreign companies (N=8), that was AI with 12.5% increase.

As conclusion, it can be stated that there was an increase in the usage of the majority of the emerging technologies. Foreign subsidiaries generally show a greater propensity to adopt emerging technologies, possibly benefiting from global resources and standards, and a possibly greater emphasis on innovation and digital transformation within multinational corporations.

Knowledge management strategy by information need

Analysing possible relationship between knowledge management strategy and source of information in need. The analysis employs one-way ANOVA to compare means across three groups: companies without a knowledge management strategy, those with a knowledge management strategy as a sub-strategy of an independent area, and those where it is part of the corporate strategy.

Turning to colleagues

It can be concluded from the following table, that the more integrated the corporate strategy is, the more employees turn to their colleagues with confidence. However, volume of companies with knowledge management strategy implemented is relatively low.

One-way ANOVA	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
No	1767	2.63	1.059	0.025	2.58	2.68	1	4
Yes, a sub-strategy of an independent area	268	2.84	0.967	0.059	2.73	2.96	1	4
Yes, it is part of the corporate strategy	766	3.01	0.902	0.033	2.95	3.08	1	4
Total	2801	2.75	1.023	0.019	2.72	2.79	1	4

Table 30. Knowledge management strategy – information source (one-way ANOVA)

Source: own edition

The F-test of ANOVA shows whether there is a significant difference between groups after the F sign. Its level is <0.05, so the post-hoc analysis can be performed.

ANOVA	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	81.513	2	40.757	40.013	0.000
Within Groups	2850.004	2798	1.019		
Total	2931.517	2800			

Table 31. Knowledge management strategy – information source (F-test)

Source: own edition

	value	sign.
Homogeneity of variance (not met) - Levene statistic	65.05	0.000

Table 32. Knowledge management strategy – information source (Levene)

Source: own edition

Testing homogeneity of variance, the Levene statistic value is 65.05, which is a measure of the extent to which the assumption of equal variances is violated. The significance value (sign.) associated with the Levene statistic is 0.000, indicating that the test is highly significant. This significant result suggests that the assumption of homogeneity of variances is not met for the data under consideration.

Therefore, due to the lack of homogeneity of variance, Tamhane post-hoc test has been chosen to be taken, that shows the difference between groups.

Tamhane

(I) Having an overall knowledge management strategy		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Yes, a sub-strategy of an independent area	No	**0.215**	0.064	0.003	0.06	0.37
Yes, it is part of the corporate strategy	No	**0.385**	0.041	0.000	0.29	0.48
	Yes, a sub-strategy of an independent area	**0.170**	0.067	0.036	0.01	0.33

Table 33. Knowledge management strategy – information source (Tamhane)

Source: own edition

Result of the Tamhane analysis (dependent variable: info need - I turn to my colleague) shows that in case of all groups, the difference between the averages is significant, i.e. for those who do not have knowledge management strategy it is significantly less common to turn to a colleague for gathering information. The results underscore the importance of integrating knowledge management strategies into the corporate framework to enhance collaborative information seeking among employees. Adopting a strategic approach to knowledge management can contribute to building a more informed, engaged, and collaborative workforce.

Repeating the same calculation then for the next two variables.

Turning to external sources

One-way ANOVA resulted that the more integrated the corporate strategy is, the less employees turn to external sources in case of information need. However, as for the previous variable, volume of companies with knowledge management strategy implemented is relatively low.

One-way ANOVA	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
No	1772	3.07	0.868	0.021	3.03	3.11	1	4
Yes, a sub-strategy of an independent area	268	2.90	0.868	0.053	2.79	3.00	1	4
Yes, it is part of the corporate strategy	763	2.94	0.913	0.033	2.88	3.01	1	4
Total	2803	3.02	0.883	0.017	2.99	3.05	1	4

Table 34. Information need – turning to external source (one-way ANOVA)

Source: own edition

The F-test of ANOVA again shows whether there is a significant difference between groups after the F sign. Its level is <0.05, so the post-hoc analysis can be performed.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	13.490	2	6.745	**8.698**	**0.000**
Within Groups	2171.225	2800	0.775		
Total	2184.716	2802			

Table 35. Information need – turning to external source (F-test)

Source: own edition

The next table shows the result of testing homogeneity of variance with Levene statistic.

	value	sign.
Homogeneity of variance (met) - Levene statistic	2.49	0.083

Table 36. Information need – turning to external source (Levene)

Source: own edition

Testing homogeneity of variance it can be found that it is met. Therefore, due to fulfilment of homogeneity of variance, Scheffe post-hoc test (the strictest) has been chosen to be taken, that shows the difference between groups.

Scheffe						
(I) Having an overall knowledge management strategy		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No	Yes, a sub-strategy of an independent area	**0.178**	0.058	0.009	0.04	0.32
	Yes, it is part of the corporate strategy	**0.128**	0.038	0.003	0.04	0.22

Table 37. Information need – turning to external source (Scheffe)

Source: own edition

Result of the Scheffe analysis (dependent variable: info need - I turn to external sources) shows that in case of all groups, the difference is significant, i.e. those who do not have knowledge management strategy, it is significantly more common to turn to external sources.

The analysis reveals that employees in organisations where knowledge management is more deeply integrated into the corporate strategy are less likely to turn to external sources for information. This trend suggests that a well-integrated knowledge management strategy might provide sufficient internal resources and networks, reducing the need to seek external information.

Checking the organisational database

One-way ANOVA resulted that the more integrated the corporate strategy is, the more the organisational database is used, but the average values are significantly lower than in the case of co-worker assistance.

One-way ANOVA	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
No	1750	1.58	0.879	0.021	1.54	1.62	1	4
Yes, a sub-strategy of an independent area	268	2.28	1.063	0.065	2.15	2.40	1	4
Yes, it is part of the corporate strategy	756	2.45	1.095	0.040	2.37	2.53	1	4
Total	2774	1.89	1.040	0.020	1.85	1.92	1	4

Table 38. Checking the organisational database (one-way ANOVA)

Source: own edition

The F-test of ANOVA shows whether there is a significant difference between groups after the F sign. Its level is <0.05, so the post-hoc analysis can be performed

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	440.128	2	220.064	**238.400**	**0.000**
Within Groups	2557.875	2771	0.923		
Total	2998.003	2773			

Table 39. Checking the organisational database (F-test)

Source: own edition

The next table shows the result of testing homogeneity of variance with Levene statistic.

	value	sign.
Homogeneity of variance (met) - Levene statistic	69.88	0.000

Table 40. Checking the organisational database (Levene)

Source: own edition

Testing homogeneity of variance it can be found that it is not met. Therefore, due to the lack of homogeneity of variance, again Tamhane post-hoc test has been chosen to be taken, that shows the difference between groups.

Tamhane						
(I) Having an overall knowledge management strategy		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
No	Yes, a sub-strategy of an independent area	-0.693	0.068	0.000	-0.86	-0.53
	Yes, it is part of the corporate strategy	-0.865	0.045	0.000	-0.97	-0.76
Yes, a sub-strategy of an independent area	Yes, it is part of the corporate strategy	-0.172	0.076	0.071	-0.35	0.01
Yes, it is part of the corporate strategy	No	0,865	0.045	0.000	0.76	0.97

Table 41. Checking the organisational database (Tamhane)

Source: own edition

In case of all groups, the difference between the averages is significant, i.e. for those who do not have knowledge management strategy, it is significantly less common to check the organisational database (probably because there is none).

Knowledge management strategy – information need (sectoral approach)

Turning to colleagues

Analysis has been proceeded in a similar way as in the previous case, with the difference that it examined the differences in a sectoral approach.

In the first step, in order to show the differences between the sectors, the database is split into the created 3 sector variables.

Method: One-way ANOVA									
Info need - I turn to my colleague									
sectoral		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
primary	No	44	2.52	0.952	0.144	2.23	2.81	1	4
	Yes, a sub-strategy of an independent area	6	2.67	0.816	0.333	1.81	3.52	2	4
	Yes, it is part of the corporate strategy	14	3.07	1.072	0.286	2.45	3.69	1	4
	Total	64	2.66	0.979	0.122	2.41	2.90	1	4
secondary	No	287	2.57	1.014	0.060	2.46	2.69	1	4
	Yes, a sub-strategy of an independent area	40	2.95	0.783	0.124	2.70	3.20	1	4
	Yes, it is part of the corporate strategy	91	3.12	0.828	0.087	2.95	3.29	1	4
	Total	418	2.73	0.982	0.048	2.64	2.82	1	4
tertiary	No	1313	2.66	1.070	0.030	2.60	2.72	1	4
	Yes, a sub-strategy of an independent area	190	2.82	1.002	0.073	2.68	2.96	1	4
	Yes, it is part of the corporate strategy	526	3.03	0.894	0.039	2.96	3.11	1	4
	Total	2029	2.77	1.033	0.023	2.73	2.82	1	4

Table 42. Knowledge management strategy – turning to colleagues (one-way ANOVA)

Source: own edition

Then, homogeneity of variance has been tested, which met for the primary sector and resulted in non-homogeneity for the secondary and tertiary sectors.

Test of Homogeneity of Variances				
Info need - I turn to my colleague				
sectoral	Levene Statistic	df1	df2	Sig.
primary	0.215	2	61	0.807
secondary	13.987	2	415	0.000
tertiary	46.789	2	2026	0.000

Table 43. Knowledge management strategy – turning to colleagues (Levene)

Source: own edition

Applying ANOVA, it can be concluded that in a sectoral approach, there are no significant differences between the groups in the primary sector, but there are in the other two sectors.

ANOVA						
Info need - I turn to my colleague						
		Sum of Squares	df	Mean Square	F	Sig.
primary	Between Groups	3.198	2	1.599	1.704	0.190
	Within Groups	57.239	61	0.938		
	Total	60.438	63			
secondary	Between Groups	22.742	2	11.371	**12.428**	**0.000**
	Within Groups	379.710	415	0.915		
	Total	402.452	417			
tertiary	Between Groups	53.450	2	26.725	**25.631**	**0.000**
	Within Groups	2112.441	2026	1.043		
	Total	2165.891	2028			

Table 44. Information need – turning to colleagues – sectoral (one-way ANOVA)

Source: own edition

Applying Tamhane method, results show that having an overall knowledge management strategy has a more positive effect on the secondary (manufacturing) sector in the aspect of turning to colleagues in case of information need. Other important finding is that there is a significant average difference in both sectors at two levels: when there is no knowledge management strategy - and it is part of the corporate strategy, and when there is no knowledge management strategy - and the knowledge management strategy is a sub-strategy of an independent area. There is a large average difference (also within the

sectors) where there is no knowledge management strategy at all or where the knowledge management strategy is part of the corporate strategy (that is, as integrated as possible).

Tamhane							
sectoral			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
secondary	Yes, a sub-strategy of an independent area	No	**0.375**	0.137	0.025	0.04	0.71
	Yes, it is part of the corporate strategy	No	**0.546**	0.105	0.000	0.29	0.80
tertiary	Yes, it is part of the corporate strategy	No	**0.375**	0.049	0.000	0.26	0.49
		Yes, a sub-strategy of an independent area	**0.213**	0.083	0.030	0.02	0.41

Table 45. Information need – turning to colleagues – sectoral (Tamhane)

Source: own edition

Turning to external sources

Similarly like for the previous variable, the database is split into the created 3 sector variables. Applying ANOVA, it can be concluded that in a sectoral approach, there are no significant differences between the groups in the secondary sector, but there are in the other two (primary, tertiary) sectors.

ANOVA						
Info need - I turn to external sources (e.g. internet)						
sectoral		Sum of Squares	df	Mean Square	F	Sig.
primary	Between Groups	5.657	2	2.828	**4.173**	**0.020**
	Within Groups	41.343	61	0.678		
	Total	47.000	63			
secondary	Between Groups	0.994	2	0.497	0.684	0.505
	Within Groups	301.602	415	0.727		
	Total	302.596	417			
tertiary	Between Groups	12.369	2	6.184	**8.179**	**0.000**
	Within Groups	1531.883	2026	0.756		
	Total	1544.251	2028			

Table 46. Information need – Turning to external sources (one-way ANOVA)

Source: own edition

Differences between groups are only significant in the tertiary sector, where the presence or absence of a knowledge management strategy really exerts its effect in terms of turning to external sources only in this sector.

Tamhane			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
tertiary	Yes, a sub-strategy of an independent area	No	**-0.189**	0.067	0.015	-0.35	-0.03
	Yes, it is part of the corporate strategy	No	**-0.152**	0.047	0.003	-0.26	-0.04

Table 47. Information need – Turning to external sources (Tamhane)

Source: own edition

The results indicate that employees in service industries are more likely to turn to their colleagues for information when there is a well-integrated knowledge management strategy within the corporate framework. This highlights the importance of knowledge management in facilitating information exchange and collaboration in service sectors.

Checking the organisational database

Again, database is split into the created 3 sector variables. Then, homogeneity of variances is tested with Levene statistic, where it is found that within the primary sector, homogeneity of variance is met and in the other two sectors it is not.

sectoral	Levene Statistic	df1	df2	Sig.
primary	0.246	2	61	**0.782**
secondary	8.105	2	415	0.000
tertiary	61.958	2	2026	0.000

Table 48. Information need – Checking the organisational database (Levene)

Source: own edition

Applying ANOVA, it can be seen that in a sectoral approach, there are no significant differences between the groups in the primary sector, but there are in the other two (secondary, tertiary) sectors.

ANOVA						
Info need - I check the org database						
sectoral		Sum of Squares	df	Mean Square	F	Sig.
primary	Between Groups	2.291	2	1.145	1.055	0.354
	Within Groups	66.194	61	1.085		
	Total	68.484	63			
secondary	Between Groups	77.695	2	38.848	**52.549**	**0.000**
	Within Groups	306.795	415	0.739		
	Total	384.490	417			
tertiary	Between Groups	286.665	2	143.333	**150.949**	**0.000**
	Within Groups	1923.782	2026	0.950		
	Total	2210.448	2028			

Table 49. Information need – Checking the organisational database (one-way ANOVA)

Source: own edition

Employees in companies with a more integrated knowledge management strategy (either as a sub-strategy of an independent area or as part of the corporate strategy) are more likely to use the organisational database compared to those in companies without such a strategy.

Results out of Tamhane analysis show that having an overall knowledge management strategy (especially one that is integrated into the corporate strategy) has a more positive effect on the secondary and tertiary sectors in the aspect of checking the organisational database in case of information need, similarly to the interpretation and results in case of turning to a colleague. However, differences are even more dominant than in that variable.

Tamhane			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
secondary	Yes, a sub-strategy of an independent area	No	**0.848**	0.168	0.000	0.43	1.26
	Yes, it is part of the corporate strategy	No	**0.962**	0.113	0.000	0.69	1.24
tertiary	Yes, a sub-strategy of an independent area	No	**0.628**	0.081	0.000	0.43	0.82
	Yes, it is part of the corporate strategy	No	**0.833**	0.055	0.000	0.70	0.97

Table 50. Information need – Checking the organisational database (Tamhane)

Source: own edition

Companies in the secondary and tertiary sectors could enhance the effectiveness of their knowledge management strategies and encourage more frequent and productive use of organisational databases, leading to improved information access and decision-making within the organisation.

Knowledge management strategy - emerging technologies

Calculating Chi-square it can be stated that the higher the overall knowledge management strategy implementation level the more possible the listed technologies are applied (N=2542). For the most of the listed technologies the calculation showed significant level (except drones). The table including results can be found in the Appendix (Table 77).

Knowledge management project – emerging technologies (number)

As next, the relationship between level of knowledge management projects and the number of emerging technologies in use has been tested.

	Knowledge management project
Emerging technologies in use (number)	0.492
N	1638

Table 51. Knowledge management project – emerging technologies

Source: own edition

Analysis resulted that the level of knowledge management projects has a medium relationship with the number of emerging technologies in use (r= 0.492), suggesting that as the level of engagement in knowledge management projects increases, so does the adoption of emerging technologies.

Sectoral distribution is shown by the following table.

	Primary	Secondary	Tertiary
Emerging technologies in use (number)	0.606	0.506	0.486
N	38	267	1333

Table 52. Knowledge management project – emerging technologies

Source: own edition

This relationship was consistent across different sectors, with the primary sector showing a slightly higher correlation (0.606) compared to the secondary (0.506) and tertiary (0.486) sectors, although the primary sector had a smaller sample size and overall minor use of emerging technologies.

Knowledge management project - emerging technologies

The following table presents a comprehensive view of the adoption of various knowledge management projects and technologies across organisations, categorised by their current status with respect to these initiatives.

		We do not have a knowledge management project and do not plan to introduce one	Assessment is in progress currently whether there is a need for such a project	We thought about introducing the program, but rejected it	The knowledge management project is being developed	We have a knowledge management project	Chi-Square	Cramer V
Business intelligence application	yes	36	20	2	62	185	168.676	0.321
	yes %	5.3%	18.9%	3.7%	26.2%	**32.6%**		
	no	638	86	52	175	382		
	no %	94.7%	81.1%	96.3%	73.8%	67.4%		
Ticket management system	yes	51	14	1	54	161	109.349	0.258
	yes %	7.6%	13.2%	1.9%	22.8%	**28.4%**		
	no	623	92	53	183	406		
	no %	92.4%	86.8%	98.1%	77.2%	71.6%		
Chatbot	yes	14	7	2	19	77	61.774	0.194
	yes %	2.1%	6.6%	3.7%	8.0%	13.6%		
	no	660	99	52	218	490		
	no %	97.9%	93.4%	96.3%	92.0%	86.4%		
E-HR	yes	19	12	4	34	97	75.099	0.214
	yes %	2.8%	11.3%	7.4%	14.3%	17.1%		
	no	655	94	50	203	470		
	no %	97.2%	88.7%	92.6%	85.7%	82.9%		
Biometric authentication	yes	14	6	3	18	52	30.865	0.137
	yes %	2.1%	5.7%	5.6%	7.6%	9.2%		
	no	660	100	51	219	515		
	no %	97.9%	94.3%	94.4%	92.4%	90.8%		
VR technologies	yes	8	5	3	20	67	61.525	0.194
	yes %	1.2%	4.7%	5.6%	8.4%	11.8%		
	no	666	101	51	217	500		
	no %	98.8%	95.3%	94.4%	91.6%	88.2%		
3D printing	yes	41	16	5	33	97	39.197	0.155
	yes %	6.1%	15.1%	9.3%	13.9%	17.1%		
	no	633	90	49	204	470		
	no %	93.9%	84.9%	90.7%	86.1%	82.9%		
Management Information System	yes	34	23	13	63	178	152.220	0.305
	yes %	5.0%	21.7%	24.1%	26.6%	**31.4%**		
	no	640	83	41	174	389		
	no %	95.0%	78.3%	75.9%	73.4%	68.6%		
Collaborative technologies	yes	56	23	5	74	201	150.665	0.303
	yes %	8.3%	21.7%	9.3%	31.2%	**35.4%**		
	no	618	83	49	163	366		
	no %	91.7%	78.3%	90.7%	68.8%	64.6%		

(table continued)		**We do not have a knowledge management project and do not plan to introduce one**	**Assessment is in progress currently whether there is a need for such a project**	**We thought about introducing the program, but rejected it**	**The knowledge management project is being developed**	**We have a knowledge management project**	**Chi-Square**	**Cramer V**
Artificial intelligence	yes	5	5	1	9	60	66.199	0.201
	yes %	0.7%	4.7%	1.9%	3.8%	10.6%		
	no	669	101	53	228	507		
	no %	99.3%	95.3%	98.1%	96.2%	89.4%		
Fraud detection software	yes	8	6	3	11	61	55.245	0.184
	yes %	1.2%	5.7%	5.6%	4.6%	10.8%		
	no	666	100	51	226	506		
	no %	98.8%	94.3%	94.4%	95.4%	89.2%		
Content-based recommendation system	yes	16	4	2	20	50	28.947	0.133
	yes %	2.4%	3.8%	3.7%	8.4%	8.8%		
	no	658	102	52	217	517		
	no %	97.6%	96.2%	96.3%	91.6%	91.2%		
Virtual assistant	yes	11	5	3	9	58	47.069	0.170
	yes %	1.6%	4.7%	5.6%	3.8%	10.2%		
	no	663	101	51	228	509		
	no %	98.4%	95.3%	94.4%	96.2%	89.8%		
Robotic process automation	yes	14	9	2	38	100	96.398	0.243
	yes %	2.10%	8.50%	3.70%	16.00%	17.60%		
	no	660	97	52	199	467		
	no %	97.90%	91.50%	96.30%	84.00%	82.40%		
Customer relationship management	yes	13	6	0	20	58	44.28	0.164
	yes %	1.9%	5.7%	0.0%	8.4%	10.2%		
	no	661	100	54	217	509		
	no %	98.1%	94.3%	100.0%	91.6%	89.8%		
Drones	yes	42	10	2	20	58	-	-
	yes %	6.2%	9.4%	3.7%	8.4%	10.2%		
	no	632	96	52	217	509		
	no %	93.8%	90.6%	96.3%	91.6%	89.8%		
Internet of Things	yes	28	9	5	34	96	58.107	0.188
	yes %	4.2%	8.5%	9.3%	14.3%	16.9%		
	no	646	97	49	203	471		
	no %	95.8%	91.5%	90.7%	85.7%	83.1%		
Big data, data mining	yes	28	13	7	43	150	125.042	0.276
	yes %	4.2%	12.3%	13.0%	18.1%	**26.5%**		
	no	646	93	47	194	417		
	no %	95.8%	87.7%	87.0%	81.9%	73.5%		
None of the listed	yes	439	35	26	47	90	361.430	0.470
	yes %	65.1%	33.0%	48.1%	19.8%	15.9%		
	no	235	71	28	190	477		
	no %	34.9%	67.0%	51.9%	80.2%	84.1%		

Table 53. Knowledge management project – emerging technologies

Source: own edition

Business intelligence application has a significant presence, with 32.6% of organisations reporting that they have a knowledge management project in place, and only 5.3% not considering one at all. Collaborative technologies are also prominent, with 35.4% of organisations having a project, suggesting a strong trend towards collaborative tools in knowledge management. Big data, data mining shows a substantial percentage (26.5%) of organisations that have adopted this technology, indicating its importance in the current business landscape. MIS is another area where a significant number of organisations (31.4%) have implemented projects, highlighting the value placed on information systems for managing knowledge. Technologies like ticket management system and e-HR are in the development phase in 22.8% and 14.3% of organisations, respectively, showing ongoing interest in these areas. The Chi-Square and Cramer V values across all technologies indicate that there are statistically significant differences in the adoption rates of these knowledge management projects.

Emerging tech - info need to solve a problem

Applying independent sample t-test/ Welch's test to see whether there is significant difference in regards to usage of specific emerging technologies and source of information gathering. Overall, it can be found that in case the listed emerging technology is in use by the respondents then it raises possibility that they gather information for solving a problem by turning to their colleagues / turning to external sources (e.g.internet) / checking the organisational database.

The following table includes results based on the statistical calculations mentioned beforehand with regards to turning to a colleague in case of information need. For the other two information sources the exactly same emerging technologies' usage are the ones that makes significant difference – 14 out of the 18 listed emerging technologies, where only 3D printing, content-based recommendation system, virtual assistant and drones are the four technologies that do not make any significant difference in information gathering.

	I turn to my colleague				
	Yes (N=407)	No (N=2271)	**Levene statistics**	**t-test**	**Mean Difference**
BI application	3.04 (STD= 0.869)	2.72 (STD= 1.038)	64.9511259597904 (sign.= 0.000)	6.485 (sign. = 0.000)	0.313
	Yes (N=381)	No (2297)	Levene statistics	t-test	Mean Difference
Ticket management	3.11 (STD= 0.0870)	2.72 (STD= 1.033)	51.753 (sign.= 0.000)	7.981 (sign.= 0.000)	0.395
	Yes (N=176)	No (2502)	Levene statistics	t-test	Mean Difference
Chatbot	3.02 (0.935)	2.75 (1.024)	17.093 (sign.= 0.000)	3.58194340978959 (sign.= 0.000)	0.263
	Yes (N=219)	No (2459)	Levene statistics	t-test	Mean Difference
E-HR	3.02 (STD= 0.878)	2.75 (STD= 1.029)	34.754 (sign.= 0.000)	4.277 (sign.= 0.000)	0.269
	Yes (N=120)	No (2589)	Levene statistics	t-test	Mean Difference
Biometric authentication	2.97 (STD=0.907)	2.76 (STD=1.025)	16.143 (sign.= 0.000)	2.410 (sign. =0.017)	0.205
	Yes (N=126)	No (2583)	Levene statistics	t-test	Mean Difference
VR technologies	3.13 (STD=0.820)	2.75 (STD=1.026)	22.713 (sign.= 0.000)	4.937 sign.=(0.000)	0.374
	Yes (N=283)	No (2426)	Levene statistics	t-test	Mean Difference
3D printing	2.87 (STD=0.944)	2.76 (STD=1.029)	11.042 (sign.= 0.000)	1.909 sign.=(0.114)	0.06
	Yes (N=414)	No (2295)	Levene statistics	t-test	Mean Difference
MIS	3,03 (STD=0,825)	2,72 (STD=1,025)	109,879 (sign.= 0,000)	6,553 sign. = (0,000)	0.302
	Yes (N=467)	No (2242)	Levene statistics	t-test	Mean Difference
Collaborative technologies	3.07 (STD=0.844)	2.71 (STD=1.025)	90.764 (sign.= 0.000)	7.967 sign.=(0.000)	0.358
	Yes (N=94)	No (2615)	Levene statistics	t-test	Mean Difference
Artificial intelligence	3.22 (STD=0.844)	2.75 (STD=1.023)	9.862 (sign.= 0.000)	5.252 sign.=(0.000)	0.469
	Yes (N=120)	No (2589)	Levene statistics	t-test	Mean Difference
Fraud detection	3.03 (STD=0.825)	2.76 (STD=1.027)	25.363 (sign.= 0.000)	3.148 sign.=(0.001)	0.266
	Yes (N=121)	No (2288)	Levene statistics	t-test	Mean Difference
Content-based recommendation	2.89 (STD=0.911)	2.76 (STD=1.025)	9.647 (sign.= 0.001)	1.500 sign.=(0.136)	0.085
	Yes (N=122)	No (2587)	Levene statistics	t-test	Mean Difference
Virtual assistant	2.91 (STD=0.979)	2.76 (STD=1.022)	5.150 (sign.= 0.000)	1.606 sign.=(0.111)	0.146
	Yes (N=191)	No (2518)	Levene statistics	t-test	Mean Difference
Robotic process automation	3.07 (STD=0.859)	2.75 (STD=1.029)	34.263 (sign.= 0.000)	4.894 sign. = (0.000)	0.32
	Yes (N=120)	No (2589)	Levene statistics	t-test	Mean Difference
CRM	3.12 (STD=0.780)	2.75 (STD=1.028)	25.591 (sign.= 0.000)	4.896 sign. = (0.000)	0.362
	Yes (N=192)	No (2517)	Levene statistics	t-test	Mean Difference
Drones	2.85 (STD=0.911)	2.76 (STD=1.028)	8.492 (sign.= 0.004)	1.227 sign. = (0.221)	0.085
	Yes (N=220)	No (2489)	Levene statistics	t-test	Mean Difference
IoT	2.99 (STD=0.917)	2.75 (STD=1.027)	18.514 (sign.= 0.000)	3.685 sign.= (0.000)	0.24
	Yes (N=318)	No (2391)	Levene statistics	t-test	Mean Difference
Big data, data mining	3.08 (STD=0.846)	2.73 (STD=1.035)	53.621 (sign.= 0.000)	6.862 sign. = (0.000)	0.356

Table 54. Emerging tech – info need

Source: own edition

Interpretation of these results on the example of business intelligence application is explained as follows. The null hypothesis states that there is no significant difference in the mean ratings of respondents who use the business intelligence application compared to those who do not use it. The alternative hypothesis suggests that there is a significant difference between the two groups.

Since the Levene's test statistic is significant (p = 0.000), it indicates a violation of the assumption of equal variances between the two groups. Therefore, Welch's test's results should be relied on, which does not assume equal variances.

Significance level: The t-test statistic for Welch's test is 6.485, and the associated p-value is 0.000. Since the p-value is less than 0.05 (significance level), we can conclude that the result is statistically significant.

Based on the statistical analysis, there is a statistically significant difference in the mean ratings of respondents who use the business intelligence application (M = 3.04, STD = 0.869) compared to those who do not use it (M = 2.72, STD = 1.038). The positive mean difference of 0.313 indicates that, on average, respondents who use the business intelligence application reported higher ratings than those who do not use it.

By understanding and leveraging the relationship between emerging technology usage and information-gathering behaviors, organisations could enhance their knowledge management practices, improve problem-solving capabilities, and foster a more collaborative and informed workforce.

The usage of emerging technologies and their connections

The next part of the analysis provides an overview on correlations between the usage of emerging technologies and knowledge management strategy, technological intensity and sources of information.

Number of emerging technologies in use - knowledge management strategy

The number of technologies in use has relationship with the level of implementation of the knowledge management strategy, i.e. the more they are used, the more likely is that knowledge management strategy is an integrated part of the corporate strategy.

In the case of the secondary sector, this correlation is close to medium.

			Sectoral breakdown		
		Having an overall KM strategy (for the full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	0.388	0.366	0.456	0.376
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	2542	64	418	2029

Table 55. Number of emerging technologies in use – KM strategy (sectoral)

Source: own edition

The table displays the results of a Pearson correlation analysis examining the relationship between the number of emerging technologies used by organisations and the level of their knowledge management strategy across different sectors. For the full sample, there is a positive correlation of 0.388 between the number of emerging technologies used and having an overall knowledge management strategy, which is statistically significant with a 2-tailed significance level of 0.000. This suggests that as the number of emerging technologies used increases, the likelihood of having a knowledge management strategy also increases. The correlation is slightly stronger in the secondary sector (0.456) compared to the primary (0.366) and tertiary (0.376) sectors, indicating that the secondary sector may place more emphasis on integrating emerging technologies with KM strategies. All correlations are statistically significant across the board, as indicated by the significance level of 0.000 for all sectoral breakdowns. The sample sizes for the correlations are 2542 for the full sample, 64 for the primary sector, 418 for the secondary sector, and 2029 for the tertiary sector. By recognising the link between the adoption of emerging technologies and the development of KM strategies, organisations can better position themselves to leverage these technologies for improved knowledge management and overall organisational performance.

