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Navigating the digital landscape: A conceptual framework for understanding digital entrepreneurship and business transformation

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ABSTRACT

Objective: The article aims to identify and characterise the most important aspects of the digital transformation of entrepreneurship and business as an essential trend in the modern economy and contemporary business.

Research Design & Methods: The article is a typical narrative and critical literature review that collects, analyses, and critiques the literature on the subject.

Findings: The article focuses on three issues. Firstly, the concept and scope of technology entrepreneurship and new technology-based firms are discussed while indicating selected entrepreneurial mechanisms that are specific to this phenomenon. The next part of the article examines the digital competencies that are essential for modern business, especially the digitisation of entrepreneurship and business. Thirdly, the article reveals digital transformation as a change agent in entrepreneurship; as a game-changer, especially in the post-pandemic period.

Implications & Recommendations: The study is devoted to digital transformation, which has influenced present-day entrepreneurship and contemporary business in recent years. Undoubtedly, today, digital transformation is the challenge of the third decade of the twenty-first century, especially in the post-pandemic period.

Contribution & Value Added: The article's added value consists in the updated and synthetic presentation of business digitalisation's most essential aspects and areas. The overview presents the current state of the art on digital transformation and its functions.

Article type:	research article
Keywords:	digitalisation; digital transformation; digital technologies; digital skills; digital literacy; technology-based entrepreneurship
JEL codes:	L26, L10

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INTRODUCTION

Digital technologies have always been an accelerator of change in business, economy, social life (Etemad, 2023a; Tung et al., 2023; Rymarczyk, 2020), and, in particular, entrepreneurship (Galindo-Martín *et al.*, 2023). Their use, seen as a driver of multidimensional transformations especially in business, affecting all aspects of human life, is referred to as digital transformation (Kraus *et al*., 2021; van der Linden & Łasak, 2023). The profound and radical transformations under their influence concern not only the technological dimension, but also the cultural and social dimensions. Digital transformation is a broad term. It encompasses information technology (IT) or wider information and communication technology (ICT), which has long been used in business, especially in certain industries (Bharadwaj *et al.,* 2013) and mobile technologies, cloud computing, Blockchain, big data analytics, internet of things, social media, augmented reality (AR), and virtual reality (VR). Undoubtedly, artificial intelligence (AI) (Korzyński *et al.*, 2023; Wach *et al.*, 2023b) and evolutionary algorithms (Sieja & Wach, 2019) play increasingly important roles in con-

temporary business. Moreover, it means integrating this technology into all areas of a company's operations, changing organisational culture, creating a specific ecosystem and influencing external actors, such as the demand side. It is therefore characterised by new, generative, malleable, and combinatorial attributes, and the emerging overarching digital infrastructure is open and flexible, prepared to be used by anyone (Hanelt *et al.,* 2021).

The topic of digital transformation of entrepreneurship and business has been developing rapidly in practice and also in the literature, especially in recent years (Ajide, 2022; Kraus *et al.,* 2023). Based on the search records of publications in the Web of Science and Scopus databases, we see that interest in this topic has escalated, especially after 2019 (an increase of 100%). We should link this to the conditions resulting from the Covid-19 pandemic; it is, in fact, widely known that the pandemic crisis has accelerated the digitalisation of economic and social processes. It is apparent that the Covid-19 pandemic forced a change in the functioning of all economic and social actors and highlighted the importance of digital transformation as an agent of these changes.

The article aims to identify and characterise the most important aspects of the digital transformation of entrepreneurship and business as an important trend in the modern economy and contemporary business. Achieving the objective will also allow us to answer the three research questions:

RQ1: What is the nature of technological entrepreneurship?

RQ2: What digital competencies are necessary in the contemporary labour market in the digital era?

RQ3: Is the COVID-19 pandemic an accelerator of business digital transformation?

Apart from the introduction and conclusion sections, the central part of this article will be devoted to the literature review and technology development. The first section will discuss the impact of new technologies on entrepreneurship, which are the most critical determinant of the technology-based entrepreneurship phenomenon. The next section will address the competencies changes (digital skills, digital literacy). The last section will focus on modelling digital transformation in business, especially in the post-pandemic period.

MATERIAL AND METHODS

The study used a narrative and critical literature review (Ratten, 2023). It developed a conceptual framework based on a literature study and desk research. This conceptual study extracted its research questions and a theoretical framework from a survey of the relevant literature and desk research, as this topic is still relatively new to economics and international business theory. Jacobson (2021) underscores that 'digitisation of business and digital transformation have been buzzwords for more than a decade, but this terminology is still going strong for a reason.' We investigated secondary sources using the combination of two screening terms: 'business digitalisation' ('digitalisation of business') and 'digital transformation' (Table 1). Many of these publications provide identical viewpoints, but this article only mentions the most pertinent ones for further research.

Conceptualization of the key terms used in the article (Table 1) allowed for a thorough understanding of the analysed concept before proceeding to the collection and selection of materials that are the basis of the researched problem. It was an important part of our initial research work, which helped to avoid limitations that could potentially arise in subsequent, more advanced literature studies. In brief, this work should be viewed as a conceptual article in which a literature survey and desk research result in the formulation of theoretical premises. Regarding the research methodology, this article employs a qualitative study strategy, indirect observation, cause-and-effect analysis, theoretical modelling and synthesis. To gain the most beneficial cognitive benefits of the research process, the conduct of scientific research had to adhere to a protocol based on predetermined procedures (Babbie, 2012). The investigation was multifaceted, serving exploratory, descriptive, analytic, and prescriptive aims (Collis & Hussey, 2009). A comprehensive literature review was conducted to conceptualize and operationalize the research endeavour. Hence, the primary approach of the study was a literature review with constructive criticisms. Fisher's (2010) five-stage approach for a critical literature evaluation was utilized in this study. This approach aims to summarise and synthesise the existing body of work on the issue under study and to

critique and interpretively analyse it (Wach, 2020). In doing so, we attempted to propose a conceptual model of digital entrepreneurship transformation that can serve as a starting point for a broader discussion on the rationale, architecture, and consequences of digital entrepreneurship transformation.