The same analysis has been conducted to examine ownership breakdown.

		Ownership breakdown	
	Having an overall KM strategy (for the full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	0.383	0.344
	Sig. (2-tailed)	0.000	0.000
	N	261	2281

Table 56. Number of emerging technologies in use – KM strategy (ownership)

Source: own edition

The same analysis has been conducted to examine ownership breakdown. There is a positive correlation for both foreign-owned (0.383) and domestically-owned (0.344) organisations, indicating that as the number of emerging technologies used increases, so does the likelihood of having an overall knowledge management strategy. The correlation is slightly stronger in foreign-owned organisations compared to domestic ones, suggesting that foreign-owned entities may be more proactive or have more resources to integrate emerging technologies with their knowledge management strategies. Both correlations are statistically significant with a 2-tailed significance level of 0.000, confirming that the relationships are not due to random chance. The sample size for the analysis is 261 for foreign-owned organisations and 2,281 for domestically-owned organisations, providing a substantial dataset for the observed correlations.

Number of emerging technologies in use - knowledge management projects

The number of technologies in use has a positive effect on the implementation level of knowledge management projects, i.e. the more it is used, the more likely it is that the organisation has a realised knowledge management project.

In the case of the secondary sector, this correlation is close to medium.

			Sectoral breakdown		
		Knowledge management project implementation level (for the full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	**0.417**	0.405	0.462	0.415
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	1659	38	267	1333

Table 57. Number of emerging technologies in use – KM project (sectoral)

Source: own edition

The Pearson correlation coefficients are quite strong and statistically significant for the full sample (0.417), primary (0.405), secondary (0.462), and tertiary (0.415) sectors, with a 2-tailed significance of 0.000 in all cases. This suggests a consistent trend across sectors where an increase in the use of emerging technologies is associated with a higher level of knowledge management project implementation. The sample sizes for the analysis are 1659 for the full sample, 38 for the primary sector, 267 for the secondary sector, and 1333 for the tertiary sector, indicating a robust data set, especially for the secondary and tertiary sectors.

		Ownership breakdown	
	Knowledge management project implementation level (for the full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	0.324	0.393
	Sig. (2-tailed)	0.000	0.000
	N	188	1471

Table 58. Number of emerging technologies in use – KM project (ownership)

Source: own edition

The table shows a positive correlation between the number of emerging technologies used and the level of knowledge management project implementation, broken down by ownership type. For foreign companies, the Pearson correlation coefficient is 0.324, and for domestic companies, it is 0.393, both of which are statistically significant with a 2-tailed p-value of 0.000. This indicates that in both foreign and domestic companies, as the number of emerging technologies used increases, the level of knowledge management

project implementation also tends to increase, with the relationship being slightly stronger in domestic companies. The sample sizes are 188 for foreign companies and 1471 for domestic companies, providing a substantial basis for these findings.

Number of emerging technologies in use - technological intensity of products and services

The number of technologies in use positively affects the level of technology intensity of products and services.

In the case of the primary sector, there is the strongest correlation, which is somewhat weaker than average.

			Sectoral breakdown		
		Technological intensity of products and services (for the full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	**0.317**	0.339	0.238	0.329
	Sig. (2-tailed)	0.000	0.000	0.000	0.000
	N	2637	65	440	2101

Table 59. Emerging technologies – Tech intensity of products & services (sectoral)

Source: own edition

The table displays a positive correlation between the number of emerging technologies used and the technological intensity of products and services across different sectors. The Pearson correlation coefficients indicate a moderate positive relationship for the full sample (0.317), primary (0.339), secondary (0.238), and tertiary (0.329) sectors, with all correlations being statistically significant (p-value of 0.000). This suggests that as companies in these sectors use more emerging technologies, the technological intensity of their products and services tends to be higher. The sample sizes for the analysis are substantial, with 2637 for the full sample, 65 for the primary sector, 440 for the secondary sector, and 2101 for the tertiary sector, which supports the reliability of these findings.

		Ownership breakdown	
	Technological intensity of products and services (for the full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	0.367	0.293
	Sig. (2-tailed)	0.000	0.000
	N	286	2351

Table 60. Emerging technologies – Tech intensity of products and services (ownership)

Source: own edition

The table indicates a positive correlation between the number of emerging technologies used and the technological intensity of products and services, differentiated by ownership type. For foreign companies, the Pearson correlation coefficient is 0.367, and for domestic companies, it is 0.293, both statistically significant with a p-value of 0.000. This suggests that in both foreign and domestic companies, an increase in the use of emerging technologies is associated with a higher technological intensity in their products and services. The relationship is somewhat stronger in foreign companies. The sample sizes are 286 for foreign-owned companies and 2351 for domestic companies, providing a solid basis for these conclusions.

Number of emerging technologies in use - technological intensity of corporate operational processes

The number of technologies in use has a positive effect on the technological intensity of the corporate operational processes.

In the case of the tertiary sector, there is the strongest correlation, which is somewhat weaker than average.

		Sectoral breakdown			
		Technological intensity of corporate operational processes (for the full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	**0.341**	0.305	0.318	0.344
	Sig. (2-tailed)	0.000	0.015	0.000	0.000
	N	2616	63	437	2085

Table 61. Emerging technologies – Tech intensity of corporate processes (sectoral)

Source: own edition

The table presents a positive correlation between the number of emerging technologies used and the technological intensity of corporate operational processes across different sectors. The Pearson correlation coefficients show a moderate positive relationship for the full sample (0.341), primary (0.305), secondary (0.318), and tertiary (0.344) sectors, with all correlations being statistically significant. The significance levels (2-tailed) are 0.000 for the full sample, tertiary, and primary sectors, indicating a very strong likelihood that these correlations are not due to random chance. The secondary sector has a significance level of 0.015, which is still statistically significant, but less than the other sectors. The sample sizes are large, with 2616 for the full sample, 63 for the primary sector, 437 for the secondary sector, and 2085 for the tertiary sector, lending credibility to the robustness of these findings.

		Ownership breakdown	
	Technological intensity of corporate operational processes (for the full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	0.443	0.294
	Sig. (2-tailed)	0.000	0.000
	N	282	2334

Table 62. Emerging technologies – Tech intensity of corporate processes (ownership)

Source: own edition

The table shows a positive correlation between the number of emerging technologies used and the technological intensity of corporate operational processes, with a distinction between foreign and domestic ownership. For foreign companies, the Pearson correlation coefficient is 0.443, indicating a moderately strong positive relationship. For domestic companies, the coefficient is 0.294, suggesting a moderate positive relationship. Both correlations are statistically significant with a p-value of 0.000, indicating a high level of confidence that these relationships are not due to random chance. The sample sizes are 282 for foreign-owned companies and 2334 for domestically-owned companies, which are sufficiently large to support the validity of these results. This suggests that both foreign and domestic companies that utilise more emerging technologies tend to have more technologically intensive operational processes, with the effect being more pronounced in foreign-owned companies.

Number of emerging technologies in use - information sources

The number of technologies in use has a positive effect on the degree of **turning to a colleague** in case of info need.

In the case of the tertiary and secondary sectors, there is a weak correlation.

			Sectoral breakdown		
		Info need - I turn to my colleague (full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	**0.149**	-0.74	0.156	0.152
	Sig. (2-tailed)	0.000	0.541	0.000	0.000
	N	2709	71	446	2085

Table 63. Emerging technologies – Info need - I turn to my colleague (sectoral)

Source: own edition

For the full sample, there is a small but statistically significant positive correlation (0.149), suggesting that as the number of emerging technologies used increases, so does the tendency to consult colleagues. This pattern holds true for the tertiary (0.152) and secondary (0.156) sectors, with both showing positive correlations that are statistically significant. However, for the primary sector, the correlation is negative (-0.74) but not statistically significant (p-value 0.541), indicating no reliable relationship between technology use and seeking information from colleagues in this sector. The sample sizes are substantial, with 2709 for the full sample, 71 for the primary sector, 446 for the secondary sector, and 2085 for the tertiary sector, providing a solid basis for these conclusions.

		Ownership breakdown	
	Info need - I turn to external sources (full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	-0.055	0.032
	Sig. (2-tailed)	0.349	0.115
	N	295	2414

Table 64. Emerging technologies – Info need - I turn to my colleague (ownership)

Source: own edition

For foreign entities, there is a slight negative correlation (-0.055), and for domestic entities, there is a slight positive correlation (0.032); however, neither correlation is statistically significant, with p-values of 0.349 and 0.115 respectively. This suggests that, regardless of ownership, the number of emerging technologies an organisation uses does not have a significant impact on the likelihood of employees seeking information from external sources.

The number of technologies in use does not affect the extent of **turning to external sources**, there has been no correlation.

The number of technologies in use has a positive effect on the degree of **use of the organisational database** in case of a problem. In the case of the tertiary sector, there is a correlation that is weaker than average.

			Sectoral breakdown		
		Info need - I check the org database (full sample)	Primary	Secondary	Tertiary
Emerging technologies in use (number)	Pearson Correlation	**0.266**	0.145	0.233	0.268
	Sig. (2-tailed)	0.000	0.226	0.000	0.000
	N	2616	71	446	2085

Table 65. Emerging technologies – Info need – org database (sectoral)

Source: own edition

The table presents the correlation between the number of emerging technologies used and the frequency of employees checking the organisational database for information across different sectors. For the full sample, there is a moderate positive correlation (0.266), indicating that as the number of emerging technologies increases, employees are more likely to turn to the organisational database. This trend is also observed in the tertiary sector (0.268) and secondary sector (0.233), both showing statistically significant correlations. However, in the primary sector, while the correlation is positive (0.145), it is not statistically significant (p-value 0.226), suggesting that the relationship between technology use and database consultation in this sector is not reliably established. The sample sizes are large, with 2616 for the full sample, 71 for the primary sector, 446 for the secondary sector, and 2085 for the tertiary sector, ensuring a robust analysis.

		Ownership breakdown	
	Info need - I check the org database (full sample)	Foreign	Domestic
Emerging technologies in use (number)	Pearson Correlation	0.324	0.218
	Sig. (2-tailed)	0.000	0.000
	N	295	2414

Table 66. Emerging technologies – org database (ownership)

Source: own edition

The table indicates a positive correlation broken down by ownership. In foreign entities, there is a moderate positive correlation (0.324), suggesting a stronger relationship between the adoption of emerging technologies and the use of the organisational database compared to domestic entities, which show a weaker but still significant positive correlation (0.218). Both correlations are statistically significant with p-values of 0.000, indicating a reliable relationship in the sample. The sample size for foreign entities is 295, while for domestic entities it is substantially larger at 2414, providing a solid basis for comparison between the two groups.

Influencing factors on number of emerging technologies in use

During PLS method it has been investigated how company size, net income, level of knowledge management strategy, implementation level of knowledge management projects, technological intensity of products and services and technological intensity of corporate operational processes factors affect the number of emerging technologies in use (regression model). It aims to identify and quantify the impact of various organisational characteristics and strategies on the adoption of emerging technologies.

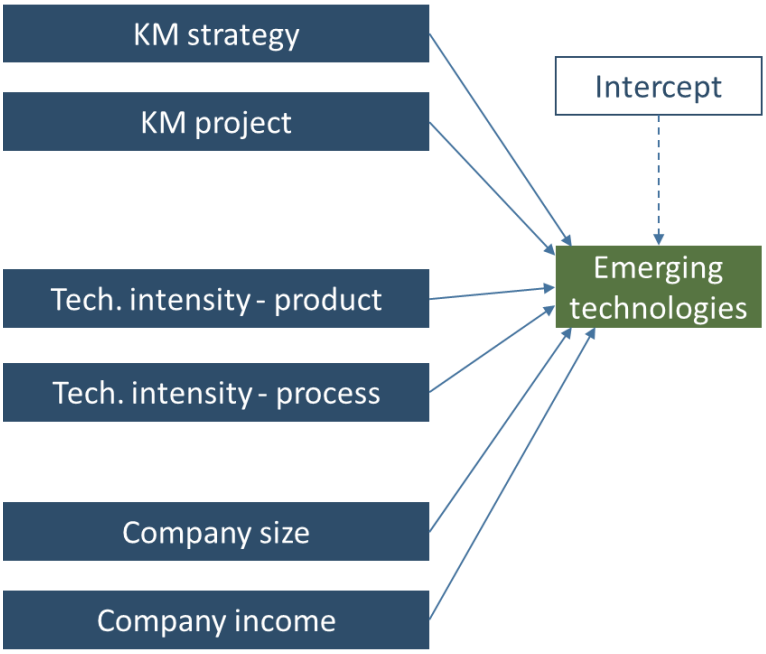

Figure 10. Regression model – number of emerging technologies in use

Source: own edition

The explanatory power of the model

The explanatory power of the model is measured by the corrected R-square index which is 0.263. This means that the variables included in the model explain 26.3% of the number of emerging technologies used. This level of explanatory power suggests a moderate degree of influence from the identified variables on technology adoption.

	Emerging tech use sum
R-square	0.265
R-square adjusted	0.263
Durbin-Watson test	1.962

Table 67. Influencing factors on emerging technologies – explanatory power

Source: own edition

Based on the Model summary table, the value of the Durbin-Watson test is d = 1.962. Therefore, at 5% significance level for 6 explanatory variables dU = 1.926 < 1.962 the null hypothesis should be accepted, the error terms are not considered autocorrelated, lending credibility to the model's findings.

Checking autocorrelation between explanatory (independent) variables (VIF indicator)

The value can be accepted if the Variance Inflation Factor (VIF) value is below the threshold of 5, confirming that multicollinearity is not a concern in this model, thereby ensuring the reliability of the results, which is fulfilled for all variables.

	VIF
Knowledge management project	2.037
Intensity of process technology	2.049
Net income	3.060
Intensity of product technology	1.875
Knowledge management strategy	1.986

Table 68. Autocorrelation-check between independent variables (VIF)

Source: own edition

The results showed that all variables, except the size of the company, significantly affect the number of emerging technologies in use.

The value of beta shows which factor has an effect (the higher the value, the greater the effect it has on the dependent variable (the number of technologies used).

Emerging tech use sum	**Unstandardised coefficients**	**Standardised coefficients (Beta)**	**SE**	**T value**	**P value**	**2.5 %**	**97.5 %**
Intensity of process technology	0.199	0.091	0.068	2.949	0.003	0.067	0.332
Knowledge management strategy	0.241	0.105	0.070	3.465	0.001	0.105	0.378
Net income	0.356	0.147	0.092	3.885	0.000	0.176	0.535
Knowledge management project	0.241	0.206	0.036	6.682	0.000	0.170	0.311
Intensity of product technology	0.291	0.136	0.063	4.604	0.000	0.167	0.415
Company size	0.094	0.053	0.066	1.420	0.156	-0.036	0.223

Table 69. Influencing factors on emerging technologies (Beta)

Source: own edition

The most influential factor is the implementation level of knowledge management projects, followed by net income, and the technological intensity of products and services. This highlights the critical role of knowledge management initiatives and financial capacity in driving technology adoption.

Despite a positive coefficient (0.094), the influence of company size on the adoption of emerging technologies is not statistically significant in this model, as indicated by its p-value (0.156) being above the conventional threshold for significance (0.05). This suggests that, unlike other factors, the size of a company may not be a decisive factor in determining its propensity to adopt emerging technologies.

5.3. Qualitative analysis

Based on the findings of the quantitative research, the qualitative study was completed by expanding upon the earlier data gathered during the quantitative analysis.

5.3.1. Data collection

During the empirical research, to establish a more in-depth understanding on findings of the quantitative research, qualitative methodology is used. Qualitative research is exploratory, and aims to shed light on 'how' and 'why' a particular social phenomenon, or program, behaves in a certain way in a particular context. Therefore it supports partial validation of the analysis findings.

For this purpose, as primary data collection pillar, semi-structured interviews were conducted. In these semi-structured interviews the researcher focuses on a specific subject matter to explore, has several prepared questions and is ready to ask questions that can assist in organizing received information. An interview questionnaire guide was designed to support the research.

Confidentiality and anonymity concerns were verified. All participants signed a confirmation letter outlining the purpose of the study, verifying the interviewee's voluntary participation, and outlining how the data will be used. Every personal detail was deleted. Open-ended questions from a pre-written interview framework (Appendix – Interview questionnaire) were given to responders in advance to their interview appointments to ensure ample time to prepare to any particular subjects they thought would be pertinent.

Additionally, in order to validate the findings of the quantitative research, each interview participant were asked to fulfil the online questionnaire anonymously, therefore their answers were collected as preparation before the interview appointment to help the researcher to be prepared with details shared by the questionnaire in advance to the interview appointment.

Semi-structured interviews contained specific questions as well as allowed the participants to share their views freely, while still providing data pertinent to the study objectives. All data were audio-recorded,- and subsequently transcribed verbatim for use in the analysis that also included the researcher's notes. This semi-structured research consisted of four major parts; general understanding and impression about-,

organisational practice and individual experience in emerging technologies in the business, and organisational strategy of knowledge management and emerging technologies. Based on information shared by respondents from the observed organisations, our research aims to understand the organisational purpose to establish and pursue knowledge management strategies and practices, as well as to uncover the most often used supporting technologies in use.

The duration of each interview took between 1-1,5 hours via an online communication platform (Zoom). To conduct interviews, direct sampling method was followed.

Interview results then were summarised in case studies. The case study method involved the analysis of mentioned sources (information shared by the interview participants) from different companies.

More details about the sampling, results and findings are detailed in the next paragraph.

5.3.2. Sample description

Normally in qualitative research, the sample size tends to be small to support a case-based analysis of this mode of inquiry (Sandelowski, 1996). In the course of this study, four respondents were selected out of high-tech knowledge-intensive services and high-tech manufacturing industries based on Eurostat (2014a, 2014b) and EIBIS (2021) reports, and vary also by employee size. All respondents are subject matter experts (SMEs), positioned in research-relevant management areas and have an overall view and understanding of the inquired topics.

Pseudonym	**Organisation**		**Respondent**		**Date of interview**
	Industry	**Size (employees)**	**Position**	**Area**	
'A'	Information and communication	0-49	Middle-manager	IT management	14 Jan 2022
'B'	Manufacturing	500+	Middle-manager	IT management	22 Jan 2022
'C'	Financial and insurance activities	500+	White-collar employee	Knowledge management	19 Jan 2022
'D'	Professional, scientific and technical activities	500+	Middle-manager	Knowledge management	18 Jan 2022

Table 70. Characteristics of the interview participants

Source: own edition

Respondents were chosen based on the network of the researcher with the direct sampling.

Given the exploratory, inductive, and qualitative nature of this study, analysis techniques including explanation building and pattern matching were chosen to analyse the data (Charmaz, 2006; Corbin & Strauss, 2008; Yin, 2009).

5.4. Findings of the qualitative research

The first part of the interview was intended to introduce emerging technologies and gather general perceptions on them. Understanding perceptions on emerging technologies and positioning of Hungary in the topic were important to see whether reports like DESI or EIBIS could be underlined by the respondent or not. It is important to note that none of the statistics or reports were mentioned or presented by the interviewer during the course of the interviews in order to avoid biases in their answers.

Perception of emerging technologies

It can be concluded that all respondents (A, B, C, and D) view emerging technologies positively, seeing them as beneficial and revolutionary. Respondents generally see the value and potential of emerging technologies, with a shared sentiment that they can transform industries, businesses, and personal lives, A mentioned ‘innovation’, B mentioned ‘validity’, C mentioned ‘new perspectives’, and D emphasised ‘development’.

Implementation challenges, human aspect and ethical concerns and practical application in the business were the main topics highlighted. Both A and D mention challenges related to discerning genuine innovations from hype and improper or thoughtless implementation of technologies. C emphasises the human side of technology, its potential impact on freedom, and the importance of ethical considerations. B gives detailed examples of how emerging technologies are being implemented within their organisation.

The overall conclusion is that emerging technologies are perceived as valuable and transformational across different industries. However, there are recurring themes related to the challenges of discerning genuine innovations, potential mistakes in implementations, and the broader societal and ethical implications. The insights from these respondents provide a balanced perspective, highlighting both the potential benefits and pitfalls of adopting and implementing emerging technologies.

Positioning

In the exploratory part a question was formulated about the Hungary's positioning in terms of application of emerging technologies in the business area and about the viewpoint on the positioning compared to 'other countries' ('other countries' were by intention not specified better during the course of this question to avoid bias). There were identifiable patterns across the responses around the perception of Hungary's positioning: all the four interview participants shared similar opinion that Hungary is not at the forefront globally in terms of emerging technologies, but it is not lagging too far behind either. Respondent A highlighted that Hungary is probably in the second tier right after the global leaders. Both A and C mentioned the impact of multinationals and innovations coming from abroad, while B emphasised Hungarian start-ups and domestic innovation. While much of the innovation in Hungary might be driven by multinationals, as C suggested, A and B both emphasised that Hungary has its share of innovative companies and start-ups, with B providing specific examples of Hungarian start-ups that have gained global recognition. B and C highlighted the competitive position of Hungary within the European region, drawing comparisons with countries like Romania, Poland, and India.

Concluding the answers regarding Hungary's positioning in terms of usage of emerging technologies, Hungary occupies a unique position in the global landscape of emerging technologies. While it might not be a global leader, it demonstrates resilience, adaptability, and a foundation for innovation, both from domestic companies and multinational entities. The nation's rapid adaptation to new technologies during the pandemic, its start-ups' global successes, and its role as a hub for R&D for various multinational companies highlight its potential in the tech domain. Challenges persist, especially in terms of regional competition and economic factors, but the foundation and will for innovation and growth are evident.

Emerging technologies' profile

The aim of questions raised regarding emerging technologies and their usage in operations were to get a deeper insight related to **RQ4**.

According to this research, competition, cost-effectiveness, quality improvement, and efficiency gain are the primary drivers of technology adoption. Figure 11. shows the most often used technology and tools cited by respondents.

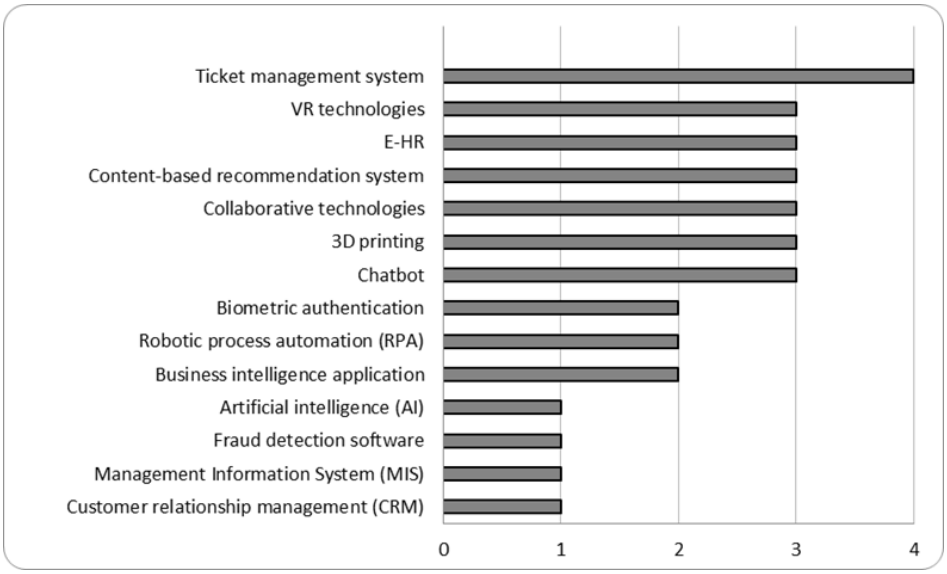

Figure 11. Technologies in use

Source: own edition

All the respondents mentioned that they use ticket management systems such as JIRA, SPC, and ServiceNow. Three out of four use chatbots, 3D printing, collaborative technologies (e.g. Slack), content-based recommendation systems, e-HR (e.g. CV filters, reskilling and upskilling support tools), and virtual reality technology. All participants mentioned the use of specific tools to aid in their automation processes. Development and HR processes were the most commonly mentioned areas of focus.

Half of the interviewees' organisations use business intelligence applications (e.g. PowerBI, SAP Analytics Cloud, etc.), RPA like Power Automate and biometric authentication tools. Furthermore, CRM technologies (e.g. Aaron, Presence AI, Spin), MIS, fraud detection software and AI applications like TensorFlow or IBM Watson were also mentioned as less frequently used only by one of the questioned firms.

According to the tool and automation related answers, emerging technologies-related profile have been created by the researcher based on some characteristics, these are shown in the following tables.

Participant A	
Overview	Company is primarily involved in IT product development. They focus on automating development processes and corporate administrative tasks. They use various software tools for these purposes.
Areas of Automation	Development Processes: Software development and automation of mundane components. Corporate Processes and Administration: Employment contracts, HR processes, recruitment, onboarding, equipment requests, surveys, expense reports, and travel organisation.
Tools Mentioned	Development: Kubernetes, CI/CD (Jenkins, Drone), JIRA, Confluence. Corporate Processes: DocuSign, BambooHR, Lever, ServiceNow, Culture Amp.
Approach to Tool Adoption	Agile, preferring smaller, adaptable tools rather than comprehensive enterprise solutions. This flexibility means they frequently change tools, which can sometimes be a downside due to parallel usage and lack of migration.

Table 71. Emerging technologies profile – A

Source: own edition

Participant B did not answered this question particularly.

Participant C	
Overview	Company aims to automate easily automatable processes, primarily in finance and HR. The organisation is flexible, allowing for decentralised decision-making and experimentation.
Areas of Automation	Finance: Processes with standardised data. HR: Especially in recruitment.
Tools Mentioned	-
Approach to Tool Adoption	A mix of out-of-the-box solutions and experimental initiatives. While some efforts remain localised, successful initiatives can expand and become mainstream.

Table 72. Emerging technologies profile - C

Source: own edition

Participant D	
Overview	Company has embarked on technological development in Hungary over the past 2-3 years. They have established an automation team to implement automation across various functional areas.
Areas of Automation	Tasks with repetitive and transactional activities, irrespective of the department (IT, customer service, finance).
Tools & approach	Excel macros, workflows, process mining. The primary goal is efficiency (measured in monetary terms) with secondary attention to improving the customer experience.
Strategic Outlook	The company uses automation primarily to increase profit rather than solely improving the customer experience. They have a quality management system ambassador community to disseminate knowledge, including about automation.

Table 73. Emerging technologies profile – D

Source: own edition

The interview touched the topic of application of artificial intelligence and tools applying it, purpose and area. This part of the interview was designed to get an overall understanding related to **RQ4** especially with artificial intelligence in focus, which is one of the most frequently mentioned emerging technology nowadays.

The following table provides a structured summary on the results of the analysis based on answers given.

	A	B	C	D
Usage of AI	Minor usage of AI, mainly in external tools.	Chatbot used in IT service management (ITSM) and HR areas; AI functionalities in learning suggestions.	AI tools related to insurance and agricultural damages; external purchases of tools; usage of robots and chatbots.	Limited to a basic chatbot.
Tools & Domain	Office365's search function (keyword-based search); Sentiment analysis tool for marketing campaigns	Chatbot (ITSM and HR); My Learning Hub (online training system) suggesting courses based on user history; Workday (HR) but uncertain about its AI functionalities	Insurance-related AI tools for detecting fraud and agricultural damages alerts using satellite imagery	Basic chatbot in IT
Development Origin	External tool for sentiment analysis; not developed internally	Limited visibility into the origin for marketing technologies	Majority of tools purchased externally	Chatbot with no learning or self-improving functionalities
Learning and Advanced Features	Sentiment analysis for marketing campaigns	My Learning Hub suggests further training based on previous searches/courses	Alerts based on satellite imagery for agricultural damages	Chatbot with no learning or self-improving functionalities
Perspective on AI	AI is more in the background, not a significant player	Usage in different areas but limited visibility into all of them	AI tools for specific industry challenges	Minimal AI, mainly keyword-based chatbot

Table 74. Usage of AI

Source: own edition

As conclusion, it can be stated that across the board, while AI is present, its intensity and application vary significantly, ranging from passive functionalities to industry-specific applications. Notably, there is also a mix of in-house development and external purchasing of AI tools.

Emerging technology-supported knowledge management profile

Related to **RQ4**, researcher formulated some questions to interpret approaches of participant SMEs on knowledge management, especially knowledge sharing and their potential support by emerging technologies

For all of the organisations interviewed, managing organisational knowledge is critical. The following figure shows the technologies and practices that support knowledge management.

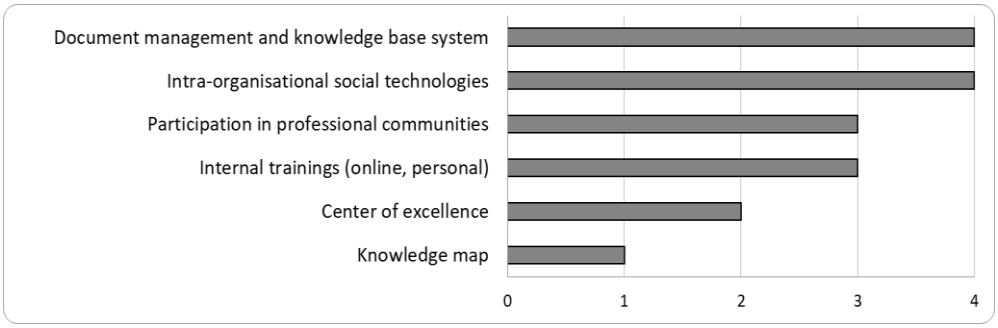

Figure 12. Knowledge management technologies and practices

Source: own edition

In order to support knowledge management, groupware tools, cloud-based company-owned network storage, messaging network, video sharing tools & online training portals and training recommender machine learning were the most referred technology which is used by all the four assessed organisations. Tools that were mentioned are Jira, Confluence, Slack, Trello, Miro, Bamboo, ServiceNOW, CultureAmp, Lever, PagerDuty, Udemy, LearnUpon, Workday, NextThink, Office365 - MS Teams, Google Classroom, Zoom, Sharepoint, Quip and Kryon capturing. There was also a question raised about the mostly digitally-supported business processes. According to the respondents, those are the ones that enable self-help functions in HR, finance, IT service management, IT processes like programming/ development, marketing & communication and insurance areas.

The human perspective, future of knowledge workers

In order to receive a deeper understanding on the human-perspective, areas like roles created or replaced by emerging technologies and changes from the employees' perspective. None of the research questions were specifically described around the

investigation of potential changes in the light of the human perspective, therefore interviews intended to look into this aspect.

During the interview, respondents were asked whether emerging technologies are and will be supporting or replacing knowledge workers. Answers to it were consistent; the major functions and tasks where emerging technologies, especially automation, machine learning and AI are growing are the ones which are repetitive and transactional. Currently, the majority of the role of the technologies is supporting knowledge workers, especially in the decision-preparation function. However, there are already some fields where the substitutional purpose has been realised, where employees embodied database functions. New roles are also being created simply by the application of technologies, e.g. developers taking care of chatbot programming, mentor - trainer or business analyst roles. One of the respondents' organisations plays a unique role in this question because the entire organisation was founded as a result of technological advancements, specifically the rise of the social media industry. As a result, the conclusion is that emerging technology was responsible for that company's existence as well as most of its employees' roles.

Concluding the answers, a recurring theme was the dual nature of technology – its ability to replace certain tasks or roles and its capability to create entirely new roles. The key takeaway is the adaptability of companies and their workforce to the challenges and opportunities presented by emerging technologies.

Furthermore, emerging technologies have instigated various shifts in the workplace:

- skills and competencies: there is a marked shift from traditional IT operational skills to those revolving around software and cloud operations. The importance of quick learning, adaptability, and problem-solving in the digital realm is evident.
- communication tools: tools like MS Teams have revolutionised communication and collaboration. They offer faster and more efficient modes of interaction.
- adaptability and acceptance: employees, irrespective of their tenure, go through an acceptance curve for new technologies. While initial resistance is common, eventual acceptance and reliance become the norm.
- recruitment: the modern recruitment process places a greater emphasis on adaptability, tech familiarity, and the potential to learn. The objective is to blend experience with the agility required for the modern digital age.

Managing knowledge produced by technology

The interview was concentrating on how organisations manage knowledge assets created and accumulated by technologies like AI or machine learning to investigate knowledge management produced by applied technologies. All four respondents said that their organisation is not managing such knowledge yet or that they do not have the visibility into how the AI-based tools' outputs are managed or utilised. Respondent D even mentioned that ‘the existing document management system is viewed negatively by the employees. The commitment from management towards knowledge management overall is low. Despite this, their Hungarian site is noted to be an outlier with a dedicated knowledge manager position and an ISO-certified system’.

Most of these tools generate a set of information with which they do not yet know what they can do, who will evaluate and filter the information, select the useful parts, etc. Respondents believed that management of technology-created data and knowledge is the next level of maturity they are not practising yet.

As conclusion from the responses, a clear pattern emerges regarding the management of knowledge assets generated by new technologies. Importance of awareness is mentioned by most respondents (A, B, C), they suggested either an absence or limited use of AI-generated knowledge assets in their companies. Only one of the respondents (D) cited a knowledge management tool ('Kryon') that produces vast amounts of data.

Overall, while the emergence of new technologies and tools offers potential, the effective harnessing of their outputs into actionable knowledge assets appears to be a challenge, and this challenge is enhanced by a lack of dedicated strategies and commitment.

Outlook, personal insights

Considering potential future strategies and predictions, the question raised about planned implementations of emerging technologies, especially within the next 5 years. Repondent C did not answer this particular question. Respondent A emphasised agility in response to rapid changes in the social media industry. ’A potential tool or platform may be adopted based on these changes, like TikTok.’ Respondent B predicted ’a broad transition to the cloud for most companies, accelerated by the pandemic’. Views Microsoft's suite (Teams, Office, OneDrive) as dominant in the remote work landscape. Emphasised ’the importance of proactive IT solutions like NextThink and the integration of cloud-based asset management solutions’. Highlighted the role of BPM in process automation and

improvement. According to respondent D, the aim is to ’regularly review and refine existing tools and processes, with emphasis on ISO-certified knowledge management at the Hungarian site’. Envisions continued use and potential expansion of the tools mentioned.

It can be concluded that different companies have varying focuses and planning horizon based on their sector, maturity, and business model.

Further potential areas of implementing emerging technologies in the participants’ companies are considered mainly in automation: in software development, operational processes like manufacturing or supply chain management, in financial and IT support sectors in collaboration with e.g. suppliers, particularly in invoicing and daily operations, and in administration and handling of documents.

Across the participants, there was a consensus that staying competitive in the industry is a significant motivator for adopting emerging technologies. This competitive drive is often rooted in the desire to improve productivity, efficiency, and reduce costs. Quality improvement, both in terms of reducing human error and enhancing the human experience, was another recurrent theme.

While profit and financial considerations play a significant role in the adoption of technologies (especially as mentioned by participant D), there was also an underlying sentiment about the irreplaceable value of human roles and the desire to enhance human value and happiness (especially emphasised by participant C). This reflects a balanced perspective where technological advancements are seen not just as tools for efficiency and profit but also as enablers of human-centric values and benefits.

Also, the respondents highlighted a range of concerns related to the adoption of emerging technologies. Central to these concerns is the human factor: resistance to change, fear of job loss, the need for specialised expertise, and the potential erosion of social bonds. Ethical concerns, particularly surrounding data privacy, are also prominent. Financial and strategic considerations play a role, especially concerning the cost of technology and its proven effectiveness. Effective communication, proper training, and a balance between automation and human interaction are among the solutions proposed to address these challenges. The cultural backdrop also influences how technological advancements are perceived and adopted.

6. Findings of the research

This section presents the findings of the quantitative and qualitative empirical research detailed in chapter 5, including hypotheses testing, answers to the research questions and collection of theses formulated. It describes the novelty and practical implications of the research findings and summarises limitations and future research potentials.

6.1. Hypotheses testing

In the following section hypotheses testing are presented resulting in either acceptance, partial acceptance or rejection of hypotheses. These are all based on the results of the quantitative analysis, while qualitative findings were used mainly for validation of answers to the research questions.

6.1.1. Testing H1

Hypothesis 1. There are sectoral differences in the integration of knowledge management in the context of technological capabilities and operational processes of organisations.

Based on the literature, in the process of testing H1 and its four sub-hypotheses, Crosstab, Pearson's Chi-Square, and Cramer's V have been used during the quantitative analysis to examine the relationship between sectors (based on industries, including technological intensity factors) and knowledge management.

First, companies' technological intensity of products and services and of operational processes in sectoral approach has been investigated.

Testing technological intensity of products and services, and corporate operational processes *(H1a)*, results of the analysis showed that in terms of proportions according to the sectoral approach, the services sector had the highest technological intensity of products and services, followed by the secondary then the primary sectors. This finding underscores the varying levels of technological advancement and innovation across sectors, with a pronounced emphasis on technology in the services sector.

Second, knowledge management characteristics (knowledge management strategy, projects, and impediments) were in focus.

Testing knowledge management strategy in the sectoral approach *(H1b)*, the findings indicated that there is no variation in the degree of knowledge management strategy integration by sectors. A significant majority of firms (approx. 68%), regardless of sector, do not possess a formal knowledge management strategy, suggesting a widespread underutilisation of knowledge management practices in business strategies.

Regarding knowledge management project-related potential differences by sectors *(H1c)*, the degree of knowledge management projects are implemented in the tertiary sector to a greater extent than to the other sectors. However, it is noteworthy that only a minority of firms (approx. 35%) have active knowledge management projects, indicating a gap in the adoption of these practices across all sectors.

The analysis of various impediments to knowledge management implementation *(H1d)*, revealed no significant differences across sectors. This suggests that the challenges in implementing knowledge management are universally experienced, regardless of the sector's technological intensity or nature.

Therefore, overall there is a proven finding out of testing H1, which is the following: **knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.**

The overarching finding from testing H1 is the pronounced initiation of knowledge management projects within the tertiary (services) sector compared to the primary and secondary sectors. This outcome highlights a sector-specific tendency towards knowledge management projects, particularly in sectors with higher technological intensity. The result contributes to an understanding of how sectoral characteristics influence the adoption and integration of knowledge management strategies and projects within Hungarian organisations, with a special emphasis on the role of technological intensity in these dynamics.

These findings are in line with the assumption posed based on the examined literature, that there are sectoral differences in the integration of knowledge management. It supplements the literature, as results are focusing especially on knowledge management projects in the context of technological capabilities and operational processes of organisations, where recent literature seems to be lacking.

6.1.2. Testing H2

Hypothesis 2. Sectoral and ownership-related differences have relationship with permitted and used knowledge management technologies.

During the quantitative study to investigate the relationship between sectoral and ownership-related approach and knowledge management technologies, the following statistical tests were used: Crosstab, Pearson's Chi-Square, and Cramer's V.

Testing knowledge management technologies in the sectoral approach *(H2a)*, conclusion was drawn that most of the significant relationships found between knowledge management practices and sectors are confirming that these knowledge management practices are used in a greater extent within the tertiary sector.

Checking knowledge management technologies in the ownership approach *(H2b)*, it was found that there is a significant relationship between only a few of the knowledge management practices applied and ownership type of the companies (external professional communities are used to a significantly greater extent by foreign companies' subsidiaries, external messaging network technologies are used significantly greater extent by purely domestic companies).

To conclude finding out of testing H2, it has been proven that **knowledge management practices are permitted and used to a greater extent within the tertiary sector.**

These results show partial consistency with the expectation based on the literature, that sectoral and ownership-related differences have relationship with permitted and used knowledge management practices, as sectoral difference has been proven.

6.1.3. Testing H3

Hypothesis 3. The integration of knowledge management strategies has relationship with the information sources employees using to solve problems.

The following statistical analyses were employed in the quantitative study to investigate the relationship between knowledge management strategy implementation and information gathering by employees, therefore to test H3: One-way ANOVA, Levene statistic, Tamhane and Scheffe post-hoc tests.

The analysis suggested that employees are more likely to turn to their colleagues for information when a knowledge management strategy is part of the corporate strategy, as

opposed to when there is no such strategy or when it is merely a sub-strategy of an independent area. This indicates that a more integrated knowledge management strategy fosters a culture of internal knowledge sharing and collaboration.

Conversely, the more integrated the corporate strategy is, the less likely employees are to turn to external sources for information. This suggests that a well-embedded knowledge management strategy may make internal resources more accessible or perceived as more reliable, reducing the need to seek external information.These findings are aligned with the suggestions based on the literature.

The organisational database is used more when the knowledge management strategy is more integrated *(H3a)*, according to the results of the one-way ANOVA. This implies that comprehensive knowledge management strategies may enhance the organisation, accessibility, and utility of internal databases, making them a preferred source of information.

Furthermore, out of the results of Chi-square analysis it can be stated that the higher the overall knowledge management strategy implementation level, the higher the possibility that employees use more emerging technologies *(H3b)*. The integration of technologies like business intelligence applications, which are associated with significant differences in information-seeking behavior, should be done thoughtfully to ensure they complement existing workflows and enhance organisational knowledge sharing.

In conclusion, main findings of this part of the analyses are that **the higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need**, and that **the higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies**.

The hypothesis underscores the role of knowledge management strategies in shaping information-seeking behaviours within organisations. It suggests that a well-integrated strategy not only promotes internal knowledge sharing and utilisation of organisational resources but also potentially reduces reliance on external sources, which could have implications for efficiency, information reliability, and knowledge retention within the organisation.

6.1.4. Testing H4

Hypothesis 4. There is relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes.

In the process of testing H4, Crosstab, Pearson's Chi-Square, and Cramer's V have been utilised during the quantitative analysis to examine the relationship between emerging technologies and knowledge management strategies, projects, and the technological intensity of products, services, and operational processes.

The findings showed correlation between the number of emerging technologies utilised by an organisation and the implementation level of its knowledge management strategy and projects. This suggests that organisations employing a greater variety of technologies are more likely to have advanced and effective knowledge management strategies and projects in place. This aspect of the thesis highlights the critical role of technology in enhancing the capability of organisations to manage and leverage knowledge effectively.

The analysis also revealed that the number of technologies in use correlates to the level of technological intensity of products and services. This finding underscores the idea that the adoption of a diverse range of emerging technologies contributes to the development and offering of technologically advanced products and services, thereby enhancing the organisation's competitive edge in the market.

Similarly, relationship is observed in the technological intensity of operational processes within organisations. This indicates that the integration of multiple emerging technologies leads to more technologically sophisticated operational processes, potentially improving efficiency, innovation, and overall operational excellence.

The study also examined the relationship between the number of technologies in use and information-seeking behaviour of employees within organisations. It was found that the higher the number of technologies the more the employees turn to their colleagues and check the organisational database in case of information needs. However, interestingly, the extent of turning to external sources had no relationship with the number of technologies in use, indicating no significant correlation in this aspect.

The key findings from testing H4 is that **the volume of emerging technologies used by an organisation is closely linked to knowledge management strategies and projects.**

Furthermore, **the volume of emerging technologies in use correlates with the technological intensity of both products and services, as well as corporate operational processes**.

Findings are aligned with the assumption formulated based on related literature. This suggests that organisations that embrace a variety of emerging technologies are more likely to develop advanced knowledge management practices and to create products and services with higher technological sophistication. It also adds emphasis on the critical role of strategic technology integration in driving competitive advantage and operational excellence.

6.1.5. Testing H5

Hypothesis 5. The adoption of emerging technologies in organisations is influenced by organisational characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes).

During of testing H5, PLS, Durbin-Watson test, and VIF have been used to investigate the potential influence of organisational characteristics to the volume of emerging technologies in use.

According to the analyses, it was concluded that the volume of the used emerging technologies is mostly influenced by the implementation level of the knowledge management project, followed by the net income (after all, this has to be financed from something) and the technological intensity of the product and services.

Therefore, the proven finding out of testing H5 is that **the adoption of emerging technologies in organisations is predominantly influenced by internal factors such as the level of implementation of knowledge management projects, the organisation's net income, and the technological intensity of its products and services.**

The findings imply that organisations seeking to increase their adoption of emerging technologies should focus on enhancing their knowledge management practices and ensuring sufficient financial resources, rather than relying solely on their size or scale. This finding provides valuable insights for organisational leaders and policymakers aiming to foster a more technologically advanced and innovative business environment.

The following table demonstrates the summary of hypotheses testing and their results.

	Hypotheses	Result
H1: There are sectoral differences in the integration of knowledge management in the context of technological capabilities and operational processes of organisations.		PARTIALLY ACCEPTED
H1a:	Technological intensity of products and processes is the highest within the secondary (manufacturing) sector.	REJECTED
H1b:	Knowledge management strategy is implemented within the tertiary (services) sector to a greater extent than within the other sectors.	REJECTED
H1c:	Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.	ACCEPTED
H1d:	Impediments due to the lack of knowledge management strategy or project are different depending on sectors.	REJECTED
H2: Sectoral and ownership-related differences have relationship with permitted and used knowledge management practices.		PARTIALLY ACCEPTED
H2a:	Knowledge management practices are permitted and used to a greater extent within the tertiary sector.	ACCEPTED
H2b:	Knowledge management practices are permitted and used to a greater extent by subsidiaries of foreign companies.	REJECTED
H3: The integration of knowledge management strategies has relationship with the information sources employees using to solve problems.		ACCEPTED
H3a:	The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.	ACCEPTED
H3b:	The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.	ACCEPTED
H4: There is relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes.		PARTIALLY ACCEPTED
H4a:	There is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects.	ACCEPTED
H4b:	There is relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes.	ACCEPTED
H4c:	There is relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees.	PARTIALLY ACCEPTED
H5: The adoption of emerging technologies in organisations is influenced by organisational characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes).		PARTIALLY ACCEPTED

Table 75. Summary of hypotheses tests with results

Source: own edition

Overall, out of the five main hypotheses one was fully accepted and four were partially accepted due to some rejected sub-hypotheses.

6.2. Additional results

Impact of COVID-19 on the Adoption of Emerging Technologies

This dissertation extends its analysis beyond the hypotheses to explore the nuanced dynamics of how the COVID-19 pandemic has accelerated the adoption and utilisation of emerging technologies across various sectors. Utilising a comprehensive quantitative methodology, which included Crosstab, Pearson's Chi-Square, and Cramer's V tests, the investigation delved into the shifts in technology usage patterns precipitated by the global crisis. Based on previous findings in related research it was predicted that the pandemic served as a catalyst for increased deployment of emerging technologies.

The analytical outcomes revealed a statistically significant correlation with a subset of the technologies that had been previously identified, indicating an augmentation in the engagement with a broad spectrum of emerging technologies. Notably, findings resulted in significant relationship with some of the pre-listed technologies, and there was an overall increase in the usage in majority of the emerging technologies. Furthermore, the top technologies (collaborative technologies, business intelligence application, MIS, big data, data mining, IoT and chatbots) showed growth due to the pandemic regardless of sectors.

This trend reflects a broader digital transformation driven by the pandemic, as organisations and sectors as a whole turn to emerging technological solutions to adapt to the new normal. The extensive use of these technologies not only reflects a tactical response to immediate operational challenges but also indicates a strategic realignment towards a more resilient and agile operational paradigm.

6.3. Answers to research questions

The research aimed to provide understanding on the multifaceted dimensions of knowledge management and its interplay with various factors, including the influence of external and internal characteristics of organisations and emerging technologies.

Starting with **RQ1**, the study sought to discern how different sectors approach and integrate knowledge management in the context of their technological capabilities and operational processes. The overarching hypothesis suggested that there are sectoral differences in the integration of knowledge management in the context of their technological capabilities and operational processes, which was partially accepted.

Delving deeper, the research found that the technological intensity of products and processes was not the highest within the manufacturing sector, contrary to the initial hypothesis. Interestingly, while it was hypothesised that the tertiary (services) sector would implement knowledge management strategies and initiate projects to a greater extent than other sectors, only the latter was accepted.

RQ2 aimed to understand the relationship between sectoral and ownership-related differences on the implementation of permitted knowledge management technologies. The results were mixed. Knowledge management practices were found to be more prevalent in the tertiary sector. However, contrary to expectations, subsidiaries of foreign companies did not use these practices more than domestic entities.

RQ3 explored the relationship between knowledge management strategies and information gathering by employees. The findings were affirmative. Higher implementation of knowledge management strategy resulted in employees relying less on external sources for information. Furthermore, a strong correlation was found between the level of knowledge management strategy implementation and the likelihood of employees using more emerging technologies.

RQ4 delved into the relationship between emerging technologies and knowledge management. The research found that there is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects, as well as technological intensity of their products and services, and corporate operational processes.

Lastly, **RQ5** sought to identify the factors influencing the adoption of emerging technologies. Organisational characteristics, including company size, income, and the presence of a knowledge management project, were found to have a partial influence on the adoption of emerging technologies.

In conclusion, the research provided invaluable insights into the intricate dynamics of knowledge management and its interrelation with various sectors, emerging technologies. The findings underscore the importance of adapting to technological advancements and understanding sectoral differences to harness the full potential of knowledge management.

6.4. Collection of Theses

Thesis 1 posits that the technological intensity of products and processes is highest within the tertiary (services) sector. Contrary to the initial hypothesis that the manufacturing sector would dominate in this regard, the research findings underscore the pivotal role of the services sector in driving technological intensity. This shift can be attributed to the rapid digital transformation and the increasing reliance on technology-driven solutions in service delivery.

Thesis 1. *Technological intensity of products and processes is the highest within the tertiary (services) sector.*

Thesis 2 emphasises that knowledge management projects are predominantly initiated within the tertiary sector. This aligns with the growing recognition of the importance of knowledge as a critical asset in service-oriented industries. The emphasis on knowledge management projects in this sector underscores the need for continuous learning, innovation, and adaptation to changing market dynamics.

Thesis 2. *Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.*

Thesis 3 and Thesis 4 examine into the different aspects of knowledge management practices. While the research confirms that these practices are more prevalent in the tertiary sector, it challenges the notion that subsidiaries of foreign companies are more inclined towards these practices than domestic entities. This finding suggests that local companies are equally, if not more, proactive in harnessing knowledge management practices to drive organisational success.

Thesis 3. *Knowledge management practices are permitted and used to a greater extent within the tertiary sector.*

Thesis 4. *Ownership type influences participation in external professional communities (are used to a significantly greater extent by foreign companies' subsidiaries) and usage of external messaging network technologies (are used significantly greater extent by purely domestic companies).*

Thesis 5 highlights the relationship between knowledge management strategies and employees' information-seeking behaviours. A higher implementation of knowledge management strategy correlates with a reduced reliance on external information sources.

Furthermore, a robust knowledge management strategy encourages employees to embrace emerging technologies, emphasising the mutual benefits between strategic planning and technological adoption.

Thesis 5. *Implementation of knowledge management strategies has relationship with information gathering by employees.*

The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.

The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.

Thesis 6 encapsulates the relationship between emerging technologies and knowledge management. The volume of these technologies in use directly impacts the integration of knowledge management strategies and projects. Moreover, it influences the technological intensity of products, services, and corporate operational processes.

Thesis 6. *Organisations that utilise higher volume of emerging technologies will exhibit more advanced knowledge management strategies and projects.*

A greater volume of emerging technologies adopted by organisations correlates with increased technological intensity of products and services and corporate operational processes.

Overall summary of the research, including research questions, hypotheses, measurement and theses are presented in the following table.

Summary of the research

Research questions		Hypotheses		Results	Methods	Theses
RQ1: How different sectors approach and integrate knowledge management in the context of their technological capabilities and operational processes?		H1: There are sectoral differences in the integration of knowledge management in the context of technological capabilities and operational processes of organisations.		PARTIALLY ACCEPTED	Crosstab: Pearson's Chi-Square, Cramer's V	
RQ1a:	Are there any sectoral differences with regards to technological intensity of products and processes?	H1a:	Technological intensity of products and processes is the highest within the secondary (manufacturing) sector.	REJECTED	Crosstab: Pearson's Chi-Square, Cramer's V	Thesis 1. Technological intensity of products and processes is the highest within the tertiary (services) sector.
RQ1b:	Are there any sectoral differences with regards to knowledge management strategy?	H1b:	Knowledge management strategy is implemented within the tertiary (services) sector to a greater extent than within the other sectors.	REJECTED	Crosstab: Pearson's Chi-Square	
RQ1c:	Are there any sectoral differences with regards to knowledge management project?	H1c:	Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.	ACCEPTED	Crosstab: Pearson's Chi-Square	Thesis 2. Knowledge management projects are initiated within the tertiary (services) sector to a greater extent than within the other sectors.
RQ1d:	Are there any sectoral differences with regards to impediments due to missing knowledge management?	H1d:	Impediments due to the lack of knowledge management strategy or project are different depending on sectors.	REJECTED	Crosstab: Pearson's Chi-Square, Cramer's V	

(table continued) **Research questions**	*(table continued)* **Hypotheses**	*(table continued)* **Results**	*(table continued)* **Methods**	*(table continued)* **Theses**
RQ2: How is the relationship between sectoral and ownership-related differences and the implementation of permitted knowledge management technologies?	H2: Sectoral and ownership-related differences have relationship with permitted and used knowledge management practices.	PARTIALLY ACCEPTED	Crosstab: Pearson's Chi-Square, Cramer's V	
	H2a: Knowledge management practices are permitted and used to a greater extent within the tertiary sector.	ACCEPTED	Crosstab: Pearson's Chi-Square, Cramer's V	Thesis 3. Knowledge management practices are permitted and used to a greater extent within the tertiary sector.
	H2b: Knowledge management practices are permitted and used to a greater extent by subsidiaries of foreign companies.	REJECTED	Crosstab: Pearson's Chi-Square, Cramer's V	Thesis 4. Ownership type influences participation in external professional communities (are used to a significantly greater extent by foreign companies' subsidiaries) and usage of external messaging network technologies (are used significantly greater extent by purely domestic companies).

(table continued) **Research questions**		*(table continued)* **Hypotheses**		*(table continued)* **Results**	*(table continued)* **Methods**	*(table continued)* **Theses**
RQ3: How is the relationship between knowledge management strategies and information gathering by employees?		H3:	The integration of knowledge management strategies has relationship with the information sources employees using to solve problems.	ACCEPTED	One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe	Thesis 5. Implementation of knowledge management strategies has relationship with information gathering by employees.
RQ3a:	Is there a relationship between knowledge management strategies and information sources of employees?	H3a:	The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.	ACCEPTED	One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe	The higher the knowledge management strategy implementation the lower the possibility that employees turn to external sources in case of information need.
RQ3b:	Is there a relationship between knowledge management strategies and the implementation of emerging technologies?	H3b:	The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.	ACCEPTED	One-way ANOVA, Levene statistic, Tamhane post-hoc test, Scheffe	The higher the knowledge management strategy implementation the higher the possibility that employees use more emerging technologies.

(table continued) **Research questions**		*(table continued)* **Hypotheses**		*(table continued)* **Results**	*(table continued)* **Methods**	*(table continued)* **Theses**
RQ4: How is the relationship between emerging technologies in use and knowledge management?		H4:	There is relationship between emerging technologies in use and knowledge management strategies and projects, as well as technological intensity if products and processes.	PARTIALLY ACCEPTED	Crosstab: Pearson's Chi-Square, Cramer's V, Pearson correlation	Thesis 6. Organisations that utilise higher volume of emerging technologies will exhibit more advanced knowledge management strategies and projects. A greater volume of emerging technologies adopted by organisations correlates with increased technological intensity of products and services and corporate operational processes.
RQ4a:	Is there a relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects?	H4a:	There is relationship between the volume of emerging technologies used by organisations and the level of implementation of their knowledge management strategies and projects.	ACCEPTED	Pearson correlation	
RQ4b:	Is there a relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes?	H4b:	There is relationship between the volume of emerging technologies used by organisations and technological intensity of their products and services, as well as corporate operational processes.	ACCEPTED	Pearson correlation	
RQ4c:	Is there a relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees?	H4c:	There is relationship between the volume of emerging technologies used by organisations and information-seeking sources of their employees.	PARTIALLY ACCEPTED	Pearson correlation	
RQ5: Which characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes) influence the adoption of emerging technologies in organisations?		H5:	The adoption of emerging technologies in organisations is influenced by organisational characteristics (company size, income, knowledge management project & strategy, technological intensity of products and processes).	PARTIALLY ACCEPTED	PLS, Durbin-Watson test, VIF	

Table 76. Research summary

Source: Own edition

6.5. Novelty of the research

The field of academic research is continually evolving, with scholars striving to address gaps, introduce new methodologies, and provide fresh perspectives on existing knowledge. This section is to highlight novelty and innovation encompassed within this dissertation centred on knowledge management, digitalisation and emerging technologies in Hungary.

New, novel results

One of the primary novelties of this research is its extensive sample-based quantitative analysis pertaining to knowledge management in Hungary that fills a critical gap in the literature. Such a comprehensive approach ensures a robust and representative understanding of the subject.

The research introduces the application of a new analysis technique, namely Partial Least Squares Structural Equation Modelling (PLS-SEM), in the context of knowledge management. This advanced statistical method offers a nuanced understanding of complex relationships.

The research delves into the intricate relationship between organisational knowledge management and emerging technologies, providing insights into how the two domains intersect and influence each other which was underexplored in existing research. The detailed investigation into sector-specific technological intensity and its influence on knowledge management provides a more granular understanding than the broader analyses typically found in the literature.

The dissertation contributes to the advancement of innovation studies by expressing relationships among constructs that are autonomous (organisational knowledge management, emerging technologies) and do not appear to be to be not well-connected in the literature yet. The study newly establishes a detailed exploration of various relationships, such as the relationship between sectors and the technological intensity of products, services, operational processes, knowledge management projects, and the application of knowledge management practices. It also examines the influence of ownership type on participation in external professional communities and the usage of external messaging network technologies. According to the literature review, this has not yet been investigated in such form before.

Innovative Aspects of the Research

Building upon previous studies, this research offers a renewed examination of knowledge management practices in Hungary including an extensive and representative sample, ensuring that the findings are up-to-date and relevant.

The study provides an unprecedented overview of the current status of knowledge management in Hungary. It investigates various facets, including technological intensity, knowledge management strategies, projects, initiators, and the primary challenges that hinder the implementation of knowledge management within Hungarian companies.

The research offers a holistic understanding of digitalisation, especially from a sectoral perspective. It also ensures a comparative analysis with findings of public reports by the European Union (e.g., DESI, EIBIS). However, this research takes a step further by dissecting the implications of these findings for Hungarian organisations specifically, thereby offering targeted insights that have practical relevance and applicability.

Furthermore, it also assesses the impact of the COVID pandemic on the increased usage of emerging technologies and the association between knowledge management strategy implementation and the information sources utilised by employees, with a particular focus on external information sources and emerging technologies.

In conclusion, this PhD research introduces novel methodologies, exploring uncharted relationships, and building upon previous studies. This research not only addresses current gaps but also lays a solid foundation for subsequent studies. It paves the way for exploring the potential benefits of applying knowledge management from a practical standpoint, such as e.g. the development of an emerging technologies based knowledge management maturity model.

6.6. Practical implications

As technology advances, businesses are becoming more flexible and adaptable to change, even at the strategic level. In the evolving landscape of business, the relationship between knowledge management and technological adoption has emerged as a critical determinant of organisational efficacy. The research offers significant implications for enterprises.

The analysis of sectoral differences in knowledge management integration, particularly in the context of technological intensity and operational processes, underscores the necessity for a sector-specific approach in organisational strategy development. The

finding that technological intensity is most pronounced within the services sector within the examined organisations from Hungary underscores the sector's pivotal role in driving innovation and adaptation. Organisations operating within this domain are thus forced to continually invest in technological advancements, ensuring they remain at the forefront of service delivery and operational efficiency. The emphasis on knowledge management initiatives within the tertiary sector highlights the sector's recognition of knowledge as a key asset. This suggests a pressing need for organisations to foster a culture that values continuous learning, promotes knowledge sharing, and implements systems for knowledge management. The universal challenges in implementing knowledge management, regardless of the sector's technological intensity, indicate a common set of barriers that organisations face. By developing a culture that values knowledge sharing and continuous learning, organisations can minimise these impediments and maximise the potential of their human capital.

Interestingly, the research challenges the notion that subsidiaries of foreign companies are more inclined towards knowledge management practices than domestic entities. This finding underscores the universality of knowledge management practices, suggesting that their adoption is not strictly contingent upon organisational origin.

In addition, the democratisation of technology through digital transformation offers smaller businesses the opportunity to compete on a larger scale. By leveraging cloud computing, AI, and other emerging technologies, smaller firms can offer innovative services and products that were previously the domain of larger corporations. This levels the playing field and fosters a more dynamic and competitive business environment.

The marked influence of the COVID-19 pandemic on the adoption of emerging technologies provides a clear directive for organisations. In an era marked by remote work and digital collaboration, the integration of collaborative tools has transitioned from being a luxury to a necessity. Organisations must, therefore, be proactive in taking the initiative to apply these technologies to ensure agility, business continuity and effective stakeholder communication.

The alignment of knowledge management strategies with employee information-seeking behaviours emerges. Organisations are responsible for making sure that their knowledge management strategies resonate with the informational needs of their employees. This alignment not only optimises information flow and reliability but also enhances overall organisational efficiency.

The research underscores the significance of digital literacy not just among employees but also within leadership teams. Leaders must understand the potential and limitations of emerging technologies to make informed decisions that drive digital transformation efforts. This leadership digital literacy is pivotal in navigating the complexities of the digital landscape and steering organisations towards successful digital adoption.

Lastly, the relationship between emerging technologies and knowledge management is evident. The integration of cutting-edge technologies can significantly amplify knowledge management processes, enabling organisations to derive actionable insights and foster innovation. Organisations should focus on strengthening their internal capabilities and ensuring adequate financial resources to support the adoption of emerging technologies, thereby enhancing their technological intensity and operational excellence.

However, the advancements that promise increased efficiency, innovation, and competitiveness come with major challenges. The human challenge, including the digital skills gap and resistance to change, directly opposes the need for a digitally literate workforce and leadership essential for leveraging emerging technologies. Technological challenges, such as the digital divide and security concerns, hinder the seamless integration of collaborative tools and advanced technologies crucial for remote work and digital collaboration.

Financial constraints pose a barrier to the required investments in technology, contrasting with the need for substantial financial commitment to foster innovation and digital growth. Organisational rigidity and a traditional attitude resist the cultural shift towards continuous learning and knowledge sharing, which are vital for digital adaptation. Legal and environmental barriers could further complicate the adoption of emerging technologies, highlighting the need for supportive regulations and government investment in digital infrastructure.

Addressing these challenges requires a multi-faceted approach, including enhancing digital literacy, fostering a culture of adaptability, securing necessary financial resources, and advocating for supportive legal and environmental frameworks. By acknowledging and tackling these barriers, organisations can fully harness the benefits of digital transformation and navigate the complexities of the digital era.

6.7. Limitations & future research

This research offers interesting insights, but it is also limited by some constraints. This part of the dissertation is to emphasise limitation and future research potentials.

6.7.1. Limitations

This research offers interesting insights, but it is also limited by some constraints. The empirical investigation encountered limits, as indicated by the partial fulfilment of hypotheses and the interpretation of the findings.

Regarding the reliability of the findings from the questionnaire study, it is pertinent to highlight that the responses measured via the Likert-scale utilised a four-point continuum. Consequently, the inherent nature of this scale introduces a degree of inherent bias that cannot be completely eliminated from the respondents' results.

Furthermore, the duration allocated for completing the questionnaire was not standardised. As a result, the extent to which each participant deliberated over their responses, or approached the fulfilment routinely, may introduce bias. The process of interpreting questions in a questionnaire, that is, the decoding by respondents, invariably leads to a subjective distortion. The reliability of the described results can be increased with the help of additional post qualitative-quantitative research, with additional expert interviews, or by repeating the questionnaire at a later date.

During the qualitative part of the research, direct sampling indicated limitations. Due to this sampling method, the sample can be biased since it relies on social networks. People often know others who are similar to them, which might not represent the diversity within the larger population. The researcher has less control over the sampling process as compared to probability sampling techniques. Furthermore, results from direct sampling are not statistically generalisable to the wider population due to the non-random nature of sample selection.

Interviews, especially the applied semi-structured interviews hold limitations, too. Even though questions were asked consistently, and the same timeframe was dedicated to each interviews, the method itself gives the flexibility to the interviewer to introduce bias in case of unintentional lead of the participant towards certain answers. Additionally, as many of the qualitative methods, findings of these semi-structured interviews are not generalisable to larger populations.

Altogether, the findings' comparability with other countries is limited since it focuses on the present and future of knowledge management and knowledge workers in light of emerging technologies in Hungarian companies. The sample was white-collar worker centric. Due to the nature of this study, it does not intend to generalise its findings, but to get deep knowledge of the participated organisations' practice within knowledge management and its relation to emerging technologies based on the focus aspects defined by the researcher in Hungary.

6.7.2. Future research

As further study, in order to generalise findings, other countries could be analysed with the same hybrid-approach, building on quantitative methodology with large sample and applying qualitative approach for the in-depth understanding and validation of the results out of the quantitative part to make it possible to explore the topic.

Results of the current study would make it possible to analyse and make conclusions regarding potential individual and organisational influencing factors on knowledge sharing.

A possible research scope extension to cultural peculiarities would allow to conclude potential further differences on knowledge management by countries classified into cultural blocks based their organisational culture.

Another future research using longitudinal data is recommended. By repeating the quantitative research at a later time or even repeating it at regular intervals would open the possibility to explore changes and connections caused by them between digitisation and knowledge management. The aim of the research is to improve the knowledge management practice of Hungarian organisations getting to know it more precisely, identifying the direction of changes and development.

A possible future research option is to conclude the findings of the current study in a maturity model based on some characteristics (e.g. volume of emerging technologies in use) and create profiles that would give the benefit to score the Hungarian organisations. Creation and implementation of such maturity model would allow comparison of knowledge management practices supported by emerging technologies of organisations.

7. Discussion and conclusion

The main goal of the dissertation was to provide a thorough, meaningful, and practical exploration of interaction between organisational knowledge management and emerging technologies in the context of digital transformation in Hungary.

The research provides new insights into important aspects to the understanding knowledge management in the light of emerging technologies within Hungarian organisations.

In conclusion, it presented invaluable insights into the dynamics of knowledge management and its interrelation with various sectors, organisational ownership, company characteristics, emerging technologies, and in addition, global events like the COVID-19 pandemic.

Findings of the quantitative research showed that there are sectoral differences in the integration of knowledge management in the context of technological intensity, products and processes in the tertiary (services) sector exhibit the highest level of technological intensity. Significant relationship has been found between knowledge management projects and the tertiary sector. The services sector, also stands out in terms of the adoption of knowledge management practices. This indicates that businesses within this sector are more inclined to integrate advanced technologies into their operations and are more proactive in employing knowledge management strategies to enhance their services and processes.

The deployment of knowledge management strategies is linked to how employees gather information. With more comprehensive implementation of KM strategies, employees are less likely to seek information from external sources. Additionally, a higher level of strategy implementation increases the likelihood of employees leveraging emerging technologies for information needs. Thus, the effectiveness of knowledge management strategies within an organisation directly influences employees' information-seeking behaviors, encouraging a shift towards internal resources and the adoption of innovative technologies for their informational requirements.

Study revealed also that there is a clear link between the extent of emerging technology usage within organisations and the advancement of their knowledge management strategies and projects, along with an enhancement in the technological intensity of their products and services and corporate operational processes.

Findings out of the qualitative research enhances understanding findings of the quantitative research. They show that knowledge management and emerging technologies are essential in the practices of the analysed organisations. However, in some cases, external motivations such as competition, automation and the emerging need to support white-collar employees collaborating remotely worldwide, knowledge sharing, and effective use of resources prompted companies to increase their use of emerging technologies, and pressured companies to increase their use of recently available technologies.

Besides the external motivator factors, increasing interest in technology utilisation is observed mainly in order to rearrange the usage of valuable human resources and re-skill or upskill them from doing low value-added, repetitive and transactional tasks to higher value-added, creative, human intelligence-demanding activities. AI has been discovered to be more prevalent in bots and automation, with applications in HR, finance, IT service management, IT processes such as programming and development, marketing and communication, and insurance operations.

These findings underscore the importance of adapting to technological advancements and understanding sectoral differences to harness the full potential of knowledge management.

8. References

1. Abonyi, J. – Miszlivetz, F. (2016): Hálózatok metszéspontjain: A negyedik ipari forradalom társadalmi kihívásai. Savaria University Press, ISBN 978-615-5251-65-8
2. Ackoff, R. L. (1989): From Data to Wisdom. Journal of Applied Systems Analysis, 16, pp. 3-9.
3. Adamopoulou, E. – Moussiades, L. (2020): Chatbots: History, technology, and applications. Machine Learning with Applications, Vol. 2.
4. Adler, P. S. (1995): Comment on I. Nonaka: Managing innovation as an organizational knowledge creation process. In J. Allouche & G. Pogorel (Eds.), Technology management and corporate strategies: A tricontinental perspective, Amsterdam, Elsevier, pp. 110-124.
5. Adomako, S. (2021): Resource-induced coping heuristics and entrepreneurial orientation in dynamic environment. Journal of Business Research, Vol.122, pp. 477–487.
6. Akhavan, P. – Ebrahim, N. A. – Fetrati, M. A. – Pezeshkan, A. (2016): Major trends in knowledge management research: a bibliometric study. Scientometrics, Vol.107, pp. 1249–1264. doi: 10.1007/s11192-016-1938-x
7. Alashwal, A. M. – Abdul-Rahman, H. – Radzi, J. (2016): Knowledge utilization process in highway construction projects. Journal of Management in Engineering, 32(4), 05016006.
8. Alavi, M. – Leidner, D. E. (2001): Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. MIS quarterly, 25(1), pp. 107-136.
9. Al-Emran, M. – Mezhuyev, V. – Kamaludin, A. – Shaalan, K. (2018): The impact of knowledge management processes on information systems: A systematic review. Int. J. Inf. Manag., 43, pp. 173–187.
10. Allameh, S.M. – Zare, S.M. (2011): Examining the impact of KM enablers on knowledge management processes. Procedia Comput. Sci. 3, pp. 1211–1223.
11. Ali, A. A. – Paris, L. – Gunasekaran, A. (2019): Key factors influencing knowledge sharing practices and its relationship with organizational performance

within the oil and gas industry. Journal of Knowledge Management 23, pp. 1806–1837. doi: 10.1108/jkm-06-2018-0394

12. Al-Shanti, M. A. (2017): The role of transformational leadership on the knowledge management: An applied study on the employees in the Palestinian interior ministry-Gaza strip. The Jordan Journal of Business Administration, 13(3), pp. 435-459.
13. Al-Tit, A. A. (2016): The mediating role of knowledge management and the moderating part of organisational culture between HRM practices and organisational performance. International Business Research, 9(1), 43.
14. Amayah, A.T. (2013): Determinants of knowledge sharing in a public sector organisation. Journal of Knowledge management, 17(3), pp. 454-471, doi: 10.1108/JKM-11-2012-0369
15. Anklam, P. (2009): Ten years of net work. The Learning Organization, 16(6), pp. 415-426. https://doi.org/10.1108/09696470910993909
16. 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), pp. 323–346. https://doi.org/10.1108/BPMJ-04-2017-0088.
17. Argote, L. (2013): Organizational Learning: Creating, Retaining and Transferring Knowledge. Springer.
18. Argote, L. – Ingram, P. (2000): Knowledge transfer: A basis for competitive advantage in firms. Organizational behavior and human decision processes, 82(2), pp. 150-69.
19. Astorga-Vargas, M. A. – Flores-Rios, B. L. – Licea-Sandoval, G. – Gonzalez-Navarro, F.F. (2017): Explicit and tacit knowledge conversion effects, in software engineering undergraduate students. Knowledge management Research & Practice. Vol. 15, pp. 336–345.
20. Atkinson, R. D. (2018): Emerging Technologies and Preparing for the Future Labor Market. Information Technology & Innovation Foundation
21. Awad, E. M. – Ghaziri, H. M. (2004): Knowledge management. Upper Saddle City, NJ, Pearson Educational International
22. Babbie, E. (1996): A társadalomtudományi kutatás gyakorlata. Balassi Kiadó, Budapest

23. Badawy, T. A. E. – Marwan, R. – Magdy, M. M. (2015): The Impact of Emerging Technologies on Knowledge Management in Organizations. International Business Research, Vol. 8, No. 5, pp. 111- 119.
24. Bair, J. (2004): Making Knowledge Work, Chapter 4. KM technologies that work, How to Maximise the Value of Portals, Collaboration and Information Systems; Ark Group, London, pp. 63-79.
25. Bakacsi, Gy. (2000): Stratégiai emberi erőforrás menedzsment. KJK-KERSZÖV Jogi és Üzleti Kiadó Kft, Budapest
26. Balaton, K. – Dobák, M. (1991): Mennyiségi és minőségi módszerek az empirikus szervezetkutatásban. (Antal-Mokos, Z., Drótos, Gy., Kovács, S. (szerk.): Módszertani gyűjtemény a vezetés és szervezés tárgyhoz) Aula Kiadó, Budapest
27. Baloh, P. – Desouza, K. C. – Paquette, S. (2011): The concept of knowledge. In: K. C. Desouza and S. Paquette (Eds.), Knowledge Management: An Introduction, New York: NY: Neal-Schuman Publishers, Inc., pp. 35-71.
28. Baptista, J. – Stein, M.K. – Klein, S. – Watson-Manheim, M.B. – Lee, J. (2020): Digital work and organisational transformation: emergent digital/human work configurations in modern organisations. The Journal of Strategic Information Systems, Vol. 29 No. 2, doi: 10.1016/j.jsis.2020.101618.
29. Bartol, K. M. – Srivastava, A. (2002): Encouraging knowledge sharing: The role of organizational rewards systems. Journal of Leadership and Organization Studies, 9(1), pp. 64−76.
30. Baxter, P. – Jack, S. (2008): Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. The Qualitative Report, 13(4), pp. 544-559.
31. BCG (2015): How will technology transform the industrial workforce through 2025?. Man and Machine in Industry 4.0, The Boston Consulting Group.
32. Beckett, A.J. – Wainwright, C.E.R. – Bance, D. (2000): Knowledge management: strategy or software?. Management Decision, Vol 38, No. 9, pp. 601-606.
33. Behringer, N. – Sassenberg, K. (2015): Introducing social media for knowledge management: Determinants of employees' intentions to adopt new tools. Computers in Human Behavior, vol. 48, pp. 290-296.
34. Bereznoy, A. – Meissner, D. – Scuotto, V. (2021): The intertwining of knowledge sharing and creation in the digital platform based ecosystem. A conceptual study

on the lens of the open innovation approach. Journal of Knowledge management, Vol. 25 No. 8, doi: 10.1108/JKM-10-2020-0769.

35. 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, Vol 1, pp 329–355.
36. Blanchet, M. – Rinn, T. (2016): The Industrie 4.0 Transition Quantified. Roland Berger Think Act, Munich
37. Becerra-Fernandez, I. – Sabherwal, R. (2015): Knowledge management: Systems and processes. Routledge.
38. Belisle, C. (2006): Literacy and the digital knowledge revolution.
39. Bencsik, A. – Hargitai, D. M. (2023): Human Aspects of Digitalisation. 4th International Scientific Conference on Innovations in the Digital Economy, Communications in Computer and Information Science series (SPRINGER), under release.
40. Bencsik, A. (2016): A tudásmenedzsment elméletben és gyakorlatban. Akadémiai Kiadó. ISBN: 978 963 059 784 5
41. Bencsik, A. (2021): The sixth generation of knowledge management – the headway of artificial intelligence. Journal of International Studies, Volume 14, Issue 2, pp. 84-101.
42. Bencsik, A. (2021): Vezetői felkészültség felmérése a digitális kor kihívásaira. Nemzetközi összehasonlítás. Vezetéstudomány-Budapest Management Review, 52(4), pp. 93-108. https://doi.org/10.14267/VEZTUD.2021.04.08
43. Birkinshaw, J. – Bouquet, C. – Barsoux, J-L. (2011): The 5 Myths of Innovation. MIT Sloan Management Review. 52. pp. 43-50.
44. Bloomfire Blog (2023): The Role of Knowledge Management in the Business Service Industry. Available at https://bloomfire.com/blog/knowledge-management-in-the-service-industry/
45. Bochulia, T. (2021): Digital business transformation: Trends, innovative models, a development program. E3S Web of Conferences 307, 02001, https://doi.org/10.1051/e3sconf/202130702001
46. Boisot, M.H. (1998): Knowledge Assets: Securing Competitive Advantage in the Information Economy. Oxford University Press, New York, NY.

47. Boon, W. – Moors, E. (2008): Exploring emerging technologies using metaphors - A study of orphan drugs and pharmacogenomics. Social Science & Medicine, 66(9), pp. 1915–1927.
48. Bordeianu, O. (2015): The role of knowledge management and knowledge management strategies within learning organizations. Ecoforum, 4(1), pp. 1–21.
49. Buntak, K., Kovačić, M. and Martinčević, I. (2020): Impact of digital transformation on knowledge management in organisation. Advances in Business-Related Scientific Research Journal, Volume 11, No.1.
50. Busch, P. (2008): Tacit Knowledge in Organisational Learning. IGI-Global Hershey, Pennsylvania, USA
51. Buttle, F. – Maklan, S. (2019): Customer Relationship Management: Concepts and Technologies (4th ed.). Routledge
52. Cabrera, A. – Collins, W. C. – Salgado, J. F. (2006). Determinants of individual engagement in knowledge sharing. International Journal of Human Resource Management, 17(2), pp. 245−264.
53. Carlaw, K. – Oxley, L. – Walker, P. S. – Thorns, David – Nuth, M. (2006). Beyond the hype: Intellectual property and the knowledge society/knowledge economy. Journal of Economic Surveys. 20. pp. 633-690. doi: 10.1111/j.1467-6419.2006.00262.x.
54. Carlucci, D. – Schiuma, G. (2006): The Knowledge-Based Foundations of Organisational Performance Improvements: An Action Research Approach. Electronic Journal of Knowledge Management, Volume 8, Issue 3 pp. 333 – 344.
55. Carlucci, D. – Marr, B. – Schiuma, G. (2004): The knowledge value chain: how intellectual capital impacts on business performance. Int. J. Technology Management 27 (6/7), pp. 575–590.
56. Castelo-Branco, I. – Cruz-Jesus, F. – Oliveira, T. (2019): Assessing Industry 4.0 readiness in manufacturing: evidence for the European Union. Computers in Industry, Vol. 107, pp. 22-32. doi: 10.1016/j.compind.2019.01.007.
57. Castrogiovanni, G. – Ribeiro-Soriano, D. – Mas-Tur, A. – Roig-Tierno, N. (2016): Where to acquire knowledge: adapting knowledge management to financial institutions. Journal of Business Research, Vol. 69 No. 5, pp. 1812-1816.
58. Charmaz, K. (2006): Constructing grounded theory: A practical guide through qualitative analysis. London: Sage Publications

59. Chiabrishvili, M. – Zaim, H. (2018): The role of knowledge management for long-term sustainability in Kuwait companies. Middle East Journal of Management, 5(4), 340–355.
60. Chien, Y. C. – Yuan, K. – Hsiung, K. (2015): The influences of knowledge management on organisational performance of Taiwan-Listed IC design houses: Using intellectual capital as the mediator. The Journal of International Management Studies, 10(1), pp. 50-67.
61. Choo, C. W. (2002): Knowledge management. In: J. R. Schement (Ed.) Encyclopedia of Communication and Information, New York, NY: Macmillan Reference, pp. 501-506.
62. Cohendet, P. (2014): Interaction between tacit and explicit knowledge in socio-spacial context. Prometheus, 32(1), pp.101-104.
63. Coradi, A. – Heinzen, M. – Boutellier, R. (2015): A longitudinal study of workspace design for knowledge exploration and exploitation in the research and development process. Creativity and Innovation Management, 24(1), pp. 55–71. https://doi.org/10.1111/caim.12099
64. Corbin, J. – Strauss, A. (2008): Basics of qualitative research: techniques and procedures for developing grounded theory (3rd ed.). Thousand Oaks: SAGE Publications
65. Creswell, J. W. (2009): Research Design Qualitative & Quantitative Approaches. Sage Publications, Thousand Oaks
66. Csizmadia, T. – Obermayer, N. – Banász, Z. (2022): Examining Contactless Digital Technologies (CDTs) in the midst of the COVID-19. Emerging Science Journal, 6, pp. 212–228.
67. Csizmadia, T. – Obermayer, N. – Bogdány, E. – Purnhauser, P. – Banász, Z. (2023): Examining Industry 4.0 through the lens of human resource and knowledge management: Implications for SMEs. Management & Marketing, 18(1), pp. 1-19.
68. Cummings, J. N. (2004): Work groups, structural diversity, and knowledge sharing in a global organization. Management Science, 50(3), pp. 352−364.
69. Dalkir, K. (2005). Knowledge management in theory and practice. Elsevier.
70. Davenport, T, H & Prusak. L. (1998): Working Knowledge, How Organisations Manage What They Know. Boston: Harvard Business School Press.

71. Davenport, T. H. – Kirby, J. (2016): Just how smart are smart machines?. MIT Sloan Management Review, 57(3), 21-25.
72. Davenport, T. H. – De Long, D. W. – Beers, M. C. (1998) Successful Knowledge Management Projects. Sloan Management Review, 2(2), pp. 43-57.
73. Davenport, T. H. – Prusak, L. (1998): Working Knowledge: How Organisations Manage What They Know. Harvard Business School Press, Boston
74. Devinney, T., Dowling, G. (2020): What is strategy? In The strategies of Australia's universities: Revise & resubmit, Palgrave Macmillan, pp. 45–59. https://doi.org/10.1007/978-981-15-3397-6_4
75. D'Innocenzo, L. – Luciano, M. M. – Mathieu, J. E. – Maynard, M. T. – Chen, G. (2016): Empowered to perform: A multilevel investigation of the influence of empowerment on performance in hospital units. Academy of Management Journal, 59(4), 1290–1307.
76. Dorst, K. (2015): Frame Innovation. Cambridge, MA, MIT Press, doi: 10.7551/mitpress/10096.001.0001.
77. Easa, N. (2011): Knowledge creation process & innovation in Egyptian banking sector. Organization Learning, Knowledge and Capabilities (OLKC) Conference. Retreived from https://warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/olkc6/papers/ideasa.pdf
78. EIBIS (2022): Digitalisation in Europe 2021-2022. Retreived from https://www.eib.org/attachments/publications/digitalisation_in_europe_2021_2022_en.pdf
79. EIBIS (2022): Hungary overview. EIB INVESTMENT SURVEY. European Investment Bank. Retreived from https://www.eib.org/attachments/lucalli/20220266_econ_eibis_2022_hungary_en.pdf
80. EIBIS (2022): European Union overview. EIB INVESTMENT SURVEY. European Investment Bank. Retreived from https://www.eib.org/attachments/lucalli/20220219_econ_eibis_2022_eu_en.pdf
81. Engeström, Y. (1999): Innovative learning in work teams: Analyzing cycles of knowledge creation in practice. In Y. Engeström, R. Miettinen, & R.-L. Punamäki (Eds.), Perspectives on activity theory, Cambridge, UK, Cambridge University Press, pp. 377-406.

82. Ettore B. - Meliha H. (2015): Advances in Knowledge management: Celebrating Twenty Years of Research. Springer, ISBN 978-3-319-09500-4, pp. 19-37.
83. Epetimehin, F. M. – Ekundayo, O. (2011): Organisational knowledge management: survival strategy for Nigeria insurance industry. Interdisciplinary Review of Economics and Management, 1(2), pp. 9-15.
84. European Commission (2022): DESI (2022) Digital Economy and Society Index (DESI) 2022 Hungary. Retreived from https://ec.europa.eu/digital-single-market/en/desi
85. European Commission (2001): Foreign owned enterprises in the EU. European Communities, Luxembourg, ISBN 92-894-0312-8
86. Eurostat (2014a): High-tech classification of manufacturing industries, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech_classification_of_manufacturing_industries
87. Eurostat (2014b): Knowledge-intensive services (KIS). https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Knowledge-intensive_services_(KIS)
88. Eurostat (2023): Statistical classification of economic activities in the European Community (NACE). Retreived from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Statistical_classification_of_economic_activities_in_the_European_Community_(NACE) and https://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF
89. Fehér, P. (2004): Tudásmenedzsmentet támogató tényezők szerepe szoftverfejlesztő szervezetekben. Budapesti Corvinus Egyetem, Információrendszerek tanszék, Budapest
90. Ferreira, J. – Mueller, J. – Papa, A. (2018): Strategic knowledge management: Theory, practice and future challenges. Journal of knowledge management, 24(2), pp. 121–126.
91. Gaál, Z. (2000): Tudásmenedzsment: a HR-szakemberek úton a siker felé?!. A Pécsi Tudományegyetem TTK Felnőttképzési és Emberi Erőforrás Fejlesztési Intézetének periodikája, II. évfolyam, 1. sz.
92. Gaál, Z. – Szabó, L. – Obermayer-Kovács, N. (2009): "Tudásmenedzsment-profil" érettségi modell. Vezetéstudomány 40:6, pp. 2-15.

93. Gaál Z. – Szabó L. – Obermayer-Kovács N. – Csepregi A. (2015): Exploring the Role of Social Media in Knowledge Sharing. Electronic Journal of Knowledge Management, 13(3) pp. 185-197.
94. García-Villaverde, P. M. – Rodrigo-Alarc´on, J. – Parra-Requena, G. – Ruiz-Ortega, M. J. (2018): Technological dynamism and entrepreneurial orientation: The heterogeneous effects of social capital. Journal of Business Research, 83, 51–64.
95. Gartner (2018): Hype Cycle for Artificial Intelligence 2018. Gartner Report, Stamford, USA, Retreived from https://www.gartner.com/en/documents/3883863
96. Gartner (2021): Gartner Top Strategic Technology Trends for 2021. Retrieved from https://www.gartner.com/smarterwithgartner/gartner-top-strategic-technology-trends-for-2021/
97. Gartner (2020): The Future of Business Is Composable. Retreived from https://www.gartner.com/smarterwithgartner/gartner-keynote-the-future-of-business-is-composable
98. Gartner (2007): Why Knowledge management Is No Longer on the Gartner Hype Cycles. Retreived from Why Knowledge management Is No Longer on the Gartner Hype Cycles
99. Gartner (2021): Gartner Forecasts Worldwide Artificial Intelligence Spending to Reach $124 Billion in 2025. Retrieved from https://www.gartner.com/en/newsroom/press-releases/2021-06-29-gartner-forecasts-worldwide-artificial-intelligence-spending-to-reach-124-billion-in-2025
100. Gaspar, D. – Coric, I. – Mabic, M. (2023): Is composable enterprise the key to digital transformation?. Book of Proceedings, 6th International Scientific Conference on Digital Economy DIEC 2023, pp. 141-158.
101. Gaughan, D. – Natis, Y. – Alvarez, G. – O'Neill, M. (2020): Future of Applications: Delivering the Composable Enterprise. Retreived from https://www.gartner.com/en/doc/465932-future-of-applications-delivering-the-composable-enterprise
102. Gfrerer, A. – Hutter, K. – Füller, J. – Ströhle, T. (2021): Ready or Not: Managers' and Employees' Different Perceptions of Digital Readiness. California Management Review 63 (2), 23–48. https://doi.org/10.1177/0008125620977487

103. Ginevičius, T., Kaklauskas, A. and Kazokaitis, P. (2011): Knowledge model for integrated construction project management. Business: Theory & Practice, Vol. 12 No. 2, pp. 162-174.
104. Girard, J. P. (2006): Where is the knowledge we have lost in managers ?. Journal of Knowledge Management, 10(6), pp. 22-38.
105. Glisby, M. – Holden, N. (2003): Contextual constraints in knowledge management theory: The cultural embeddedness of Nonaka's knowledge-creating company. Knowledge and Process Management, 10(1), pp. 29–36.
106. Gourlay, S. N. – Nurse, A. (2005): Flaws in the "Engine" of Knowledge Creation: A Critique of Nonaka's SECI Model, Chapter 13. In Challenges and Issues in Knowledge Management, Buono, A. F., and Poulfelt, F. (eds) Research in Management Consulting Series, Volume 5, Greenwich, Connecticut: Information Age Publishing, pp. 293-315.
107. Gupta, S. – Tuunanen, T. – Kar, A.K. – Modgil, S. (2022): Managing digital knowledge for ensuring business efficiency and continuity. Journal of KnowledgeManagement, doi: 10.1108/JKM-09-2021-0703.
108. Gururajan, V. – Fink, D. (2010): Attitudes towards knowledge transfer in an environment to perform. Journal of knowledge management, 14(6), pp. 828-840.
109. Gyökér, I. (2004): A vállalat szellemi tőkéje – számolatlan vagyon. Harward Business Manager, 6. sz.
110. Haenlein, M. – Kaplan, A. M. (2004): A Beginner's Guide to Partial Least Squares Analysis. Understanding Statistics 3: 283–97. https://doi.org/10.1207/s15328031us0304_4
111. Hanafi, M. – Widiyanto, A. – Rahman, H. F. – Adhitama, M. R. (2021): Implementation of Knowledge Management in Different Industries. IJIIS: International Journal of Informatics and Information Systems. Vol. 4. pp. 103-111. Doi: 10.47738/ijiis.v4i2.107.
112. Hansen, M. T. – Nohria, N. – Tierney, T. (1999): What's Your Strategy for Managing Knowledge?. Harvard Business Review, March-April, pp. 106-116.
113. Hargitai, D. – Bencsik, A. (2023): The Role of Leadership in Digital Learning Organisations. 7. pp.111-124. 10.28991/ESJ-2023-SIED2-09.
114. Hansen, N. K. – Gürttel, W. H. – Swart, J. (2019): HRM in dynamic environments: Exploitative, exploratory, and ambidextrous HR architectures. The International Journal of Human Resource Management, 30(4), 648–679.

115. Hair, J. F. – Ringle, C.M. – Sarstedt, M. (2011): PLS-SEM: Indeed a silver bullet. Journal of Marketing theory and Practice 19: 139–52. https://doi.org/10.2753/MTP1069-6679190202
116. Hecklau, F. – Galeitzke, M. – Flachs, S. – Kohl, H. (2016): Holistic approach for human resource management in Industry 4.0. Procedia CIRP, Vol. 54, pp. 1-6, doi: 10.1016/j.procir.2016.05.102.
117. Hedlund, G. (1994): A Model of Knowledge management and the N-form Corporation. Strategic Management Journal, 15, pp. 73-90.
118. Hofmann, E. – Rüsch, M. (2017): Industry 4.0 and the current status as well as future prospects on logistics. Computers in Industry, Vol. 89, pp. 23-34, doi: 10.1016/j.compind.2017.04.002.
119. 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, Vol. 146, pp. 119-132, doi: 10.1016/j.techfore.2019.05.021
120. Huber, G. P. (1991): Organizational learning: The contributing processes and the literatures. Organization Science, 2(1), pp. 88−115.
121. Hunady, J. – Fendekova, J. – Orviska, M. (2020): Attitudes and trust to recent digital technologies: using standards to improve them. Paper presented at 25th EURAS Annual Standardisation Conference–Standards for Digital Transformation: Blockchain and Innovation, Glasgow, Scotland, June 10–12.
122. IBM (2023): SPSS Statistics. Retrieved from https://www.ibm.com/docs/en/spss-statistics/saas?topic=edition-core-features
123. Jánosa, A. (2011): Adatelemzés SPSS használatával. ComputerBooks Kiadói Kft., Budapest
124. Javaid, M. – Haleem, A. – Singh, R. P. – Haq, M. I. U. – Raina, A. – Suman, R. (2020): Industry 5.0: Potential applications in covid-19. Journal of Industrial Integration and Management, 5(4).
125. Jeon, S. – Kim, Y. G. – Koh, J. (2011): An integrative model for knowledge sharing in communities-of-practice. Journal of Knowledge management, 15, pp. 251–269.
126. Jia, J. Y. (2020): Introduction to Part II: What is a system? In The corporate energy strategist's handbook, Springer, pp. 83–86. https://doi.org/10.1007/978-3-030-36838-8_8

127. Johnson, R. D. – Gueutal, H. G. (2011): Transforming HR Through Technology - The Use of E-HR and HRIS in Organisations. SHRM Foundation, https://www.shrm.org/hr-today/trends-and-forecasting/special-reports-and-expert-views/documents/hr-technology.pdf
128. Josephine, S. K. – Kimencu, L. (2021): Resource Allocation in Strategy Implementation and Performance of Nairobi City County Government, Kenya. International Journal of Business Management and Finance, 3(1).
129. Juhász, V. (2011): Az azonnali üzenetküldő (IM) rendszerekről és az üzenetküldések néhány diskurzussajátosságáról. In: Gecső T. és Kiss Z. (szerk.): Az alkalmazott nyelvészet integritásának kérdései, Tinta Könyvkiadó, Budapest. pp. 113–127.
130. Kabeyi, M. (2019): Organizational strategic planning, implementation and evaluation with analysis of challenges and benefits. International Journal of Applied Research and Studies, 5(6), pp. 27-32.
131. Kaburu, C. M. – Simba, F. (2020): Influence of Strategic Planning Factors on Organizational Performance of State Corporations in Mombasa County, Kenya. International Journal of Advanced Research and Review, 5(4), pp. 96-119.
132. Kalseth K. (1999): Knowledge management from a business strategy perspective. Journal of FID Review, pp. 37-41.
133. Kalyal, H. – Huey, L. – Blaskovits, B. – Bennell, C. (2020): 'If it's not worth doing half-assed, then it's not worth doing at all': Police views as to why new strategy implementation fails. Police Practice and Research, 21(2), pp. 117-133.
134. Kane, G. C. – Palmer, D. – Phillips, A. N. – Kiron, D. – Buckley, N. (2014): Moving Beyond Marketing: Generating Social Business Value Across the Enterprise
135. Kane, G. C. – Phillips, A. N. – Copulsky, J. R. – Andrus, G. R. (2019): The Technology Fallacy: How People Are the Real Key to Digital Transformation. MIT Press.
136. Kaplan, A. M. – Haenlein, M. (2010): Users of the World, Unite! The Challenges and Opportunities of Social Media. Business Horizons, 53(1), pp. 59-68.
137. Kazár, K. (2014): A PLS-útelemzés és alkalmazása egy márkaközösség pszichológiai érzetének vizsgálatára. Statisztikai Szemle 92, pp. 33–52.
138. Kiel, D. – Arnold, C. – Voigt, K.I. (2017a): The influence of the industrial internet of things on business models of established manufacturing companies –

a business level perspective. Technovation, Vol. 68, pp. 4-19, doi: 10.1016/j.technovation.2017.09.003.

139. Kiel, D. – Müller, J.M. – Arnold, C. – Voigt, K.I. (2017b): Sustainable industrial value creation: benefits and challenges of industry 4.0. International Journal of Innovation Management, Vol. 21 No. 8, pp. 1740015, doi: 10.1142/S1363919617400151.
140. Kiss, F. (2023): Fenntartható tudástranszfer-technológiák. In: Noszkay, E. (2023): Tudásmenedzsment a következő két évtized határán, Akadémiai Kiadó, Budapest, ISBN, 978 963 454 913 0
141. Klein, V.B. – Todesco, J.L. (2021): COVID-19 crisis and SMEs responses: the role of digital transformation. Knowledge and Process Management, Vol. 28 No. 2, pp. 117-133.
142. Koleva, N. (2019): An empirical study on human resources' attitude towards manufacturing digitalization. Proceedings of International Conference on Creative Business for Smart and Sustainable Growth (CREBUS), Sandanski, Bulgaria, pp. 1-5, doi: 10.1109/CREBUS.2019.8840057.
143. Kozanoglu, C. D. – Abedin, B. (2021): Understanding the role of employees in digital transformation: conceptualization of digital literacy of employees as a multi-dimensional organisational affordance. Journal of Enterprise Information Management, Vol 34, No. 6, pp. 1649-1672.
144. KPMG Magyarország (2000): Tudásmenedzsment Magyarországon – Felmérés. Budapest
145. KPMG-BME Akadémia (2006): Tudásmenedzsment Magyarországon 2005/2006, KBA Oktatási Kft, Budapest
146. KPMG Akadémia (2014): Szervezeti tudásmegosztás Magyarországon 2013/2014. Tudatos Vezetés, Budapest, Retrieved from http://tudatosvezetes.hu/docs/tudasmegosztas.pdf
147. KSH (2019): Helyzetkép az iparról, 2019. Retrieved from https://www.ksh.hu/docs/hun/xftp/idoszaki/jelipar/2019/index.html
148. KSH (2022): Broad Structure of NACE Rev.2. Retrieved from https://www.ksh.hu/docs/osztalyozasok/teaor/teaor_structure.pdf
149. KSH (2023a): A regisztrált vállalkozások száma létszám-kategória szerint. Retrieved from https://www.ksh.hu/stadat_files/gsz/hu/gsz0004.html

150. KSH (2023b): A regisztrált vállalkozások száma nemzetgazdasági ág szerint. Retrieved from https://www.ksh.hu/stadat_files/gsz/hu/gsz0003.html
151. Kusnadi, E. - Yanitasari, Y. - Supriyadi, S. (2021): Application of Knowledge Management System for Cattle Cultivation. Ilk. J. Ilm., Vol. 13, No. 1.
152. Kwon, H. – Kim, J. – Park, Y. (2017): Applying LSA text mining technique in envisioning social impacts of emerging technologies: the case of drone technology. Technovation, Vol 60/61, pp. 15-28.
153. Lasi, H. – Fettke, P. – Kemper, H.G. – Feld, T. – Hoffmann, M. (2014): Industry 4.0., Business & Information Systems Engineering, Vol 6, pp 239–242.
154. Lee, C.C. – Yang, J. (2000): Knowledge value chain. Journal of Management, Vol 19, No. 9, pp 783-793.
155. Lee, H. – Choi, B. (2003): Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination. Journal of Management Information Systems, 20(1), pp. 179-228.
156. Lee, J. – Fink, D. (2013): Knowledge mapping: Encouragements and impediments to adoption. Journal of Knowledge Management, 17(1), pp. 16-28.
157. Légrádiné, L. Sz. (2006): Tréningmódszer a felsőoktatásban. In: Tudásmenedzsment, Vol.1, pp. 60-67.
158. Levitt, B. – March, J. (1988): Organizational Learning. Annual Review of Sociology. 14, pp. 319-338. https://doi.org/10.1146/annurev.so.14.080188.001535
159. Liao, Y. – Deschamps, F. – Loures, E. – Ramos, L. (2017): Past, present and future of Industry 4.0 - a systematic literature review and research agenda proposal, International Journal of Production Research, 55(12), pp. 3609– 3629.
160. Lindner, J. (2022): Composability – Quick wins in a world of constant change. E-3 Magazine, December 2021/January 2022. Retreived from https://www.oracle.com/a/ocom/docs/applications/erp/composability-quick-wins-in-a-world-of-change.pdf
161. Li, S. – Easterby-Smith, M. – Hong, J. F. L. (2019): Towards an understanding of the nature of dynamic capabilities in high-velocity markets of China. Journal of Business Research, 97, 212–226.
162. Lin, C. – Wayne Yu, W. C. – Wang, J. (2014): Cloud Collaboration: Cloud-based Instruction for Business Writing Class. World Journal of Education, 4(6), pp. 9-15.

163. Lin, H. F. (2011): Antecedents of the stage-based knowledge management evolution. Journal of Knowledge Management, Vol 15, No. 1, pp. 136-155.
164. Lin, H.F. – Lee, G.G. (2006): Effects of socio-technical factors on organizational intention to encourage knowledge sharing. Management Decision, Vol 44, No. 1, pp. 74-88.
165. Lloyd, B. (1996): Knowledge management: the key to long-term organisational success. Long Range Planning, Vol. 29, No.4, pp. 576-580.
166. Lops P. – de Gemmis M. – Semeraro G. (2011): Content-based Recommender Systems: State of the Art and Trends. In: Ricci F., Rokach L., Shapira B., Kantor P. (eds) Recommender Systems Handbook. Springer, Boston, MA
167. Machado, C.G. – Winroth, M. – Almström, P. – Ericson Öberg, A. – Kurdve, M. – AlMashalah, S. (2021): Digital organisational readiness: experiences from manufacturing companies. Journal of Manufacturing Technology Management, 32(9), pp. 167-182.
168. Maddikunta, P.K.R. – Pham, Q.-V. – Liyanage, M. (2021): Industry 5.0: A survey on enabling technologies and potential applications. Journal of Industrial Information Integration, 100257
169. Magistretti, S. – Dell'Era, C. – Petruzzelli, A.M. (2019): How intelligent is Watson? Enabling digital transformation through artificial intelligence. Business Horizons, Vol. 62 No. 6, pp. 819-829, doi: 10.1016/j.bushor.2019.08.004.
170. Malhotra, N. K. – Simon, J. (2008): Marketingkutatás. Akadémiai Kiadó, Budapest
171. March, J. G. (1991): Exploration and Exploitation in Organizational Learning. Organization Science, Vol. 2, No. 1, Special Issue: Organizational Learning: Papers in Honor of (and by) James G. March. (1991), pp. 71-87.
172. Marr, B. (2004): Measuring and benchmarking intellectual capital. Benchmarking, Vol. 11, pp. 559-570.
173. Martin, B. R. (1995): Foresight in science and technology. Technology Analysis & Strategic Management, 7(2), pp. 139–168.
174. Masa'deh, R. (2016): The role of knowledge management infrastructure in enhancing job satisfaction at Aqaba five star hotels in Jordan. Communications and Network. 8(4), pp. 219-240.
175. Masic, B. – Nesic, S. - Nikolic, D. – Dzeletovic, M. (2017): Evolution of knowledge management. Industrija, Vol.45, No.2, pp. 127-147.

176. Matt, C. – Hess, T. – Benlian, A. (2015): Digital transformation strategies. Business and Information Systems Engineering, 57 (5), pp. 339–343.
177. McDermott, R. – O'Dell, C. (2001): Overcoming Cultural Barriers to Sharing Knowledge. Journal of Knowledge management, pp. 76-85.
178. Metaxiotis, K. – Ergazakis, K. – Samouilidis, E. - Psarras, J. (2003): Decision support through knowledge management: The role of the artificial intelligence. Inf. Manag. Comput. Secur. 11, 216–221.
179. Mihalca, R. – Uta, A. – Intorsureanu, I. – Andreescu, A.I. (2008): Knowledge management in e-learning systems. Informatica Economica Journal, Vol. 12 No. 2, pp. 365-369.
180. Mikulás, G. (2005): A kultúra kérdése – lépések a tudásmenedzsment felé. Könyv Könyvtár Könyvtáros 14, pp. 37-46.
181. Mostafapour, M. – Kashef, S.M. – Esmaeilpour, H.M. – Akbarzadeh, V. (2014): The relationship between knowledge management and the application of information technology in the departments of youth and sport organization of West Azarbaijan Province. Journal of Physical Education, 2(1), pp. 29-34.
182. Müller, J.M. – Kiel, D. – Voigt, K. (2018): What drives the implementation of Industry 4.0? The role of opportunities and challenges in the context of sustainability. Sustainability, Vol. 10 No. 1, pp. 247, doi: 10.3390/su10010247.
183. Jennex, M. E. (2019): Towards Understanding Knowledge Management Strategy. Information Institute Conferences, Las Vegas, NV.
184. 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, Vol. 10 No. 10, 3491.
185. Nagy, J. (2019): Az ipar 4.0 fogalma és kritikus kérdései – vállalati interjúk alapján. Vezetéstudomány/ Budapest Management Review, Vol. 50 No. 1, pp. 14-26, doi: 10.14267/VEZTUD.2019.01.02.
186. Nambisan, S. – Lyytinen, K. – Majchrzak, A. – Song, M. (2017): Digital innovation management: reinventing innovation management research in a digital world. MIS Q. 41, pp. 223-238.
187. Natarajan, G. (2018): Knowledge management and big data. Confederation of Indian Industry
188. Nemzeti cégtár (2023): https://www.nemzeticegtar.hu/

189. Ng, J. – Li, K. (2003): Implications of ICT for knowledge management in globalization. Information Management & Computer Security, 11(4), pp.167-174.
190. Ngoc-Tan, N. – Gregar, A. (2018): Impacts of knowledge management on innovations in higher education institutions: An empirical evidence from Vietnam. Economics and Sociology, 11(3), pp. 301–320. https://doi.org/10.14254/2071-789X.2018/11-3/18
191. Nonaka, I. – Takeuchi, H. (1995): The Knowledge-creating Company. Oxford University Press, New York
192. Nonaka, I. – Toyama, R. – Konno, N. (2000): SECI, ba and leadership: a unified model of dynamic knowledge creation, Long Range Planning, Vol. 33 No. 1, pp. 5-34, doi: 10.1016/S0024-6301(99)00115-6.
193. Noor, N. – Salim, J. (2011): Factors Influencing Employee Knowledge Sharing Capabilities in Electronic Government Agencies in Malaysia. IJCSI International Journal of Computer Science Issues, 8(4/2), pp. 106 – 114.
194. Noszkay, E. (2013): A rendszerszemléletű tudásmenedzsment. Pearson Kiadó.
195. Noszkay, E. (2017): Best Practice Model Tools and Methods for Developing KM Systems. In: Bencsik, A., Knowledge Management Initiatives and Strategies in Small and Medium Enterprises. Hershey (PA), USA, IGI Global, pp. 137-156.
196. Obermayer-Kovács, N. (2007): Tudatos tudásmenedzselés a tudásgazdaságban. Doktori (PhD) értekezés, Veszprém.
197. Obermayer, N. (2022): Milestones in the development of knowledge management. Habilitation Theses, Veszprém
198. Obermayer, N. – Csizmadia, T. – Hargitai, D. M. (2021): Influence of Industry 4.0 technologies on corporate operation and performance management from human aspects. Meditari Accountancy Research, 30(4), 1027-1049 https://doi.org/10.1108/MEDAR-02-2021-1214
199. Obermayer, N. – Csizmadia, T. – Hargitai, D. M. – Kigyós, T. A. (2021): Az Ipar 4.0 implementációval kapcsolatos vezetői motivációk és akadályozó tényezők elemzése hazai vállalatvezetők véleménye alapján. Vezetéstudomány, 52 (2), pp. 60-72.
200. Obermayer, N. – Tóth, E. V. (2019): Organizational dynamics: Exploring the Factors Affecting Knowledge Sharing Behavior, Kybernetes - Knowledge management Systems and Organizational Dynamics, 49(1), pp. 165-181.

201. Obermayer, N. – Tóth, E. V. (2021): The Impact of Emerging Technologies on Knowledge Management, Proceedings of the 22rd European Conference on Knowledge Management, ECKM 2021, pp.585-593.
202. Obermayer, N. – Nagy, V. – Toth, E. V. – Kiss, D. (2022): Overcoming the Challenges of Digitalisation in Hungarian Manufacturing Companies. Proceedings of the 23rd European Conference on Knowledge Management, ECKM 2022, pp. 845-851.
203. Obermayer, N. – Tóth, E. V. (2019): The Future of Human Knowledge and Artificial Intelligence. Proceedings of the 20th European Conference on Knowledge management (ECKM 2019), Vol.2, pp. 808-814.
204. Obermayer N. – Tóth, V. E. (2017): The Influence of Individual and Organisational Factors on Knowledge Sharing Behaviour. In Proceedings of 18th European Conference on Knowledge management (ECKM 2017), International University of Catalonia, Barcelona, Spain, pp. 778-787.
205. Obermayer, N. – Csepregi, A. – Kővári, E. (2016): Knowledge Sharing Relation to Competence, Emotional Intelligence, and Social Media Regarding Generations. In Knowledge Management Initiatives and Strategies in Small and Medium Enterprises, IGI Global, pp. 269-290.
206. Obermayer, N. (2017): Közösségi média eszközök alkalmazása a szervezeti tudásmegosztásban. In Közösségi Tudások - Tudásközösségek - Tudásmenedzsment elméleti és módszertani megközelítésben a MTA Gazdaságtudományi Bizottság Tudásmenedzsment Munkabizottságának III. számú gyűjteményes kötete 2012-2016, N & B. Kiadó, pp. 104-116.
207. Obermayer, N. – Gaál, Z. – Szabó, L. – Csepregi, A. (2020): Leveraging Knowledge Sharing over Social Media Tools. Leveraging Knowledge Sharing over Social Media Tools. In: Information Diffusion Management and Knowledge Sharing (2 Vol.), IGI Global, pp. 761-784.
208. Ode, E. – Ayavoo, R. (2020): The mediating role of knowledge application in the relationship between knowledge management practices and firm innovation. Journal of Innovation & Knowledge, 5(3), pp. 210–218.
209. O'Dell, C. – Grayson, C. (1998): If Only We Knew What We Know: Identification and Transfer of Internal Best Practices. California Management Review, 40, pp. 154-174. https://doi.org/10.2307/41165948

210. Oeberst, A. – Cress, U. – Kimmerle, J. (2016): What is Knowledge? Who Creates It? Who Possesses It? The Need for Novel Answers to Old Questions. Mass collaboration and education, pp.105-124., ISBN: 978-3-319-13535-9, doi:10.1007/978-3-319-13536-6_6
211. Organization for Economic Cooperation and Development (OECD) (2003): Science, Technology and Industry Scoreboard. OECD, Paris.
212. Organization for Economic Cooperation and Development (OECD) (2007): Science, Technology and Industry Scoreboard. OECD, Paris.
213. Oluikpe, P. (2012): Developing a corporate knowledge management strategy. Journal of Knowledge management, 16(6), pp. 862-878.
214. Omotayo, F.O. (2015): Knowledge management as an important tool in organisational management: a review of literature. Library Philosophy & Practice.
215. O'Reilly, T. (2005): What Is Web 2.0. Retrieved from https://www.oreilly.com/pub/a/web2/archive/what-is-web-20.html
216. Parida, V. – Sjödin, D. – Reim, W. (2019): Reviewing literature on digitalization, business model innovation, and sustainable industry: Past achievements and future promises. Sustainability, 11 (2), pp. 391-409. https://doi.org/10.3390/su11020391
217. Paroutis, S. – Saleh, A. A. (2009): Determinants of knowledge sharing using Web 2.0 technologies. Journal of Knowledge Management, 13(4), pp. 52-63.
218. Paquette, S. – Desouza, K. C. (2011): Knowledge transfer. In: K. C. Desouza and S. Paquette (Eds.), Knowledge management: An Introduction, New York: NY: Neal-Schuman Publishers, Inc., pp. 179-212.
219. Pereira, V. – Bamel, U. (2021): Extending the resource and knowledge based view: A critical analysis into its theoretical evolution and future research directions. Journal of Business Research, 132, pp. 557-570.
220. Pinheiro, P. G. – Antunes, H. D. J. G. (2020): Linking knowledge management, organizational learning and memory. Journal of Innovation & Knowledge, Vol. 5, pp. 140–149. doi: 10.1016/j.jik.2019.04.002
221. Podrug, N. – Filipovic, D. – Kovac, M. (2017): Knowledge sharing and firm innovation capability in Croatian ICT companies. International Journal of Manpower, 38(4), pp. 632–644. https://doi.org/10.1108/IJM-04-2016-0077.

222. Poell, R. F. – van der Krogt, F. J. (2003): Learning strategies of workers in the knowledge-creating company. Human Resource Development International 6(3). pp. 387–403.
223. Polanyi, M. (1996): The Tacit Dimension. Routledge & Kegan Paul, London
224. Polkinghorne, D. E. (2005): Language and Meaning: Data Collection in Qualitative Research. Journal of Counseling Psychology, 52, pp. 137–145.
225. Porter, M. – Sachs, J. – McArthur, J. (2002): Executive summary: Competitiveness and stages of economic development. The global competitiveness report 2001–2002, New York: Oxford University Press, pp. 16–25.
226. Probst, G. (1998): Practical Knowledge management - A Model That Works. Prism, Second Quarter, Arthur D. Little. pp. 17-29.
227. Probst, G. – Büchel, B. – Raub, S. (1998): Knowledge as a Strategic Resource. (In: von Krogh, G., Roos, J., Kleine, D. (eds), Knowing in Firms), Sage Publications, London
228. PWC (2016): The Essential Eight technologies: how to prepare for their impact, PricewaterhouseCoopers 19th Annual Global CEO survey. https://www.pwc.ru/ru/new-site-content/2016-global-tech-megatrends-eng.pdf
229. Qin, J. – Liu, Y. – Grosvenor, R. (2016): A categorical framework of manufacturing for industry 4.0 and beyond. Procedia cirp, Vol. 52, pp. 173-178.
230. Quarchioni, S. – Paternostro, S. – Trovarelli, F. (2022): Knowledge management in higher education: A literature review and further research avenues. Knowledge Management Research and Practice, 20 (2), pp. 304–319. https://doi.org/10.1080/14778238.2020.1730717
231. Rachmawati, E. – Kom, S. S. – Kom, M. (2018): Web-Based Ticketing System Helpdesk Application Using CodeIgniter Framework (Case Study: PT Commonwealth Life). International Journal of Computer Science and Mobile Computing, Vol 7, Issue 12, December, pp. 29-41.
232. Ramadan, B. M. – Dahiyat, S. E. – Bontis, N. – Al-Dalahmeh, M. A. (2017): Intellectual capital, knowledge management and social capital within the ICT sector in Jordan. Journal of Intellectual Capital, 18(2), pp. 437-462.
233. Razkenari, M. – Qi, B. – Fenner, A. – Hakim, H. – Costin, A. – Kibert, C. – Kibert, J. (2019): Industrialized Construction: Emerging Methods and

technologies, Computing in Civil Engineering. Data, Sensing, and Analytics, ASCE, Atlanta, 2019, pp. 352–359.

234. Rigby, D. – Bilodeau, B. (2007): Bain's global 2007 management tools and trends survey. Strategy &Leadership. 35(5), pp. 9-16

235. Ringle, C. M. – Wende, S. – Becker, J-M. (2015): SmartPLS 3. Boenningstedt: SmartPLS GmbH. Online: http://www.smartpls.com (accessed in Apr 2023)

236. Rizwan, M. – Khan, D.J. – Saboor, F. (2011): Relationship of job involvement with employee performance: Moderating role of attitude. European Journal of Business and Management, 3(8), pp.77-86.

237. Rogers, D. L. (2016): The Digital Transformation Playbook: Rethink Your Business for the Digital Age. Columbia Business, School Pub, New York.

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

239. Rotolo, D. – Hicks, D. – Martin, B. R. (2015): What Is an Emerging Technology?. Research Policy, vol. 44, issue 10, 1827-1843.

240. Rowley, J. (2003): Knowledge management – the new librarianship? From custodians of history to gatekeepers to the future. Library Management, 24(8/9), pp. 433- 440.

241. Rubin, R. S. – Dierdorff, E. C. – Bommer, W. H. – Baldwin, T. T. (2009): Do leaders reap what they sow? Leader and employee outcomes of leader organizational cynicism about change. The Leadership Quarterly, 20(5), pp. 680–688. https://doi.org/10.1016/j.leaqua.2009.06.002

242. Rüßmann, M. – Lorenz, M. – Gerbert, P. – Waldner, M. – Justus, J. – Engel, P. – Harnisch, M. (2015): Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. Boston Consulting Group: Boston, MA, USA, 2015; pp. 1–14. Available online: http://www.inovasyon.org/pdf/bcg.perspectives_Industry.4.0_2015.pdf

243. Saba, F. M. (2022): Knowledge Management Application in the Service Industry. Library Philosophy and Practice (e-journal), University of Nebraska - Lincoln

244. Sajtos, L. – Mitev, A. (2007): SPSS Kutatási és adatelemzési kézikönyv. Alinea Kiadó.

245. Salloum, S.A. – Al-Emran, M. – Shaalan, K. (2018): The impact of knowledge sharing on information systems: A review. International conference on knowledge management in Organisations, Springer: Berlin/Heidelberg, Germany
246. Sanchez, R. – Heene, A. – Thomas, R. (1996): Dynamics of Competence-based Competition. Elsevier Pergamon, Oxford
247. Sandelowski M. (1996): One is the liveliest number: the case orientation of qualitative research. Research in nursing & health, Vol. 19, No. 6, pp. 525-529.
248. Sangzoni, L. – Guzman, G. – Busch, P. (2017): Artificial intelligence and knowledge management: questioning the tacit dimension. Prometheus - Critical studies in Innovation, September
249. Sara, I. – Saputra, K. A. K. – Utama, I. W. K. J. (2021): The Effects of Strategic Planning, Human Resource and Asset Management on Economic Productivity: A Case Study in Indonesia. The Journal of Asian Finance, Economics and Business, 8(4), pp. 381-389.
250. Saukkonen, J. – Kreus, P. – Harju, M. (2019): Intellectual property in the era of increased clock speed: return of knowhow?. Proceedings of the 10th European Conference on Intangibles and Intellectual Capital ECIIC pp. 23-24.
251. Scuotto, V. – Nicotra, M. – Del Giudice, M. – Krueger, N. – Gregori, G. L. (2021): A microfoundational perspective on SMEs' growth in the digital transformation era. Journal of Business Research, 129, pp. 382–392. https://doi.org/10.1016/j.jbusres.2021.01.045
252. Senge, P. M. (1990): The Fifth Discipline: The Art & Practice of the Learning Organization. Currency Doubleday.
253. Serenko, A. (2013): Meta-analysis of scientometric research of knowledge management: discovering the identity of the discipline. Journal of Knowledge management, Vol. 17 No. 5, pp. 773-812.
254. Shamim, S. – Cang, S. – Yu, H. – Li, Y. (2016): Management approaches for Industry 4.0: a human resource management perspective. IEEE Congress on Evolutionary Computation (CEC), pp. 5309-5316, doi: 10.1109/CEC.2016.7748365.
255. Shamsuzzoha A. – Helob, P. – Al-Kindic, M. (2016): Implementation of Cloud-based Manufacturing Environment to Facilitate Virtual Collaboration between Industries. In Proceedings of International Conference on Applied Mechanics and Industrial Systems, Oman

256. Shujahat, M. – Sousa, M. J. – Hussain, S. – Nawaz, F. – Wang, M. – Umer, M. (2019): Translating the impact of knowledge management processes into knowledge-based innovation: The neglected and mediating role of knowledge-worker productivity. Journal of Business Research, 94, pp. 442-450.

257. Silva de Garcia, P. – Oliveira, M. – Brohman, K. (2020): Knowledge sharing, hiding and hoarding: how are they related? Knowledge management Research & Practice, https://doi.org/10.1080/14778238.2020.1774434

258. Singh, A. – Klarner, P. – Hess, T. (2020): How do chief digital officers pursue digital transformation activities? The role of organisation design parameters. Long. Range Plan. 53.

259. Small, H. – Boyack, K. W. – Klavans, R. (2014): Identifying emerging topics in science and technology. Research Policy, 48(8), pp. 1450–1467.

260. Spender, J. C. (1996): Making Knowledge the Basis of a Dynamic Theory of the Firm. Strategic Management Journal, 17 Winter Special Issue, pp. 45-62. doi: 10.1002/smj.4250171106

261. Stacey, R. D. (2001): Complex responsive processes in organizations. London: Routledge.

262. Stahl, B. C. (2011): What does the future hold? A critical view on emerging information and communication technologies and their social consequences. In Chiasson, M. - Henfridsson, O. - Karsten, H. - DeGross, J. I., (eds) Researching the Future in Information Systems: IFIP WG 8.2 Working Conference, Future IS 2011, Turku, Finland, Proceedings, pp. 59–76.

263. Statistics Solutions (2023): Directory of Statistical Analyses. Retrieved from https://www.statisticssolutions.com/free-resources/directory-of-statistical-analyses/pearsons-correlation-coefficient/

264. Stewart, T. A. (1997): Intellectual Capital: The New Wealth of Organizations. Doubleday, New York

265. Stocker, M. (2003): Hol van a tudásmenedzsment a hype görbén?. Menedzsment fórum, www.mfor.hu/cikkek/cikk.php?article=10174

266. Sung, T. K., - Gibson, D. V. (2005). Knowledge and technology transfer grid: Empirical assessment. International Journal of Technology Management, 29(4), pp. 216–230. doi:10.1504/IJTM.2005.005997

267. Suresh, S. – Olayinka, R. – Chinyio, E. – Renukappa, S. (2016): Impact of knowledge management on construction projects. Proceedings of the Institution of Civil Engineers-Management, Procurement and Law, 170(1), pp. 27-48.
268. Szabó-Szentgróti, G. – Végvári, B. – Varga, J. (2021): Impact of Industry 4.0 and Digitization on Labor Market for 2030-Verification of Keynes' Prediction. Sustainability Vol 13.
269. Tallon, P.P. – Queiroz, M. – Coltman, T. – Sharma, R. (2019): Information technology and the search for organisational agility: a systematic review with future research possibilities. The Journal of Strategic Information Systems, Vol. 28 No. 2, pp. 218-237.
270. Teece, D. J. (2020): Plotting strategy in a dynamic world. MIT Sloan Management Review, 62(1), pp. 28–33.
271. Tiwari, S. P. (2022): Knowledge management strategies and emerging technologies – An overview of the underpinning concepts. International Journal of Innovative Technologies in Economy, 1(37). https://doi.org/10.31435/rsglobal_ijite/30032022/7791
272. T. Nagy, J. – Bernschütz, M. (2017): Nemek közötti különbségek a technológia elfogadásában—A PLS-MGA alkalmazása. Statisztikai Szemle Vol. 95 pp. 51–77. doi: 10.20311/stat2017.01.hu0051
273. Trstenjak, M. – Cosic, P. (2017): Process planning in Industry 4.0 environment. Procedia Manufacturing, Vol. 11, pp. 1744-1750, doi: 10.1016/j.promfg.2017.07.303.
274. Tsoukas, H. (2003): Do we really understand tacit knowledge? In M. Easterby-Smith & M. A. Lyles (Eds.), The Blackwell handbook of organizational learning and knowledge management, Oxford, Blackwel, pp. 410–427.
275. Verhoef, P.C. – Broekhuizen, T. – Bart, Y. – Bhattacharya, A. - Dong, J.Q. – Fabian, N. – Haenlein, M. (2019): Digital transformation: A multidisciplinary reflection and research agenda. Journal of Business Research, Vol. 122, pp. 889-901.
276. Véry, Z. (2021): A társas tudás menedzselése egy kisvállalati cégcsoportnál. www.academia.edu
277. Vial, G. (2019): Understanding digital transformation: A review and a research agenda. The Journal of Strategic Information Systems, 28(2), pp. 118-144.

278. Wang, C. L. – Ahmed, P. K. (2005): The knowledge value chain: a pragmatic knowledge implementation network. Handbook of Business Strategy 6 (1): pp. 321-326.
279. Wang, G. – Gunasekaran, A. - Ngai, E.W. - Papadopoulos, T. (2016): Big data analytics in logistics and supply chain management: Certain investigations for research and applications. Int. J. Prod. Econ. 176, pp. 98–110.
280. Wang, S. – Noe, R. A. (2010): Knowledge sharing: A review and directions for future research. Human Resource Management Review, Vol. 20., pp. 115-131.
281. Weggeman, M. (1996): Knowledge management: the modus operandi for a learning organization. Science, 273, pp. 595–603.
282. Weiser, A. K. – Jarzabkowski, P. – Laamanen, T. (2020): Completing the Adaptive Turn: An Integrative View of Strategy Implementation. Academy of Management Annals, 14(2), pp. 969-1031.
283. Wenger, E. – McDermott, R. – Snyder, W. M. (2002): Cultivating Communities of Practice. Harvard Business School Press, Boston
284. Wenger, E. (1998): Communities of Practice: Learning, Meaning, and Identity. Cambridge University Press
285. Wexler, M. (2001): The who, what and why of knowledge mapping. Journal of Knowledge Management, 5(3), pp. 249-263.
286. Wiig, K.M. (1997): Knowledge management: Where Did it Come from and Where Will it Go?. Expert Systems with Applications, 13, pp. 1-14. https://doi.org/10.1016/S0957-4174(97)00018-3
287. Wiig, K. M. (1999): Comprehensive Knowledge management. Working Paper KRI #1999- 4, Revision 2, Knowledge Research Institute, Inc, Arlington, TX.
288. Winter, S. G. (1987): Knowledge and Competence as Strategic Assets. In Knowledge and Strategy, Chapter 9, Butterworth-Heinemann, pp. 157-180. https://doi.org/10.1016/B978-0-7506-7088-3.50012-7
289. Wu, L. Y. (2010): Applicability of the resource-based and dynamic-capability views under environmental volatility. Journal of Business Research, 63(1), pp. 27-31.
290. Xin, H. – Yu, T. – Keisuke, N. – Masayuki, N. - Ang Liu (2023): Opportunities and challenges of ChatGPT for design knowledge management. Procedia CIRP, Vol. 119, pp. 21-28, https://doi.org/10.1016/j.procir.2023.05.001.

291. Yin, R. K. (2009): Case study research: Design and methods. Sage Publications, Inc.
292. Zack, M.H. (1999): Developing a knowledge strategy. California Management Review, 41, pp. 125-145.
293. Zaim, H. – Muhammed, S. – Tarim, M. (2018): Relationship between knowledge management processes and performance: Critical role of knowledge utilization in organisations. Knowledge management Research and Practice, 17(1), pp. 24-38.
294. Zanuzzi, C.M.D.S. – Selig, P.M. – Pacheco, R.C.D.S – Tonial, G. (2020): Digital transformation and Brazilian agribusiness: an analysis of knowledge management in the sector. Knowledge, People, and Digital Transformation, Springer, Cham, pp. 85-101.
295. Zimmerman, A. – Lorenz, A. – Specht, M. (2003): The Use of an Information Brokering Tool in an Electronic Museum Environment. Retrieved from https://www.archimuse.com/mw2003/papers/zimmermann/zimmermann.html
296. Zhong, R.Y. – Xu, X. – Klotz, E. – Newman, S.T. (2017): Intelligent manufacturing in the context of industry 4.0: a review. Engineering, Vol. 3 No. 5, pp. 616-630, doi: 10.1016/J.ENG.2017.05.015.

9. Appendix

9.1. Appendix – Survey questionnaire

The power of digital knowledge - organisational knowledge management in the light of emerging technologies

Information about the organisation

1.1. Which industry* does your company operate in?

** https://www.ksh.hu/docs/osztalyozasok/teaor/teaor_structure.pdf*

☐ Agriculture, forestry and fishing
☐ Mining and quarrying
☐ Manufacturing
☐ Electricity, gas, steam and air conditioning supply
☐ Water supply; sewerage, waste management and remediation activities
☐ Construction
☐ Wholesale and retail trade; repair of motor vehicles and motorcycles
☐ Transportation and storage
☐ Accommodation and food service activities
☐ Information and communication
☐ Financial and insurance activities
☐ Real estate activities
☐ Professional, scientific and technical activities
☐ Administrative and support service activities
☐ Public administration and defence; compulsory social security
☐ Education
☐ Human health and social work activities
☐ Arts, entertainment and recreation
☐ Other service activities
☐ Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
☐ Activities of extraterritorial organisations and bodies

1.2. Is the company a foreign company's Hungarian subsidiary?

☐ Yes
☐ No

1.2.1. If your employer is a Hungarian subsidiary of a foreign company, what is the nationality of the foreign parent company?

(Completing the question is optional.)

☐ Austrian
☐ German
☐ American
☐ Japanese
☐ French
☐ Chinese
☐ British
☐ Other:

1.3. What is the size of the organisation based on the total number of employees in Hungary?

☐ 0-49 employees
☐ 50-99 employees
☐ 100-249 employees
☐ 250-499 employees
☐ 500+ employees

1.4. What is the organisation's annual net sales?

Public data available at *https://www.nemzeticegtar.hu*.

☐ up to 2 million euros (720 million forints)
☐ between EUR 2 million - EUR 10 million (HUF 720 million - HUF 3,600 million)
☐ between EUR 10 million - EUR 50 million (HUF 3,600 million - HUF 18,000 million)
☐ over 50 million euros (18,000 million forints)

1.5. How would you describe your company's technological intensity*?

(Please tick the appropriate answer for all items listed!)

	1- very low technological intensity	2- rather not technology-intensive	3- rather technology-intensive	4- very high technological intensity	I do not know
Technological intensity of products and services	☐	☐	☐	☐	☐
Technological intensity of company operational processes	☐	☐	☐	☐	☐

**Technological intensity refers to the extent to which machines and technology in general support autonomous human action during work processes.*

Knowledge management and emerging technologies

'Knowledge management (KM) describes the process of acquiring, developing, sharing, exploiting and protecting organisational knowledge in order to improve the competitiveness of organisations.'

(Gaál et al., 2009)

'Emerging technologies are new technologies that are currently being developed or will be developed in the next 5-10 years and have a lasting economic or social impact.'

(BusinessDictionary.com, 2020)

2.1. Does your organisation have an overall knowledge management strategy?

☐ Yes, it is part of the corporate strategy
☐ Yes, a sub-strategy of an independent area
☐ No
☐ I do not know

2.2. Does your organisation have any knowledge management projects?

☐ I have no information about knowledge management projects
☐ Assessment is in progress currently whether there is a need for such a project
☐ We have a knowledge management project
☐ We do not have a knowledge management project and do not plan to introduce one
☐ The knowledge management project is being developed
☐ We thought about introducing the program, but rejected it
☐ I do not know

2.2.1. If your organisation does not have a knowledge management strategy / project, please indicate to what extent the listed items represent an impediment!

(Please tick the appropriate answer for all items listed!)

	1 - not an impediment at all	2 – impediment to a small extent	3 – somewhat an impediment	4 – impediment to a great extent	I do not know
Knowledge management is not part of the daily work	☐	☐	☐	☐	☐
Lack of knowledge sharing culture	☐	☐	☐	☐	☐
Lack of time, wrong priorities	☐	☐	☐	☐	☐
Knowledge management is not integrated into business processes	☐	☐	☐	☐	☐
Top management is not aware of the	☐	☐	☐	☐	☐

importance of knowledge management

2.3. Who is the main initiator of knowledge management projects in your organisation?

(Please tick the appropriate answer for all items listed!)

☐ Top Management
☐ Middle management
☐ Colleagues
☐ Parent company
☐ We do not have a knowledge management project
☐ I do not know
☐ Other:

2.4. When you need information to solve a problem, who/what do you turn to most?

(Please tick the appropriate answer for all items listed!)

	1 – not relevant at all	**2 – relevant to a small extent**	**3 – highly relevant**	**4 – fully relevant**
I turn to my colleague	☐	☐	☐	☐
I turn to external sources (e.g. internet)	☐	☐	☐	☐
I check the organisational database	☐	☐	☐	☐

2.5. Which of the following technologies/practices exist at your organisation?

(Please tick the appropriate answer for all items listed!)

☐ Document management and knowledge base system (system for systematic storage, retrieval and distribution of knowledge-bearing documents)
☐ Centre of Excellence (centre bringing together consultants with the greatest knowledge and experience in a given field)
☐ Knowledge map (database that shows who and what competencies they have in specific areas within the organisation)
☐ Intra-organisational social technologies
☐ Internal blogs
☐ Information sharing
☐ Intranet network (‘internal Facebook’)
☐ Messaging network (‘Chat’)

☐ Participation in professional communities (professional forum of people collaborating in a given field)
☐ Internal trainings (online, personal)
☐ I do not know
☐ Other:

2.6. Which technologies are permitted to be used in your organisation and which of the following do you use in your work?

(Please tick the appropriate answer for all items listed!)

	Permitted to be used within the organisation	**I use it at work**	**We do not use it**	**I do not know**
External professional communities *(e.g. meetup, webinar)*	☐	☐	☐	☐
Social networking services (*e.g. Facebook, LinkedIn*)	☐	☐	☐	☐
External messaging network (*e.g. Skype, Viber, Messenger)*	☐	☐	☐	☐
External video sharing tools *(e.g. YouTube)*	☐	☐	☐	☐
Groupware tools *(e.g. Google Docs, GoogleDrive, Planner, OneDrive, OneNote, Teams)*	☐	☐	☐	☐
Professional blogs (*e.g. Blogger*) **and microblogs** (*e.g. Twitter*)	☐	☐	☐	☐
External presentation sharing tools (*e.g. Slideshare*)	☐	☐	☐	☐
Cloud based company-owned network storage (intranet)	☐	☐	☐	☐
Company-owned offline storage (intranet)	☐	☐	☐	☐

2.7. In case other tools than those listed in the previous question are used at your organisation, please name them!

(Completing the question is optional.)

2.8. Which of the following emerging technologies is used (or is being implemented) at your organisation?

(Please tick the appropriate answer for all items listed!)

☐ Business intelligence application (e.g. PowerBI, SAP Analytics Cloud, etc.)
☐ Ticket management system (e.g. JIRA, SPC, ServiceNow, etc.)
☐ Chatbot
☐ E-HR
☐ Biometric authentication
☐ VR technologies
☐ 3D printing
☐ Management Information System (MIS)
☐ Collaborative technologies (e.g. Slack)
☐ Artificial intelligence (AI) (e.g. TensorFlow, IBM Watson)
☐ Fraud detection software
☐ Content-based recommendation system
☐ Virtual assistant
☐ Robotic process automation (RPA) (e.g. Power Automate)
☐ Customer relationship management (CRM) (e.g. Aaron, Presence AI, Spin)
☐ Drones
☐ Internet of Things (IoT)
☐ Big data, data mining
☐ None of the listed
☐ Other:

2.9. In case only a few (0-3) of the previously listed emerging technologies are used, please indicate to what extent the listed ones represent an obstacle!

(Please tick the appropriate answer for all items listed!)

	1 - not an impediment at all	2 – impediment to a small extent	3 – somewhat an impediment	4 – impediment to a great extent	I do not know
The workforce does not have digital competencies	☐	☐	☐	☐	☐
Lack of access to digital infrastructure	☐	☐	☐	☐	☐
Labour market regulations	☐	☐	☐	☐	☐
Business regulations, taxation	☐	☐	☐	☐	☐
Lack of funding	☐	☐	☐	☐	☐
Uncertainty about the future	☐	☐	☐	☐	☐

2.10. How has the use of the following emerging technologies developed in your organisation as a result of the Covid-19 pandemic (compared to the level before the pandemic)?

(Please tick the appropriate answer for all items listed!)

	1 - Increased	2 – No change	3 - Decreased	We do not use it	I do not know
Business intelligence application (e.g. PowerBI, SAP Analytics Cloud, etc.)	☐	☐	☐	☐	☐
Ticket management system (e.g. JIRA, SPC, ServiceNow, etc.)	☐	☐	☐	☐	☐
Chatbot	☐	☐	☐	☐	☐
E-HR	☐	☐	☐	☐	☐
Biometric authentication	☐	☐	☐	☐	☐
VR technologies	☐	☐	☐	☐	☐
3D printing	☐	☐	☐	☐	☐
Management Information System (MIS)	☐	☐	☐	☐	☐
Collaborative technologies (e.g. Slack)	☐	☐	☐	☐	☐
Artificial intelligence (AI) (e.g. TensorFlow, IBM Watson)	☐	☐	☐	☐	☐
Fraud detection software	☐	☐	☐	☐	☐
Content-based recommendation system	☐	☐	☐	☐	☐
Virtual assistant	☐	☐	☐	☐	☐
Robotic process automation (RPA) (e.g. Power Automate)	☐	☐	☐	☐	☐
Customer relationship management (CRM) (e.g. Aaron, Presence AI, Spin)	☐	☐	☐	☐	☐
Drones	☐	☐	☐	☐	☐
Internet of Things (IoT)	☐	☐	☐	☐	☐
Big data, data mining	☐	☐	☐	☐	☐

General Information

3.1. What is your gender?

(Completing the question is optional.)

☐ Female
☐ Male

3.2. To which generation do you belong based on your age?

☐ 'Big generation'(born between 1946-1964)
☐ X generation (born between 1965-1979)
☐ Y generation (born between 1980-1994)
☐ Z generation (born between 1995-2009)

3.3. What is your highest level of education?

☐ Elementary school
☐ Vocational school
☐ Graduation
☐ Higher level vocational training
☐ College/university bachelor degree (BA / BSc)
☐ College/university master's degree MSc / MBA)
☐ PhD

3.4. What is your position in the organisation?

☐ Subordinate (mental)
☐ Subordinate (physical)
☐ Manager (top)
☐ Manager (middle)

3.5. What is your role / field within the organisation?

☐ Owner
☐ Management
☐ HR management
☐ Strategy and planning
☐ IT management
☐ Economy/finance
☐ Marketing management
☐ Procurement/logistics
☐ Consulting
☐ Knowledge management
☐ Other:

9.2. Appendix – Knowledge management strategy - emerging technologies

		Overall knowledge management strategy				
		No	Yes, a sub-strategy of an independent area	Yes, it is part of the corporate strategy	Chi-Square	Cramer V
Business intelligence application	yes	124	65	203	232.642	0.303
	yes %	31.6%	16.6%	51.8%		
	no	1534	172	444		
	no %	71.3%	8.0%	20.7%		
Ticket management system	yes	152	38	169	111.070	0.209
	yes %	42.3%	10.6%	47.1%		
	no	1506	199	478		
	no %	69.0%	9.1%	21.9%		
Chatbot	yes	53	26	89	92.125	0.190
	yes %	31.5%	15.5%	53.0%		
	no	1605	211	558		
	no %	67.6%	8.9%	23.5%		
E-HR	yes	56	42	113	151.822	0.244
	yes %	26.5%	19.9%	53.6%		
	no	1602	195	534		
	no %	68.7%	8.4%	22.9%		
Biometric authentication	yes	46	18	53	36.434	0.120
	yes %	39.3%	15.4%	45.3%		
	no	1612	219	594		
	no %	66.5%	9.0%	24.5%		
VR technologies	yes	40	15	68	67.533	0.163
	yes %	32.5%	12.2%	55.3%		
	no	1618	222	579		
	no %	66.9%	9.2%	23.9%		
3D printing	yes	135	33	102	31.488	0.111
	yes %	50.0%	12.2%	37.8%		
	no	1523	204	545		
	no %	67.0%	9.0%	24.0%		
Management Information System	yes	141	53	199	185.856	0.270
	yes %	35.9%	13.5%	50.6%		
	no	1517	184	448		
	no %	70.6%	8.6%	20.8%		
Collaborative technologies	yes	185	62	206	148.333	0.242
	yes %	40.8%	13.7%	45.5%		
	no	1473	175	441		
	no %	70.5%	8.4%	21.1%		
Artificial intelligence	yes	19	13	59	88.459	0.187

	yes %	20.9%	14.3%	64.8%		
	no	1639	224	588		
	no %	66.9%	9.1%	24.0%		
Fraud detection software	yes	27	23	62	87.333	0.185
	yes %	24.1%	20.5%	55.4%		
	no	1631	214	585		
	no %	67.1%	8.8%	24.1%		
Content-based recommendation system	yes	42	15	59	48.220	0.138
	yes %	36.2%	12.9%	50.9%		
	no	1616	222	588		
	no %	66.6%	9.2%	24.2%		
Virtual assistant	yes	43	17	57	44.892	0.133
	yes %	36.8%	14.5%	48.7%		
	no	1615	220	590		
	no %	66.6%	9.1%	24.3%		
Robotic process automation	yes	54	32	100	116.868	0.214
	yes %	29.0%	17.2%	53.8%		
	no	1604	205	547		
	no %	68.1%	8.7%	23.2%		
Customer relationship management	yes	37	21	58	59.525	0.153
	yes %	31.9%	18.1%	50.0%		
	no	1621	216	589		
	no %	66.8%	8.9%	24.3%		
Drones	yes	104	21	54	-	-
	yes %	58.1%	11.7%	30.2%		
	no	1554	216	593		
	no %	65.8%	9.1%	25.1%		
Internet of Things	yes	79	24	104	80.952	0.178
	yes %	38.2%	11.6%	50.2%		
	no	1579	213	543		
	no %	67.6%	9.1%	23.3%		
Big data, data mining	yes	99	36	163	169,198[a]	0.258
	yes %	33.2%	12.1%	54.7%		
	no	1559	201	484		
	no %	69.5%	9.0%	21.6%		
None of the listed	yes	1003	44	131	384.261	0.389
	yes %	85.1%	3.7%	11.1%		
	no	655	193	516		
	no %	48.0%	14.1%	37.8%		

Table 77. Knowledge management strategy - emerging technologies

Source: own edition

9.3. Appendix – Permitted technologies - sectoral approach

External professional communities			Not in use	In use	Total
Sectoral	Primary	Count	22	42	64
		% within Sectoral	34.4%	65.6%	100.0%
	Secondary	Count	147	284	431
		% within Sectoral	34.1%	**65.9%**	100.0%
	Tertiary	Count	577	1511	2088
		% within Sectoral	27.6%	**72.4%**	100.0%
Total		Count	746	1837	2583
		% within Sectoral	28.9%	71.1%	100.0%
Pearson Chi-Square (8.251 df=2 sign.=0.016); Cramer V (0.056)					

Table 78. External professional communities - sectoral approach

Source: own edition

Social networking services			Not in use	In use	Total
Sectoral	Primary	Count	24	38	62
		% within Sectoral	38.7%	61.3%	100.0%
	Secondary	Count	208	228	436
		% within Sectoral	47.7%	52.3%	100.0%
	Tertiary	Count	647	1464	2111
		% within Sectoral	30.6%	**69.4%**	100.0%
Total		Count	879	1730	2609
		% within Sectoral	33.7%	66.3%	100.0%
Pearson Chi-Square (47.780 df=2 sign.=0.000); Cramer V (0.135)					

Table 79. Social networking services - sectoral approach

Source: own edition

External messaging network			Not in use	In use	Total
Sectoral	Primary	Count	14	52	66
		% within Sectoral	21.2%	**78.8%**	100.0%
	Secondary	Count	119	321	440
		% within Sectoral	27.0%	73.0%	100.0%
	Tertiary	Count	420	1704	2124
		% within Sectoral	19.8%	**80.2%**	100.0%
Total		Count	553	2077	2630
		% within Sectoral	21.0%	79.0%	100.0%
Pearson Chi-Square (11.607 df=2 sign.=0.003); Cramer V (0.066)					

Table 80. External messaging network - sectoral approach

Source: own edition

External video sharing tools			Not in use	In use	Total
Sectoral	Primary	Count	36	29	65
		% within Sectoral	55.4%	44.6%	100.0%
	Secondary	Count	251	187	438
		% within Sectoral	57.3%	42.7%	100.0%
	Tertiary	Count	947	1152	2099
		% within Sectoral	45.1%	**54.9%**	100.0%
Total		Count	1234	1368	2602
		% within Sectoral	47.4%	52.6%	100.0%
Pearson Chi-Square (23.288 df=2 sign.=0.000); Cramer V (0.095)					

Table 81. External video sharing tools - sectoral approach

Source: own edition

Groupware tools			Not in use	In use	Total
Sectoral	Primary	Count	24	37	61
		% within Sectoral	39.3%	60.7%	100.0%
	Secondary	Count	114	319	433
		% within Sectoral	26.3%	73.7%	100.0%
	Tertiary	Count	516	1569	2085
		% within Sectoral	24.7%	**75.3%**	100.0%
Total		Count	654	1925	2579
		% within Sectoral	25.4%	74.6%	100.0%
Pearson Chi-Square (6.929 df=2 sign.=0.031); Cramer V (0.052)					

Table 82. Groupware tools - sectoral approach

Source: own edition

Professional blogs and microblogs			Not in use	In use	Total
Sectoral	Primary	Count	44	19	63
		% within Sectoral	69.8%	30.2%	100.0%
	Secondary	Count	318	104	422
		% within Sectoral	75.4%	24.6%	100.0%
	Tertiary	Count	1271	777	2048
		% within Sectoral	62.1%	**37.9%**	100.0%
Total		Count	1633	900	2533
		% within Sectoral	64.5%	35.5%	100.0%
Pearson Chi-Square (27.814 df=2 sign.=0.000); Cramer V (0.105)					

Table 83. Professional blogs and microblogs - sectoral approach

Source: own edition

External presentation sharing tools			Not in use	In use	Total
Sectoral	Primary	Count	49	13	62
		% within Sectoral	79.0%	21.0%	100.0%
	Secondary	Count	338	74	412
		% within Sectoral	82.0%	18.0%	100.0%
	Tertiary	Count	1469	539	2008
		% within Sectoral	73.2%	**26.8%**	100.0%
Total		Count	1856	626	2482
		% within Sectoral	74.8%	25.2%	100.0%
Pearson Chi-Square (14.908 df=2 sign.=0.001); Cramer V (0.078)					

Table 84. External presentation sharing tools - sectoral approach

Source: own edition

Cloud based company-owned network storage			Not in use	In use	Total
Sectoral	Primary	Count	32	32	64
		% within Sectoral	50.0%	50.0%	100.0%
	Secondary	Count	176	251	427
		% within Sectoral	41.2%	58.8%	100.0%
	Tertiary	Count	684	1374	2058
		% within Sectoral	33.2%	**66.8%**	100.0%
Total		Count	892	1657	2549
		% within Sectoral	35.0%	65.0%	100.0%
Pearson Chi-Square (16.402 df=2 sign.=0,080); Cramer V (0.078)					

Table 85. Cloud based company-owned network storage - sectoral approach

Source: own edition

9.4. Appendix – Emerging technologies in use in sectoral approach

	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas, steam and air conditioning supply	Water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles	Transportation and storage	Accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities	Administrative and support service activities	Public administration and defence; compulsory social security	Education	Human health and social work activities	Arts, entertainment and recreation	Other service activities	Activities of extraterritorial organisations and bodies
industry (N)	68	3	122	59	25	240	96	30	31	402	223	36	413	149	31	127	213	98	312	31
Business intelligence	8	1	28	13	2	14	19	6	2	117	33	3	58	25	2	13	21	13	29	9
proportion of users within the industry	11.76%	33.33%	22.95%	22.03%	8.00%	5.83%	19.79%	20.00%	6.45%	29.10%	14.80%	8.33%	14.04%	16.78%	6.45%	10.24%	9.86%	13.27%	9.29%	29.03%
Ticket management	0	1	10	3	1	5	10	3	3	184	20	2	64	12	5	8	6	6	38	5
proportion of users within the industry	0.00%	33.33%	8.20%	5.08%	4.00%	2.08%	10.42%	10.00%	9.68%	45.77%	8.97%	5.56%	15.50%	8.05%	16.13%	6.30%	2.82%	6.12%	12.18%	16.13%
Chatbot	4	0	6	4	0	2	4	1	3	50	19	1	23	7	1	8	11	9	23	4
proportion of users within the industry	5.88%	0.00%	4.92%	6.78%	0.00%	0.83%	4.17%	3.33%	9.68%	12.44%	8.52%	2.78%	5.57%	4.70%	3.23%	6.30%	5.16%	9.18%	7.37%	12.90%
E-HR	6	0	10	7	3	6	8	7	2	47	28	1	23	15	4	12	11	7	22	5
proportion of users within the industry	8.82%	0.00%	8.20%	11.86%	12.00%	2.50%	8.33%	23.33%	6.45%	11.69%	12.56%	2.78%	5.57%	10.07%	12.90%	9.45%	5.16%	7.14%	7.05%	16.13%
Biometric authentication	2	1	2	1	3	9	1	0	2	25	11	1	17	8	3	1	8	9	15	1
proportion of users within the industry	2.94%	33.33%	1.64%	1.69%	12.00%	3.75%	1.04%	0.00%	6.45%	6.22%	4.93%	2.78%	4.12%	5.37%	9.68%	0.79%	3.76%	9.18%	4.81%	3.23%
VR technologies	0	1	9	1	0	8	4	1	0	25	3	1	32	7	1	4	7	10	9	3
proportion of users within the industry	0.00%	33.33%	7.38%	1.69%	0.00%	3.33%	4.17%	3.33%	0.00%	6.22%	1.35%	2.78%	7.75%	4.70%	3.23%	3.15%	3.29%	10.20%	2.88%	9.68%
3D printing	1	1	30	8	2	25	11	0	1	32	7	1	81	9	1	7	25	14	20	7
proportion of users within the industry	1.47%	33.33%	24.59%	13.56%	8.00%	10.42%	11.46%	0.00%	3.23%	7.96%	3.14%	2.78%	19.61%	6.04%	3.23%	5.51%	11.74%	14.29%	6.41%	22.58%
Management Information	6	1	27	11	8	19	16	10	6	104	30	1	56	26	6	25	19	5	31	7
proportion of users within the industry	8.82%	33.33%	22.13%	18.64%	32.00%	7.92%	16.67%	33.33%	19.35%	25.87%	13.45%	2.78%	13.56%	17.45%	19.35%	19.69%	8.92%	5.10%	9.94%	22.58%
Collaborative technologies (e.g.	6	0	9	5	1	27	11	4	4	163	30	2	82	20	4	17	14	20	38	10
proportion of users within the industry	8.82%	0.00%	7.38%	8.47%	4.00%	11.25%	11.46%	13.33%	12.90%	40.55%	13.45%	5.56%	19.85%	13.42%	12.90%	13.39%	6.57%	20.41%	12.18%	32.26%
Artificial intelligence	0	0	4	0	0	2	2	0	0	39	5	0	17	4	1	1	6	1	11	1
proportion of users within the industry	0.00%	0.00%	3.28%	0.00%	0.00%	0.83%	2.08%	0.00%	0.00%	9.70%	2.24%	0.00%	4.12%	2.68%	3.23%	0.79%	2.82%	1.02%	3.53%	3.23%
Fraud detection software	2	0	5	1	2	5	6	0	0	33	18	0	13	5	0	5	3	1	16	5
proportion of users within the industry	2.94%	0.00%	4.10%	1.69%	8.00%	2.08%	6.25%	0.00%	0.00%	8.21%	8.07%	0.00%	3.15%	3.36%	0.00%	3.94%	1.41%	1.02%	5.13%	16.13%
Content-based recommendation	2	0	1	1	1	6	6	0	1	31	12	1	10	7	0	10	6	9	11	6
proportion of users within the industry	2.94%	0.00%	0.82%	1.69%	4.00%	2.50%	6.25%	0.00%	3.23%	7.71%	5.38%	2.78%	2.42%	4.70%	0.00%	7.87%	2.82%	9.18%	3.53%	19.35%
Virtual assistant	0	0	3	1	0	10	3	2	0	19	9	2	21	14	2	9	9	3	12	3
proportion of users within the industry	0.00%	0.00%	2.46%	1.69%	0.00%	4.17%	3.13%	6.67%	0.00%	4.73%	4.04%	5.56%	5.08%	9.40%	6.45%	7.09%	4.23%	3.06%	3.85%	9.68%
Robotic process automation	2	1	12	1	1	9	6	1	2	58	21	0	34	10	2	5	7	1	15	3
proportion of users within the industry	2.94%	33.33%	9.84%	1.69%	4.00%	3.75%	6.25%	3.33%	6.45%	14.43%	9.42%	0.00%	8.23%	6.71%	6.45%	3.94%	3.29%	1.02%	4.81%	9.68%
Customer relationship	1	0	4	3	0	4	1	2	1	27	15	0	15	11	0	5	10	3	14	4
proportion of users within the industry	1.47%	0.00%	3.28%	5.08%	0.00%	1.67%	1.04%	6.67%	3.23%	6.72%	6.73%	0.00%	3.63%	7.38%	0.00%	3.94%	4.69%	3.06%	4.49%	12.90%
Drones	20	1	6	8	2	31	1	3	3	21	4	4	34	1	4	7	1	15	25	1
proportion of users within the industry	29.4%	33.3%	4.9%	13.6%	8.0%	12.9%	1.0%	10.0%	9.7%	5.2%	1.8%	11.1%	8.2%	0.7%	12.9%	5.5%	0.5%	15.3%	8.0%	3.2%
Internet of Things	3	0	10	7	2	9	7	1	2	76	8	0	42	6	1	5	8	2	26	5
proportion of users within the industry	4.41%	0.00%	8.20%	11.86%	8.00%	3.75%	7.29%	3.33%	6.45%	18.91%	3.59%	0.00%	10.17%	4.03%	3.23%	3.94%	3.76%	2.04%	8.33%	16.13%
Big data, data mining	4	1	15	8	2	5	15	4	1	92	24	2	57	15	2	15	17	7	25	7
proportion of users within the industry	5.88%	33.33%	12.30%	13.56%	8.00%	2.08%	15.63%	13.33%	3.23%	22.89%	10.76%	5.56%	13.80%	10.07%	6.45%	11.81%	7.98%	7.14%	8.01%	22.58%
None of the listed	34	2	51	31	11	144	43	13	16	81	120	21	167	83	17	65	134	44	178	10
proportion of users within the industry	50.00%	66.67%	41.80%	52.54%	44.00%	60.00%	44.79%	43.33%	51.61%	20.15%	53.81%	58.33%	40.44%	55.70%	54.84%	51.18%	62.91%	44.90%	57.05%	32.26%

Table 86. Emerging technologies in use in sectoral approach (1)

Source: own edition

	primary	secondary	tertiary	Chi-square, examines the existence of a relationship	Cramer's V, examines the strength of the
	71	446	2162	Chi-square	Cramer V
Business intelligence application	9	57	341		
proportion of users within the industry	12.68%	12.78%	15.77%		
Ticket management system	1	19	361		
proportion of users within the industry	1.41%	4.26%	16.70%	56,734 (0,000)	0.146
Chatbot	4	12	160		
proportion of users within the industry	5.63%	2.69%	7.40%	14,481(0,0001)	0.071
E-HR	6	26	187		
proportion of users within the industry	8.45%	5.83%	8.65%		
Biometric authentication	3	15	101		
proportion of users within the industry	4.23%	3.36%	4.67%		
VR technologies	1	18	10		
proportion of users within the industry	1.41%	4.04%	0.46%		
3D printing	2	65	209		
proportion of users within the industry	2.82%	14.57%	9.67%	14,038 (0,001)	0.072
Management Information System	7	65	335		
proportion of users within the industry	9.86%	14.57%	15.49%		
Collaborative technologies	6	42	409		
proportion of users within the industry	8.45%	9.42%	18.92%		
Artificial intelligence	0	6	87		
proportion of users within the industry	0.00%	1.35%	4.02%	10,549 (0,005)	0.063
Fraud detection software	2	13	100		
proportion of users within the industry	2.82%	2.91%	4.63%		
Content-based recommendation system	2	9	104		
proportion of users within the industry	2.82%	2.02%	4.81%	7,413 (0,025)	0.053
Virtual assistant	0	14	105		
proportion of users within the industry	0.00%	3.14%	4.86%		
Robotic process automation	3	23	163		
proportion of users within the industry	4.23%	5.16%	7.54%		
Customer relationship management	1	14	116		
proportion of users within the industry	1.41%	3.14%	5.37%	6,415 (0,040)	0.049
Drones	21	47	123		
proportion of users within the industry	29.58%	10.54%	5.69%	68,538 (0,000)	0.16
Internet of Things	4	28	143		
proportion of users within the industry	5.63%	6.28%	6.61%		
Big data, data mining	5	30	276		
proportion of users within the industry	7.04%	6.73%	12.77%	14,648 (0,001)	0.074
None of the listed	36	237	982		
proportion of users within the industry	50.70%	53.14%	45.42%	9,228 (0,010)	0.059

Table 87. Emerging technologies in use in sectoral approach (2)

Source: own edition

Change in emerging technologies - sectors																	
	Primary (N=58)				Secondary (N=405)				Tertiary (N=1964)				Growth			Effect	
	Increased	No change	Decreased	We do not	Increased	No change	Decreased	We do not	Increased	No change	Decreased	We do not	Primary	Secondary	Tertiary	Chi-square	Cramer V
Business intelligence ap	10	12	2	38	48	61	1	297	242	366	23	1330	17%	12%	12%		
Ticket management sys	0	8	2	48	6	39	1	359	145	380	16	1423	0%	1%	7%	59,875[a]	0.111
Chatbot	6	8	1	43	16	36	1	356	116	256	15	1540	10%	4%	6%	14.924	0.56
E-HR	2	11	2	41	13	44	2	340	104	293	23	1499	3%	3%	5%	15.101	0.056
Biometric authenticatio	1	10	1	50	9	35	2	359	52	237	11	1633	2%	2%	3%		
VR technologies	2	7	1	49	9	43	3	350	66	243	16	1601	3%	2%	3%		
3D printing	1	8	1	50	17	73	6	314	80	290	27	1558	2%	4%	4%		
Management Informat	7	12	2	40	34	61	4	300	172	381	15	1372	12%	8%	9%		
Collaborative technolo	9	6	2	42	27	54	2	326	316	300	19	1307	16%	7%	16%	35.821	0.086
Artificial intelligence	1	8	1	46	6	36	1	357	54	239	11	1607	2%	1%	3%		
Fraud detection softwa	0	8	0	49	8	40	1	348	48	238	12	1612	0%	2%	2%		
Content-based recomn	4	11	1	41	6	40	5	348	103	248	17	1533	7%	1%	5%	18.737	0.063
Virtual assistant	4	9	1	41	7	41	0	350	89	242	20	1556	7%	2%	5%	16.695	0.059
Robotic process autom	2	8	1	43	7	51	0	341	105	249	14	1545	3%	2%	5%	14.85	0.056
Customer relationship	1	8	2	43	6	36	0	356	80	240	14	1569	2%	1%	4%	22.899	0.07
Drones	11	11	2	36	10	60	3	338	55	242	17	1623	19%	2%	3%	55.614	0.107
Internet of Things (IoT)	5	10	1	42	15	54	2	334	122	295	12	1480	9%	4%	6%		
Big data, data mining	5	10	0	40	17	49	2	343	162	311	16	1439	9%	4%	8%	16.82	0.059

Table 88. Change in emerging technologies by sectors

Source: own edition

INTERVIEW PROTOCOL

LOCATION, DATE, PARTICIPANT:

CONCEPTS

We refer to **emerging technologies** as those new technologies that are currently being developed or will be developed in the next 5-10 years, and have a lasting economic or social impact. (BusinessDictionary.com, 2020)

Included in this category, for example (Gartner, 2020):

- Bi-directional brain-machine interface
- Private 5G
- Biodegradable sensors
- Artificial Intelligence
  - AI marketplaces,
  - Deep learning networks (e.g., ‘deep neural networks’, ‘deep learning’)
  - Smart robots,
  - AI-enhanced developments,
  - Extended intelligence,
  - Intelligent applications,
  - Chatbots,
  - Knowledge graphs,
  - Machine learning,
  - Autonomous vehicles,
  - Social distancing technologies, etc.

Knowledge management: ‘Knowledge management (KM) describes the process of acquiring, developing, sharing, leveraging, and protecting organisational knowledge to improve the competitiveness of organisations.’ (Gaál et al., 2009).

I. INTRODUCTION TO THE TOPIC

1. What is your opinion on emerging technologies? How do you interpret them?
2. How do you think we stand in terms of applying emerging technologies in Hungary? What does this mean compared to the performance of other countries?

II. CORPORATE PRACTICE

1. What technology/tool is used in your company for the automation of internal processes? In which areas and for which processes do they appear?
2. Does your company use artificial intelligence tools? If so, which tool, for what purpose, and in what area?
3. Are there any job roles in your company that have been completely/partially replaced by any emerging technologies? What are these roles? In your company, do these technologies mainly serve a supportive function or do they replace job roles?
4. Are there any new job roles in your company that have emerged as a result of introducing emerging technologies? What are these roles?
5. From the perspective of the employees, what changes do you observe due to the emergence of new technologies?
6. In which area and with which tool do you plan to implement in the next 5 years at your company?

III. PERSONAL INSIGHT

1. On which areas do you see the potential and/or necessity of implementing emerging technologies as particularly important for your own company?
2. What are your expectations when looking at technological advancements? What benefits can they bring and what arguments support their implementation? What primarily motivates your organisation in adopting emerging technologies?
3. What arguments and considerations would you list against the introduction of emerging technologies? What factors complicate/hinder their introduction (if there are any)? How can one prepare for these?
4. Do you think your company leads in the application of new technologies compared to competitors?

IV. KNOWLEDGE MANAGEMENT AND EMERGING TECHNOLOGIES

1. What tools/technology does your company use to support knowledge and information sharing?

2. Does the application of emerging technology facilitate knowledge utilisation in your company? Do new technologies integrate into the knowledge-sharing process? If so, which ones and how?
3. How does your company manage the knowledge assets created and accumulated by new technologies? What positive/negative experiences have you had so far?

ADDITIONAL REMARKS, OBSERVATIONS, OPINION, FEEDBACK:

9.6. Appendix – Interview case studies

9.6.1. INTERVIEW 1.

LOCATION, DATE, PARTICIPANT:

Budapest, 2022.01.14. (online), **'A'**

Information related to the organisation:

• Industry: IT and communication

• Organisation size (based on the number of employees): 0-49 people

CONCEPTS

We refer to **emerging technologies** as those new technologies that are currently being developed or will be developed in the next 5-10 years, and have a lasting economic or social impact. (BusinessDictionary.com, 2020)

Included in this category, for example (Gartner, 2020):

1. Bi-directional brain-machine interface
2. Private 5G
3. Biodegradable sensors
4. Artificial Intelligence
    - AI marketplaces,
    - Deep learning networks (e.g., 'deep neural networks', 'deep learning')
    - Smart robots,
    - AI-enhanced developments,
    - Extended intelligence,
    - Intelligent applications,
    - Chatbots,
    - Knowledge graphs,
    - Machine learning,
    - Autonomous vehicles,
    - Social distancing technologies, etc.

Knowledge management: 'Knowledge management (KM) describes the process of acquiring, developing, sharing, leveraging, and protecting organisational knowledge to improve the competitiveness of organisations.' (Gaál et al., 2009).

INTRODUCTION

What is your opinion on emerging technologies? How do you interpret them?

It's a very good thing, it brings innovation into our lives. Innovations and novelties change our lives, making them, in fortunate cases, better, more beautiful, and more comfortable. The question and the problem is that usually the 'hype' and the fog surrounding these [technologies] are much larger, making it hard to discern who are the real leaders in innovation achieving serious and scientific results, and who are those merely riding these new buzzwords and technologies to produce something they try to sell under that name. So it's hard to see through them, but this is precisely because they're new, and there's no consensus yet on exactly what it means, how to do it, and what we understand by it.

How do you think we stand in terms of applying emerging technologies in Hungary? What does this mean compared to the performance of other countries?

I believe that, obviously on a global scale, we are not at the centre of these emerging technologies and new knowledge. The USA is one of them, and some Western European countries, especially Germany (they lead in this) and China. However, I also think we are closely following them. If we look at our population or GDP ratio, we are in an absolutely fair position. There are many innovative companies in Budapest, and these American, Western European companies also have research and development centres here that deal with these emerging technologies. So we're not leading the list, that's for sure, but I think we are in the second tier right after the first, who still play their part.

CORPORATE PRACTICE

What technology/tool is used in your company for the automation of internal processes? In which areas and for which processes do they appear?

Essentially, we are a company that has an IT product. That is, we develop a product and sell it. I would divide this into two parts. The first part is the automation of development

processes and the technologies, tools, and processes related to product production. This, in IT today, is quite common. We do software development, and the essence of software development is trying to automate as much as possible during the process. For us, it's also a guiding principle to ‘work smarter not harder’. We don't want to achieve great results with overtime but by thinking continuously every day and automating what can be automated, which is straightforward and doesn't require intuitive human thinking. Part of this is that we try to use existing components in the software code for the mundane parts. So, what someone has already done in the world well and stably, we'd rather just use it, and the additional domain knowledge, the local business logic, which is the 'core' value of our product, is primarily what we develop. Also, most of the development process today involves fairly standard things like continuous integration, continuous delivery, automation of software build processing, test automation, which are prevalent in our company. What's especially new and innovative is the management of software containers based on Kubernetes. We run our applications containerised. This has many advantages, it is possible to create a very scalable system, and many additional features can be implemented in a 'cost-cutting' manner that previously someone had to set up individually. The other, which I mentioned earlier, is the CI/CD (continuous integration and continuous delivery) pipeline, for which we use several tools (the specific names of the tools are irrelevant, they do similar things, e.g., Jenkins, Drone). For our development processes, we use a fairly common tool, JIRA for ticket management, and we document most things on an internal knowledge-sharing wiki page called Confluence. We have alert systems that automatically monitor the operation of our system and send an SMS or call the appropriate colleague by phone in case of a problem.

The second part is the general corporate processes and administration. We try to handle everything with some, preferably simple, intuitive, user-friendly tool. Our paper-based processes and things exist only where legally required. Starting with signing the employment contract in DocuSign with electronic signature right at the entry point. For our HR processes, we use BambooHR to track holidays; everyone's positions are in it, it has a shared calendar, and HR's daily administration happens in this. We have a system called Lever where we manage the recruitment process and the applicants, and the hiring process takes place there. We used to have a tool called Settling, which we phased out; we used it for onboarding (managing new entrants' equipment, necessary training, and knowledge management until they can start working). All equipment and access requests

are made through ServiceNow (which is also a widely used system). Within HR, we have two areas; one is talent attraction, which is about attracting and recruiting new people, and the other is employee success, where we try to track the lifecycle related to existing employees. Regarding employee success, we constantly have surveys related to company engagement in a tool called Culture Amp, asking everyone's opinion about our company. Expense reports and organising travels are also automated and done in online tools (everyone books for themselves independently; there isn't a separate department working on booking someone's flight and accommodation to Copenhagen if they need to travel there). So, whatever we can cover with automation, we do cover. But we don't do it in a way that we have a giant enterprise management system, and we monumentalise its development and customisation, but we have a very agile approach, and these multifaceted tools we use. They come and go every 1-2 years. If someone has a good idea and finds a new tool for something, a few of us will look at it, and if it's good, we'll start using it. There isn't a very deliberate and thorough procurement process behind it that we would like a tool for something and put it out to bid, but rather we look for a small simple tool for every area that covers our needs. This also has its downside because one often scratches their head, thinking that it used to be this way and now it's different, and often we use multiple tools in parallel for similar things (because neither is perfect). And this is the key issue, often what consumes a person's energy is that this doesn't become a unified something, and sometimes we don't have the capacity to migrate the old tool and switch entirely to using the new tool, so we use them in parallel, which can be the downside of the matter.

Does your company use artificial intelligence tools? If so, which tool, for what purpose, and in what area?

We don't specifically use them, they don't play a significant role in our lives, just minor aspects in the background. For instance, we use Office365, where we have our documents, and it has a search function. When someone types in a keyword, there's an algorithm behind the searches ensuring the most relevant results are presented. There's a small part in our product that helps our clients create marketing campaigns spanning across social media networks: they can set parameters with us, assemble the marketing campaign from a shared content pool, and we publish it for them (they can schedule the publishing in

advance). And when this goes out, we retrieve the reactions to these from each social media tool, trying to perform a sentiment analysis to gauge how positive the reception is, offering pointers to our users about how successful the campaign was and identifying characteristic words in the comments. But we accomplish this with an external tool; we don't develop it ourselves.

Are there any job roles in your company that have been completely/partially replaced by any emerging technologies? What are these roles?

a. In your company, do these technologies mainly serve a supportive function or do they replace job roles?

We are a relatively new company, the company is 10 years old, but out of that, the first 3-4 years was practically a garage company category with a few people, a few laptops. And from the very beginning, the company was built in a way that we looked for a tool for everything that could easily implement a process, and we used that. So, in our case, no job role was replaced; instead, a supportive function is realised.

Are there any new job roles in your company that have emerged as a result of introducing emerging technologies? What are these roles?

This applies to our entire company, as the whole company is built on the social media industry, which I consider to be a relatively new technology that impacts our lives. The company was created primarily for this reason, so in this sense, it affects all our employees.

From the perspective of the employees, what changes do you observe due to the emergence of new technologies?

We haven't seen any change because we started off with the basics. I can provide an example that often holds true in general, related to cloud operations: even as recent as 10, or even 5 years ago, we often looked for IT operational experts who understood hardware,

physically handled machines, and did network cabling, etc. Such roles are now becoming obsolete, and many are transitioning to cloud-based thinking. This means that the operators of IT and software systems should also possess software knowledge, thus requiring a completely different skill set.

In which area and with which tool do you plan to implement in the next 5 years at your company?

Generally speaking, we are among those companies that are emerging, relatively very innovative, starting as a startup but are now somewhat more mature. Also, the world of social media itself is very new and changes rapidly, year by year, and month by month. Therefore, for us, this 5-10 year vision and planning is a non-existent concept. Our foresight spans 6-12 months ahead, no more. Often, even these 6-month plans can be overwritten after just 3 months. We need to respond very agilely to the changes in the world. This is inherent in our field, and because our product is a 'second layer', a second-round offering: in the first round, there are social media providers, and in the second round, behind them, is a deeper layer of companies that utilise their APIs to create value-added services. We compete in this market, and this means we have to follow these social media networks very closely and swiftly. At any time, we might decide to introduce a new social media network; for instance, in addition to Facebook, Instagram, etc., we might want to support TikTok the day after tomorrow, which would be an additional tool in this sense. Another active project we have is transitioning to Kubernetes in the cloud, and over the next 6 months, we aim to migrate our entire production environment to it (which facilitates container-based software operations for us). That's what I can share at the moment, but we don't think 5 years ahead.

PERSONAL INSIGHT

On which areas do you see the potential and/or necessity of implementing emerging technologies as particularly important for your own company?

Generally speaking, I believe that it is essential day by day, in every area, to automate whatever we can (especially in repetitive tasks), primarily in intellectual work. If we don't,

it can lead to a significant competitive disadvantage. Today, human labour is the most expensive resource for many companies, at least for the innovative ones. In our company, this is especially crucial in software development and operational processes, but it's equally true in all other areas.

What are your expectations when looking at technological advancements? What benefits can they bring and what arguments support their implementation? What primarily motivates your organisation in adopting emerging technologies?

I fully support it. The primary goal is to remain competitive. The company's profile and the specifics of the industry drive the motivation for change.

What arguments and considerations would you list against the introduction of emerging technologies? What factors complicate/hinder their introduction (if there are any)? How can one prepare for these?

The only argument against them is that since these are innovations, there's the possibility of making mistakes. People needs to be receptive to changes (change management) and adapt when working with emerging technologies. Organisations that fundamentally focus on these technologies tend to react more easily, but resistance to change appears in every organisation in relation to new introductions. In our company, the staff understands and reacts positively, but the timing of the introduction often raises the question, 'why now, why not a bit later?'. We try to provide clear and unambiguous communication alongside the changes, explaining why certain actions are taken, their advantages, and everyone is more willing to embrace them if they're explained at their level.

Do you think your company leads in the application of new technologies compared to competitors?

It depends on how broadly I interpret the term ‘competitor’. If I say we're an IT company and our competitors are IT companies, then we absolutely lead in many areas. If I narrow

it down and compare us with our direct competitors, we still lead significantly. However, in this market, it's inherent that similar levels of technology application are observed among competitors because it's a requirement in this very new sector.

KNOWLEDGE MANAGEMENT AND EMERGING TECHNOLOGIES

What tools/technology does your company use to support knowledge and information sharing?

We use a variety of different tools. For each specific area of knowledge, we choose a tool that is a specialised instrument for that purpose; hence, we have a wide and varied set of tools. Among the most significant are: Jira (for ticketing), Confluence (as an internal wiki), and we also store software source code in a centralised source manager, which can be considered a knowledge and information management tool. The decision for the majority of tool selections is made at our parent company in Copenhagen, and it's uniformly handled for every location. Two years ago, an American company acquired us, and slowly, changes are emanating from them, initiating the search for synergies, and a few tools have been introduced, but these still represent the minority.

Does the application of emerging technology facilitate knowledge utilisation in your company? Do new technologies integrate into the knowledge-sharing process? If so, which ones and how?

The incorporation of artificial intelligence isn't very significant, but all the other technologies continuously emerge within our company.

How does your company manage the knowledge assets created and accumulated by new technologies? What positive/negative experiences have you had so far?

We don't have standalone knowledge generated by artificial intelligence.

ADDITIONAL REMARKS, OBSERVATIONS, OPINION, FEEDBACK:

The concepts of short-term and long-term have changed in IT. For us, short-term refers to 2-3 months, while long-term means 1 year. Another point is that it's very difficult to categorise large international companies based on nationality nowadays. For very emerging, innovative companies, emphasising cultural differences isn't permissible.

With the tools that come from the American parent company, there isn't really a conscious strategy, so they often cause confusion. We think, ’we're scratching our heads, there's trouble, have we gone back 10 years in time?’. For instance, using ServiceNow is a disaster (you can send a request but see nothing of it afterward; communication then occurs outside the tool and is protracted).

We are only willing to introduce tools that are relatively small, simple, intuitive, and easy to implement (and not general but specifically tailored for individual topics).

9.6.2. INTERVIEW 2.

LOCATION, DATE, PARTICIPANT:

Budapest (Zoom), 2022.01.22., **'B'**

Information related to the organisation:

- Industry: Manufacturing
- Organisation size (based on the number of employees): 500+ people

CONCEPTS

We refer to **emerging technologies** as those new technologies that are currently being developed or will be developed in the next 5-10 years, and have a lasting economic or social impact. (BusinessDictionary.com, 2020)

Included in this category, for example (Gartner, 2020):

5. Bi-directional brain-machine interface
6. Private 5G
7. Biodegradable sensors
8. Artificial Intelligence
    - AI marketplaces,
    - Deep learning networks (e.g., 'deep neural networks', 'deep learning')
    - Smart robots,
    - AI-enhanced developments,
    - Extended intelligence,
    - Intelligent applications,
    - Chatbots,
    - Knowledge graphs,
    - Machine learning,
    - Autonomous vehicles,
    - Social distancing technologies, etc.

Knowledge management: 'Knowledge management (KM) describes the process of acquiring, developing, sharing, leveraging, and protecting organisational knowledge to improve the competitiveness of organisations.' (Gaál et al., 2009).

INTRODUCTION

What is your opinion on emerging technologies? How do you interpret them?

I certainly see the validity of these technologies, and they are present in our organisation.

In our company, artificial intelligence is primarily manifested in bots and automation. We have a separate global division within the IT organisation for this purpose (which is a very crucial part of the organisation). The top management in IT also believes that we need to move in this direction; automation reduces the need for manual work, and we can focus more on our 'core' activities. A practical example is the chatbot (ITSM chatbot), which is designed with an algorithm to autonomously answer basic questions (it has a built-in script), and only forwards the customer if it can't find a solution within its own database. There's something similar in the HR area for HR-related questions. Market research in the field of artificial intelligence is also very prominent for us, where they use algorithms and bots, but I am not involved in that and don't know the background (this belongs to the robotics team). If we look at industry-leading technologies, for instance, we are about to introduce the world's first biodegradable bottled beverage this year. This is produced using a new kind of technology that is environmentally friendly (this isn't artificial intelligence, but emerging technology - how to produce a material that can keep the liquid long-term without affecting the value of the product inside, yet is biodegradable in the long run).

How do you think we stand in terms of applying emerging technologies in Hungary? What does this mean compared to the performance of other countries?

It depends on whether we are looking at Hungarian companies or Hungarian subsidiaries of global corporations. I believe that if we're discussing Hungarian subsidiaries of global companies, then we are relatively well-positioned because Hungary is often seen as an outsourcing hub, competing with countries like India, or even within the region like Romania or Poland, where R&D might also be established and where companies often pilot new solutions. From this perspective, we are currently at least in the mid-tier, but there is potential for us to be among the top-tier. Just look at the news, or over the past few years, how often have we come across a Hungarian startup that developed a

technology not previously present in the market, and now it is. For instance, the one Google acquired related to autonomous driving (a Hungarian company), or the company producing navigation software, or LogMeIn or Prezi. All these found a market niche in which they can assert themselves globally. I believe Hungary possesses the knowledge capital to be a fertile ground for such innovations. In the past, this area was a priority for the government (though the coronavirus has reshuffled this a bit), but I think Hungary has the foundation for this to work. However, it's very challenging to compete with, for instance, India (in terms of manpower costs). Our situation in the region is tricky due to the language, as Hungarian doesn't carry much weight, while in Romania, for example, people speak multiple languages simply because their mother tongue belongs to the new Latin language family, which could be a competitive advantage for them.

CORPORATE PRACTICE

What technology/tool is used in your company for the automation of internal processes? In which areas and for which processes do they appear?
Does your company use artificial intelligence tools? If so, which tool, for what purpose, and in what area?

I mentioned the chatbot (in ITSM and HR areas) as an example of artificial intelligence. We use language recognition (for instance, in Office). Within the company, we have an online training system called My Learning Hub. It includes mandatory training but also suggests further training based on previous searches and courses taken. We have a very strong marketing department, but unfortunately, I don't have visibility into the technologies they use there.

In Hungary, we use Workday for HR; I am not sure if it has artificial intelligence functions.

Are there any job roles in your company that have been completely/partially replaced by any emerging technologies? What are these roles?

a. **In your company, do these technologies mainly serve a supportive function or do they replace job roles?**

I brought up the chatbot as a practical example; it's a supportive technology. In the current situation, these chatbots are not that smart and their databases are not extensive enough to answer every specific question (only predefined questions, and even those need to be asked in a predetermined format). However, they greatly assist the work of employees (whether HR or IT service desk colleagues) by narrowing down the topics that people will search for, thereby speeding up the process.

It's not inconceivable that in the future they might become a replacement function, but currently, their role is limited to support.

Are there any new job roles in your company that have emerged as a result of introducing emerging technologies? What are these roles?

Yes, there are. They are the developers who deal with chatbot programming and development. This job role did not exist before. This is not only creating jobs within our company but also with one of our partners who is involved in its development (so it has resulted in additional opportunities both inside and outside the company).

From the perspective of the employees, what changes do you observe due to the emergence of new technologies?

Certainly, it affects both employer and employee behaviour. On the one hand, it encourages people to be much more independent; the 'self-help' approach is predominant in many areas (whether it's communication, HR, learning, IT, or even core financial functions that deal with it). It aims to accelerate problem-solving and learning; there are far fewer direct trainings (online courses are more common). People are more inclined to interact via chat or send an email than to call each other. The advantage of this is that it's

instant, faster, and also more convenient from a multitasking perspective. Collaborative platforms (like MS Teams) greatly facilitate and speed up communication and collaboration, even between different functions. I think a specific skill set is required; people need to be receptive to these new technologies, as progress has not stopped and is continuously changing. Unfortunately, not everyone is adaptable, but this is becoming increasingly important in recruitment. I don't necessarily think it's age-related, but I believe the younger generation familiarises themselves with these tools more quickly and easily simply because they use many such applications (instant messaging, social media) in their private lives, and they receive a lot of stimuli on various platforms. However, the middle-aged or older generation can also easily cope with this if there's a willingness to.

From my experience, not only recruiters but hiring managers are increasingly looking for this because experience alone is not enough for most jobs; one must learn. And how quickly someone can learn has become much more emphasised in the modern world.

In which area and with which tool do you plan to implement in the next 5 years at your company?

Our company is highly advanced from a technological standpoint. The transition to working from home following the lockdowns was smooth and quick since everything with us is cloud-based. For most companies, a significant step will be moving everything to the cloud – their communication, data warehouses, and transitioning to using cloud-based applications. This has been a trend already, but COVID accelerated it. We introduced MS Teams as a new collaboration tool. Here, people communicate based on projects within teams, rather than through emails, which greatly impacts productivity. I believe that, sooner or later, every company will need to make this move. We currently store our data in the cloud, but we're transferring it to Microsoft's OneDrive, which will facilitate and expedite the use of Teams as an entry point. Companies that can make remote working more comfortable and easier will have a competitive edge. Microsoft is well-positioned in this area, with the combination of Teams, Office, and OneDrive unmatched by any competitor. There's also backend computing where Microsoft is very strong. Our chatbot development will continue across various areas. We'll have a voice-based assistant integrated into the chatbot; our robotics team is working on this.

NextThink is a cloud-based software that allows an employer, an administrator, or an admin to supervise machines and proactively identify issues. For instance, if a user's computer freezes, slows down, or if its memory becomes full, it preemptively alerts the IT department, preventing more significant software or hardware issues. For larger companies, it can also monitor licences, helping ensure they don't purchase more licences than needed, aiding in cost-saving. It can also oversee the operations of software running on a user's computer. We currently use it with 16,000 licences. The direction is to cover our entire IT asset park. It greatly aids in proactive incident management, ensuring integration with ServiceNow and other platforms. When a user calls the service desk, the service desk agent will be aware of the usual issues faced, aside from what the user currently shares, and can proactively offer solutions. This provides an immensely positive experience, boosting productivity. It's not machine learning but a cloud-based asset management solution that will be crucial in the future, especially as people work from home.

We also have a BPM (Business Process Management) organisation in place. The Business Partner Managers maintain contact with middle management of a given function, who can forward suggestions even from the most recently hired members of their teams on how processes could be enhanced with automation solutions. BPM managers, upon receiving a request, generate a business case and might involve procurement to find a solution. Everyone's suggestions are considered; everyone can contribute to developments, but this organisational unit focuses specifically on this.

PERSONAL INSIGHT

On which areas do you see the potential and/or necessity of implementing emerging technologies as particularly important for your own company?

Certainly in the financial sector, but also in IT support. Even in monitoring, where automation exists nowadays, there could be a self-learning process that, upon noticing something, not only signals or opens a ticket but also resolves the problem. In HR, I see its significance as lesser since the focus there is on human-centredness, which often moves in the opposite direction. In manufacturing processes and supply chain management, it's vital to have more automation because these are very complex areas for

companies that produce finished products. Parts of the collaboration with suppliers could also be automated, for example, invoicing – although this is covered by the finance sector – or daily operations.

What are your expectations when looking at technological advancements? What benefits can they bring and what arguments support their implementation? What primarily motivates your organisation in adopting emerging technologies?

I'm really looking forward to these developments. I believe it's important for us to lead in the introduction and application of such technologies. This would result in increased productivity and efficiency, as well as potentially reducing costs. It can reduce the workload on employees, which in the long run could lead to a decrease in full-time equivalents (FTE). Furthermore, it also signifies an improvement in quality because, let's face it, a script or a robot is likely to make fewer mistakes than the human factor.

What arguments and considerations would you list against the introduction of emerging technologies? What factors complicate/hinder their introduction (if there are any)? How can one prepare for these?

What speaks against it is that any emerging modern technology requires a very high level of knowledge and demands very specialised expertise, which can be difficult to find in the market and even harder to replace. This in some way exposes the company to vulnerability, and the company has to decide whether the utility of this is greater than the risk it represents. Often, due to this, interactions between people become more impersonal, which can be problematic for most companies, as people generally seek social connections. This was evident during the COVID pandemic, where many turned inward, which can also have a negative impact on productivity. If we automate everything, we will need experts who develop applications, tools, and technologies, rather than solving problems collaboratively, which weakens the social factors. I'm not sure how to quantify this, but it certainly needs to be taken into consideration.

Do you think your company leads in the application of new technologies compared to competitors?

I believe that indeed, we are at the forefront. I regard many as our competitors. If I look at the company's field of activity, then our competition includes AB InBev, Heineken, or similar companies. They also have very good technologies, but we are the ones introducing the first recyclable bottle, and perhaps we have the broadest portfolio, which we expand through acquisitions. We buy up smaller brands that we see potential in, which definitely gives us a competitive edge.

If I consider the company's presence in Hungary as a financial SSC, then Vodafone, Morgan Stanley, or BP's SSC would be our competitors. I find us competitive in this regard too, not just technologically, but also financially and in terms of human resources. I believe we're competitive because the company is very employee-centric, both globally and in Budapest. The primary aim of multinationals, like all companies, is profit maximisation, but the means by which this is achieved matters. During the COVID pandemic, we proved that our employees come first.

Looking at technologies, we can also consider the IT area, which is my field of expertise. We are fully in the cloud, and we led among the companies that moved their entire infrastructure to a cloud-based system, having shut down all but one of our data centres. The question is how emerging technologies will impact this area, and how swiftly we will adapt. So far, I've seen that we constantly seek out new technologies, we test and implement new things. If something doesn't work, the project is discarded, but resources aren't spared. This kind of curiosity will undoubtedly provide a competitive advantage, as we'll likely discover or introduce new technology sooner.

Implementing a technology might also be in the interest of a Business Unit (BU), which might only operate in one country. We can decide to implement something only in Budapest; there have been such instances. We have a very good asset management system with which we can manage seating, occupancy, as well as various office and IT devices in the office. This is a solution that is only used in the Budapest SSC. The company supports this, paying from a separate budget. It's practically better than similar foreign solutions, and there's even the possibility of extending it, meaning we can introduce it elsewhere. The best thing is that despite local initiatives, everything is interconnected on a global scale. If something works very well locally, there's an opportunity for global implementation. The business case should reflect how this aligns with the company's corporate-level objectives and how it creates value for the specific business unit.

KNOWLEDGE MANAGEMENT AND EMERGING TECHNOLOGIES

What tools/technology does your company use to support knowledge and information sharing?

MyLearning Hub, MS Teams, SharePoint. Quip – this is a product by SalesForce, a very good tool for storing information, brainstorming, and creating charts (it's like OneNote but enhanced). MyLearningHub is used for training sessions. Essentially, we use these for our knowledge base. We primarily use SharePoint for storing and sharing Office documents (Word, Excel, PPT). On a daily application level, we tend to use Quip more.

Does the application of emerging technology facilitate knowledge utilisation in your company? Do new technologies integrate into the knowledge-sharing process? If so, which ones and how?

As an example, I can mention NextThink, which I believe is an emerging technology. It proactively identifies a problem and then notifies the user, who can then resolve it. It recognises the issue, signals it, and in doing so, contributes to the solution. The knowledge base can be structured in a way that problem management includes the examination of multiple similar cases. The software automatically identifies several similar cases and forwards them to the resolution team, who can then identify patterns or systems behind such incidents. Chatbots are different; they somewhat train themselves, and to some extent, the programmer trains them too, but they don't engage in knowledge-sharing processes.

We also use PowerBI for various analyses; it helps in creating dashboards and diagrams from vast datasets, and I use this on a daily basis.

How does your company manage the knowledge assets created and accumulated by new technologies? What positive/negative experiences have you had so far?

We don't have this; we don't manage this knowledge asset.

Additional remarks, observations, opinion, feedback:

We use character recognition software, which identifies the data contained in an invoice, such as the issue date, invoice number, and company name. This also replaces human resources.

I think it's important to better define emerging technology, as many of us in a multinational environment are not familiar with this term. It might be worth being a bit more specific to assist with this, so we don't just ask about it in general terms but bring up specific applications, processes, and tools as examples. What is private 5G? Does someone operate an internal 5G network? In our office, there will be a technology called a Bluetooth map. There will be one of these next to every lift, which, with the help of a phone, will allow us to orientate ourselves.

9.6.3. INTERVIEW 3.

LOCATION, DATE, PARTICIPANT:

Budapest (Zoom), 2022.01.19., **'C'**

Information related to the organisation:

- Industry: Financial and insurance activities
- Organisation size (based on the number of employees): 500+ people

CONCEPTS

We refer to **emerging technologies** as those new technologies that are currently being developed or will be developed in the next 5-10 years, and have a lasting economic or social impact. (BusinessDictionary.com, 2020)

Included in this category, for example (Gartner, 2020):

9. Bi-directional brain-machine interface
10. Private 5G
11. Biodegradable sensors
12. Artificial Intelligence
    - AI marketplaces,
    - Deep learning networks (e.g., 'deep neural networks', 'deep learning')
    - Smart robots,
    - AI-enhanced developments,
    - Extended intelligence,
    - Intelligent applications,
    - Chatbots,
    - Knowledge graphs,
    - Machine learning,
    - Autonomous vehicles,
    - Social distancing technologies, etc.

Knowledge management: 'Knowledge management (KM) describes the process of acquiring, developing, sharing, leveraging, and protecting organisational knowledge to improve the competitiveness of organisations.' (Gaál et al., 2009).

INTRODUCTION

What is your opinion on emerging technologies? How do you interpret them?

I think it's very interesting; they open new perspectives in the world, and I'm very eager to see how they will change our lives. I believe that it's simultaneously a catch-22 situation: in theory, we'll have more time, but in practice, not necessarily. For example, self-driving cars provide an entirely new platform from the perspective that I can read in the car, but the question is, what will I use that time for? I am more touched by the human aspect of technology, in terms of how much it increases or, conversely, restricts human freedom. And I think we have both a societal and individual responsibility in this regard. I firmly believe that, alongside technological advancement, it's essential that the mindset and ethics related to technology emerge as subjects to be discussed in people's lives, even in secondary schools. Discussing what this rapid digital development that surrounds us means and how, by setting boundaries, we can manage it while retaining our human touch.

How do you think we stand in terms of applying emerging technologies in Hungary? What does this mean compared to the performance of other countries?

I believe we're not in a bad position; indeed, most things come from abroad (e.g. from multinationals), but that's not necessarily a bad thing in such an interconnected world. There are those who are miles ahead of us (e.g. Silicon Valley, America, Germany, Asia), but even within the European region, there are those less developed than us. We are in a position that corresponds to our economic development.

CORPORATE PRACTICE

What technology/tool is used in your company for the automation of internal processes? In which areas and for which processes do they appear?

Primarily, we automated processes that were easy to robotise, e.g. finance, where standard data was available, and there wasn't much fuss, for instance, with formats; these could be automated quickly. We introduced many 'out of the box' solutions that are available on

the market. The company is open to almost everything, and we experiment with a lot of things. Some initiatives stick, others don't, and some remain localised. In this regard, it's good that the organisation is flexible, and not everything is centralised. This can be a disadvantage because it's harder to introduce bigger changes as the company isn't fully interconnected. But it's also an advantage because divisions can shape their own paths, they can experiment, and the organisation isn't disrupted if something changes. If a local initiative becomes a success story, however, it can grow. Currently, we are in the 'trying everything out' phase.

Within HR, a lot has been automated, especially in recruitment.

For now, I don't see precisely how our processes will change because our ongoing project is so vast that it's hard to discern its exact boundaries. The likely outcome will be a more liveable HR with much less administrative work.

Does your company use artificial intelligence tools? If so, which tool, for what purpose, and in what area?

There are tools related to insurance topics (for instance, in detecting fraud), but I can't specify exactly. For example, for agricultural damages, our insurer sometimes alerts farmers in advance using satellite images. We've purchased the majority of such tools from outside sources. We also use robots and chatbots.

Are there any job roles in your company that have been completely/partially replaced by any emerging technologies? What are these roles?

a. In your company, do these technologies mainly serve a supportive function or do they replace job roles?

There were instances where entire job roles were replaced, but this did not lead to layoffs, because we redefined their roles, and their expertise was utilised elsewhere (they transitioned into mentor-teacher roles). Their job roles changed entirely. And there are many technologies that serve a supporting function; the majority are supportive.

Document management was where the main replacement functions occurred, but it did not result in redundancies.

Are there any new job roles in your company that have emerged as a result of introducing emerging technologies? What are these roles?

I mentioned the mentor-teacher role. The entire process of planning and organisation demanded a new role, and in nearly all supporting functions, new positions emerged as a result of introducing technology. What I'm working on also came into existence because of this; I support digital transformation in an HR role.

From the perspective of the employees, what changes do you observe due to the emergence of new technologies?

The team is quite open, and it's highly positive that there's a familial atmosphere, even though we're talking about a multinational company. Many of the employees have been working here for 30-40 years, and they've seen so much that change has essentially become accepted. They are open to new things and trust the leadership, which is good. Within the framework of reskilling and upskilling, which I've worked on in recent years, people had an immense amount of video learning material as mandatory training on technologies (with a 3-4 hour training every month).

Currently, because of the COVID situation, everyone is working from home. Thus, what we had only little experience with before, we've now implemented on a larger scale to manage the transition. Due to the circumstances, people's acceptance threshold has changed, and suddenly many things became accepted because the employees felt that all these changes were for making their work life better and easier. From this perspective, COVID had a positive impact.

When colleagues come from outside, we look for open-minded people who have experience in various areas and bring a change of perspective to the company, which the team will then more easily adopt. However, the Italian-like spirit flowing through the company's veins also brings with it openness.

PERSONAL INSIGHT

On which areas do you see the potential and/or necessity of implementing emerging technologies as particularly important for your own company?

The areas of replacing administration and handling documents (although we have already made significant progress in this) are concerned. Especially in terms of online contracts, there have been significant advancements (compared to the previous paper-based system, contracts can now be processed entirely digitally).

What are your expectations when looking at technological advancements? What benefits can they bring and what arguments support their implementation? What primarily motivates your organisation in adopting emerging technologies?

The main motivation is primarily competition. For me personally, the main motivation is curiosity and the belief that we can genuinely do this well. I personally work on ensuring that the freed-up time is used not for increasing efficiency but for enhancing happiness.

From this perspective, the company's attitude is good because it takes into account the human factor. When a person fulfilled a data bank function and this was covered by technology, then people could transition to becoming mentors, mentoring newcomers with the knowledge in their heads. This 'caring' function cannot be replaced by machines, and it increases human value.

What arguments and considerations would you list against the introduction of emerging technologies? What factors complicate/hinder their introduction (if there are any)? How can one prepare for these?

GDPR comes to mind, with which I partly agree and partly don't. Often people (even as private individuals) consent to things, and many times they don't even know what they're agreeing to (e.g. a lot can be inferred from Facebook activity), and how it's used later on, for instance, to manipulate people. So, the ethical aspect is very important to be addressed, and only through awareness and considering socially ethical directions can we act on this.

Do you think your company leads in the application of new technologies compared to competitors?

In the context of Hungary, we're certainly at the forefront, with far more resources for everything than many of our competitors. In terms of foreign competitors, the fintech sector has pulled far ahead (there are insurers there where only a handful of people work). In our company, there was this consideration of whether we wanted to join this race, and we decided not to, because for us the added value is the human touch. Our agents go out and talk to the client, we assess each case individually, etc. A smart contract will never do that, but in a trust-based domain, where people turn to in times of trouble, there's definitely a place for this human touch. We try out a lot of things, but we won't replace everything, that's for sure.

KNOWLEDGE MANAGEMENT AND EMERGING TECHNOLOGIES

What tools/technology does your company use to support knowledge and information sharing?

We have a tool, a gigantic programme, which mainly supports reskilling and upskilling. It delivers knowledge in the form of videos (all hands type) and includes individual, university-level training (ranging from a few hours to complete retraining).

We've set up many document libraries where contracts can be found, and we also have information databases where one can search (decentralised, local infobanks).

We have an internal intranet where most of the information is located; articles appear there, and emails about important matters are also sent from there.

Informal knowledge sharing works very well with us; during coffee breaks, it's clear that we're working because we're exchanging information in the process. Thus, our informal knowledge network is very strong.

Does the application of emerging technology facilitate knowledge utilisation in your company? Do new technologies integrate into the knowledge-sharing process? If so, which ones and how?

We have events where innovation topics are discussed, which are open to everyone. External experts are also invited, initiating a thought process on how to introduce technologies. And there are also presentations on internal innovations for a broader audience. So, these are forums for exchanging experiences, where anyone can participate, and it's worth it because it's very interesting.

How does your company manage the knowledge assets created and accumulated by new technologies? What positive/negative experiences have you had so far?

I know we have artificial intelligence-based decision-support tools, but I don't have visibility into this area.

Additional remarks, observations, opinion, feedback:

Regarding the areas of reskilling and upskilling, I believe our company currently places a lot of emphasis on them and has dedicated a lot of resources to ensure they operate centrally through this online platform (which, for example, has a recommendation system, like on Netflix). This is very progressive and organised.

9.6.4. INTERVIEW 4.

LOCATION, DATE, PARTICIPANT:

Budapest (Zoom), 2022.01.18., **'D'**

Information related to the organisation:

- Industry: Professional, scientific and technical activities

Organisation size (based on the number of employees): 500+ people

CONCEPTS

We refer to **emerging technologies** as those new technologies that are currently being developed or will be developed in the next 5-10 years, and have a lasting economic or social impact. (BusinessDictionary.com, 2020)

Included in this category, for example (Gartner, 2020):

13. Bi-directional brain-machine interface
14. Private 5G
15. Biodegradable sensors
16. Artificial Intelligence
    - AI marketplaces,
    - Deep learning networks (e.g., 'deep neural networks', 'deep learning')
    - Smart robots,
    - AI-enhanced developments,
    - Extended intelligence,
    - Intelligent applications,
    - Chatbots,
    - Knowledge graphs,
    - Machine learning,
    - Autonomous vehicles,
    - Social distancing technologies, etc.

Knowledge management: 'Knowledge management (KM) describes the process of acquiring, developing, sharing, leveraging, and protecting organisational knowledge to improve the competitiveness of organisations.' (Gaál et al., 2009).

INTRODUCTION

What is your opinion on emerging technologies? How do you interpret them?

Every new thing serves our development, so I definitely have a positive opinion about these technologies. The realisation and introduction of them, which we perceive daily at work, usually doesn't go well. At the idea level, I really look forward to what the technology aims to achieve. However, in most cases, there's a slight disappointment because the implementation part isn't done properly. For example, Microsoft Teams is a collaboration tool designed to make it easier and simpler for team members to work together and communicate. Yet, we mindlessly create a Microsoft Teams channel for everything without truly considering its actual purpose.

How do you think we stand in terms of applying emerging technologies in Hungary? What does this mean compared to the performance of other countries?

In Hungary, there was a sudden large leap concerning COVID. Google Classroom, Zoom, MS Teams - I can mention these because I'm familiar with them, I've used them - suddenly came to life. People had to learn how to use them from one moment to the next, but they were very quickly and easily integrated into people's daily lives. Even those who aren't very computer-savvy managed to grasp them relatively easily. I'm glad that companies allowed the use of these tools and didn't overregulate them. Likely, the regulation will come now. I believe we are doing quite well in using these applications.

CORPORATE PRACTICE

What technology/tool is used in your company for the automation of internal processes? In which areas and for which processes do they appear?

Over the past 2-3 years in Hungary, technological development has also begun at our company. Every year they find a topic, a developmental goal, which can be defined in a single word e.g. 'automation' or 'agile'. We have an automation team made up of specialists who are typically programmers, IT professionals, and they also deal with

process mining. They generally apply automation in areas with repetitive and transactional activities or tasks. Often, the basis for this automation is running an Excel macro, which can even send an automated email. We also use workflows as a form of automation. Regardless of whether it's an IT environment, customer service, or a financial area, if the task is repetitive and transactional, automation appears. Every company has a strategy, which they break down into goals. Tasks to be performed lie behind the goals. If the project's objective is to achieve a certain number of automation projects that bring specified savings (in terms of money), then that's a direct direction, and the team starts researching. They look at processes, how they're performed, and how they can be automated. The primary goal is to increase efficiency (measured in money) and only secondarily or tertiarily to improve customer experience. Often, by increasing efficiency, this partially or fully occurs, but let's not deceive ourselves into thinking it's solely serving the customer's interests.

I don't think this is a competitive advantage. I believe the competitive edge is when we carry out a process more accurately or respond to a customer complaint faster and more efficiently because our knowledge is better.

We don't always use technology to improve the customer experience but rather to increase profits.

I am the functional leader of a 'quality management system ambassador' community (130 members). We tend to process and transfer knowledge on various topics to them and ask them to pass on this knowledge to their team members. One such material discussed automation. We showed them how we could contact the automation team and how to consider whether a task can be automated or submitted to the team as an automation idea. This automation team is still in its very initial phase. The Hungarian colleagues are more like business analysts who examine processes and then send their findings to the IT development team in the UK or India, who do the necessary automation development (macro, chatbot, etc.). The locals here write smaller macros. Among the centres, ours has the largest number of employees, 2500. This team was established to manage locally what we can.

Does your company use artificial intelligence tools? If so, which tool, for what purpose, and in what area?

The chatbot is the only thing that is working at us. Based on keywords, it provides an answer that is highly likely to answer the questions. We don't have something like 'Siri'; this is a less advanced chatbot that operates exclusively in a dedicated IT area. Those working in the financial sector provide services to business partners, but internally there's no demand for this. I believe it doesn't learn; it's not a self-improving tool.

Are there any job roles in your company that have been completely/partially replaced by any emerging technologies? What are these roles?

a. In your company, do these technologies mainly serve a supportive function or do they replace job roles?

We're not yet at the point where they fully replace job roles; they are merely supportive. If there are non-standard questions to be answered, where some thinking is required, or where there's a need to interact with a customer, they cannot replace that.

Are there any new job roles in your company that have emerged as a result of introducing emerging technologies? What are these roles?

Yes, there are. Power BI – Microsoft's reporting application, an emerging tech. The creation and maintenance of Power BI reports. Job roles have transformed to such an extent that these tools were introduced and people had to learn how to use them (for reporting tasks). In our organisation, business analyst roles did not exist before; now, we have them as well. These individuals review processes, identify gaps within them, ascertain their strengths and weaknesses, determine what can be automated, and produce a document based on which IT can carry out the automation. They act as intermediaries between the client and IT, understanding both the business language and the IT language. Oversight is also needed; if the automation encounters an error, an intervention is required to rectify it. This won't be done by the IT developer, but by someone who knows and understands the desired outcome. Such job roles don't exist yet, but it's likely that they will in the future.

From the perspective of the employees, what changes do you observe due to the emergence of new technologies?

I've already mentioned Teams as an example. In the beginning, the general attitude towards Power BI was negative: it was deemed unnecessary, with comments like, ’Excel is fine for me, at least I know how to use it.’ Later on, everyone wanted everything in Power BI. Currently, the sentiment is along the lines of, ’it's not that bad after all, I can filter however I want, it's great.’ Anything new goes through this 'change curve'. Initially, we struggle to accept it, we grope around, but by the end, we realise it's fantastic, and we don’t want to use anything else. Our new management is highly committed to digitalisation. We had a survey to assess the extent to which employees can use the technologies implemented in the company (SharePoint, MS Teams, automation, robotics). Based on the survey, employees received personalised training recommendations. Specific objectives in terms of digital skills haven't been set, and the expectation isn't that everyone should know everything. HR also uses tools for online interviewing. The job description and job advertisements specify the required skills. For most positions, these are still mentioned in general terms. For an automation role, of course, the requirements are more specific, detailing the needs. They can't yet test or evaluate digital competencies during the hiring process.

In which area and with which tool do you plan to implement in the next 5 years at your company?

We are in the process of introducing Kryon (a process capturing tool) and Celonis (a process mining tool), and we are continuously working on refining the existing tools. Only the Hungarian site has an ISO-certified knowledge management system. Now, at least every 3 years, documents must be reviewed. With the help of a macro file, we can easily report which documents have reached or will reach the end of their 3-year period, allowing for forward planning. We have an internally developed intranet where mandatory and optional trainings are available; in the case of mandatory ones, both the colleague and the line manager are notified. Also accessible here are all policies, group-level documents, strategies, code of conduct, objectives, subpages for various functions, video materials from webcasts, and managerial presentations. For HR purposes, we use Workday; regulations for the cafeteria system and parking can be accessed here. We use

OneNote for storing customer-specific information, which team members can use collaboratively. We utilise Forms for various surveys. We also use Yammer, Microsoft's internal Facebook-like tool, where posts that can be liked and commented on can be shared. The majority don't like it because unrelated contents merge (e.g., a post about a yoga class in the feed followed by the next post about payroll closing).

PERSONAL INSIGHT

On which areas do you see the potential and/or necessity of implementing emerging technologies as particularly important for your own company?

For me, customer experience is very important, and my customers are my colleagues. It's important that the customer can provide feedback in the easiest and simplest way possible if they are dissatisfied with the service. For instance, on Foxpost's website, there's a central telephone number hidden away, encouraging people to send their complaints via email instead. This way, they can exploit the legal possibilities (they work with a 30-day response deadline). This is a poor solution; customers should be given the option for both verbal and written feedback.

We are not in contact with end-users but with petrol stations, airports, and automotive companies.

What are your expectations when looking at technological advancements? What benefits can they bring and what arguments support their implementation? What primarily motivates your organisation in adopting emerging technologies?

I believe every profit-oriented company is motivated by money. Centralisation is typical – see the emergence of BSCs and SSCs (centralised administrative work). Of course, this centralisation doesn't always mean that it will be detrimental to the customer. However, often they experience it as a negative change, for example, if they are accustomed to using fax. Sacrifices have to be made by both sides. We impose on our customers what we perceive to be 'good practice'.

Another motivation is not to be left behind. Electric cars, environmental protection; the company cannot afford to ignore all of this, otherwise, it will lose its competitive edge, and others will overtake it. This is a long-term investment, spanning 5-10 years.

What arguments and considerations would you list against the introduction of emerging technologies? What factors complicate/hinder their introduction (if there are any)? How can one prepare for these?

It might be said that it's too expensive and can't achieve the goals the company desires. We can wait to see how successfully competitors adopt the technologies, wait for the price to drop, and then implement it ourselves. Sometimes a supplier forces us into new technology, e.g., Microsoft no longer supported Windows 7, so a transition to Windows 10 was necessary. Or they don't support Internet Explorer, requiring the use of another browser. It's also possible that the organisation isn't ready; we don't have the knowledge to use it. When Office365 SharePoint was introduced, the company decided to use it instead of SharedDrive. During the implementation, people weren't taught how to use O365; there was no training. They had to learn it by themselves, creating random SharePoint sites without owners, and even now, there are ownerless pages.

The human side, the fear that due to technology I will lose my job, means I won't share all the information I know to prevent everything from being automated and me losing my job. The right approach would be for the company to decide and communicate that we develop to improve processes and products, and due to development, we won't lay off people but rather provide them with different tasks (e.g., what Toyota did). In our company, there's no assurance that with a good idea, I won't be shooting myself in the foot, effectively making myself redundant. The Hungarian culture isn't such that they see positive opportunities everywhere, and if necessary, they stand up and move on.

Do you think your company leads in the application of new technologies compared to competitors?

We're doing very well compared to our competitors. The local highly educated colleagues have realised the potential uses of the technologies. The organisational knowledge is immense, and people have played a significant part in this. By competitors, I mean multinationals regardless of the industry. Compared to companies like Vodafone, Avis, etc., we are leagues ahead.

KNOWLEDGE MANAGEMENT AND EMERGING TECHNOLOGIES

What tools/technology does your company use to support knowledge and information sharing?

Process mapping system, as well as SharePoint sites. When colleagues need to learn a new task, we map them out using flow charts, and from this, we create a draft process description (work instruction), which is supplemented with additional information during the knowledge transfer.

The 5-year plan is for the ARIS system's front office interface to become the future document management system, and then we will abandon the SharePoint basis. During MS Teams meetings, the content is often recorded on video, but people generally don't tend to re-watch it, as it's not searchable, etc.

Does the application of emerging technology facilitate knowledge utilisation in your company? Do new technologies integrate into the knowledge-sharing process? If so, which ones and how?

Access to information has become easier, and the tools themselves now better aid in the processing and understanding of information. Visually, information is often presented in a way that doesn't require explanatory text; you look at it and immediately know what it's about. The more information that is shared, and the more people talk and discuss repeatedly, all serve the purpose of broadening our knowledge on a particular topic.

How does your company manage the knowledge assets created and accumulated by new technologies? What positive/negative experiences have you had so far?

Every idea or root cause analysis is also a knowledge asset, or training material on a topic; this doesn't come through new technologies, but rather through the person who compiles it. Except for 'Kryon'. Kryon generates a vast amount of information, and we're currently

uncertain about how to utilise it: who will evaluate and filter the information, selecting the useful parts? It captures screen shots of every click, of the steps taken in work and everything else, even if not directly related to the task (like ordering pizza between two case resolutions). These need to be manually sorted out. I don't really see how those who need to maintain this knowledge find it, how difficult it is for them, or how much the technologies assist them. People don't like the document management system itself; it has many flaws and receives a lot of negative feedback. Management's commitment to knowledge management is low, and there's no knowledge management strategy. The Hungarian site stands out amongst the international sites because it has a knowledge manager position and an ISO-certified system. But this isn't something that runs itself. You have to be constantly present, monitoring tasks, and providing guidance to the organisation.

Additional remarks, observations, opinion, feedback:

How does the technology required by knowledge management make the colleagues' work easier/more cumbersome?

How is knowledge management perceived within the organisation?