Table 1. Definitions of basic terms used in this study

Term	Definition	Source
The basic meaning of digital terms		
Digitisation	'The technical process of converting analog into digital formats.'	Seibt *et al.* (2019)
Digitalisation	'The change process of installing digital technologies to reinforce the organization's existing value proposition.'	Gong and Ribiere (2023)
Digital transformation	'A fundamental change process of an organization enabled by exploring the use of digital technologies to redefine its business models.'	Gong and Ribiere (2023)
Contemporary business dimensions of digital terms		
Business digitalisation (digitalisation of business)	'The use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business.'	Seibt *et al.* (2019)
	'Digitalization represents organizations' increasing reliance on software-based automation – grounded in data and algorithms – over human expertise and work.'	Schildt (2022)
	'Integration of digital technologies into everyday life by the digitization of everything that can be digitized.'	Hagberg *et al.* (2016)
Digital transformation	'A process where digital technologies create disruptions triggering strategic responses from organizations that seek to alter their value creation paths while managing the structural changes and organizational barriers that affect the positive and negative outcomes of this process.'	Vial (2019)
	'As the change in an organization's structure, processes, functions and business models due to the adoption of digital technologies (such as the internet of things, artificial intelligence, machine learning, augmented reality, in-memory computing).'	Cetindamar Kozanoglu and Abedin (2021)
	'A fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity [e.g., an organization, a business network, an industry, or society] and redefine its value proposition for its stakeholders.'	Gong and Ribiere (2021)

Source: own elaboration based on the listed authors.

LITERATURE REVIEW AND THEORY DEVELOPMENT

Technology-Based Entrepreneurship and Digital Entrepreneurship

A coherent explanation of the concept of entrepreneurship is impossible due to the large number and range of meanings (Wach & Głodowska, 2022; Wach, 2022). According to Shane and Venkataraman (2007), the idea of entrepreneurship poses the most significant challenge when trying to develop a theoretical framework to study the phenomenon. Cantilon was the first researcher to formally introduce the concept of entrepreneurship into the scientific literature in 1755. Cantilon referred to the imbalance between supply and demand as an opportunity to buy cheap and sell dear, and he called those who could recognise such opportunities entrepreneurs (Carlsson *et al.,* 2013). Throughout human history, many assumed that opportunities exist and that entrepreneurs either recognise them (Kirzner, 1979) or encounter them (Schumpeter, 1934; 1976). However, Shane and Venkataraman (2000) argue that an entrepreneur is a vigilant person who discovers existing opportunities and benefits from them. Timmons (1989, p. 48) emphasises that entrepreneurship is a human, creative act that builds something of value from virtually nothing. It is the pursuit of opportunity regardless of available resources or lack thereof. It requires vision and the passion and commitment to lead others in search of that vision. It also requires a willingness to take calculated risks (Wach *et al.*, 2023a; Maciejewski *et al.*, 2023).

Technological entrepreneurship (TE) or technology-based entrepreneurship (TBE) means the implementation and use of technology in a broad sense in entrepreneurial practice and is associated with new technology-based firms (NTBFs) (Badzińska, 2016). For two decades since the 1990s, entrepreneurship theory has mainly used the term new ventures and international entrepreneurship theory, the term international new ventures. New ventures are understood to be new organisations, usually ones that involve risk and include all types of business. In contrast, the last two decades (2010s and 2020s) have seen the popularisation of the term start-up, which means a new business that brings a solution to a problem, which was not apparent or guaranteed to be successful. It is an innovative business with a unique business model resulting in high growth. Thus, a start-up is a particular subset of a new business, but one that is innovative and risky. The vast majority of today's small start-ups function as new technology-based companies to grow into very well-known global market leaders (*e.g.* Uber, Skype, Netflix).

Bailetti (2012) underscores that technological entrepreneurship is an investment in a technologically unique venture. This type of entrepreneurship also accumulates and scales up the complexity related to scientific progress and knowledge management through the heterogeneous assets of the firm to create value for the business. According to Etzkowitz and Zhou (2017), the term technological entrepreneurship refers to the creative use of scientific and technical knowledge by an individual or group of individuals to create and manage a business and take financial risks with the intention of achieving their goals and prospects. Petti (2009) highlights that the concept of technological entrepreneurship includes four basic sets of activities relating to (i) the creation of new technologies or the identification of existing (but previously undeveloped) technologies, (ii) the identification and match-making of opportunities arising from the application of these technologies to emerging market needs, (iii) the development and application of technologies, and (iv) the creation of enterprises or new ventures, which is an inherent feature of entrepreneurship. Technological entrepreneurship, or the de facto emergence of technological enterprises, depends on both internal and external factors (the entrepreneurial ecosystem). Currently, technological entrepreneurship takes place mainly in technology industries, including (Głodowska, 2019):

1. high-tech (HT) industries,
2. key enabling technologies (KET) industries, which include smart specialisation, mainly in nanotechnologies, biotechnology, photonics, and advanced materials,
3. the broadly defined information technology (IT) industry and, more broadly, the information and communication technology (ICT) industry.

We can assume that several aspects related to entrepreneurial mechanisms are typical for technological entrepreneurship. Firstly, technology transfer and its use in business. Secondly, entrepreneurial characteristics of enterprises. Thirdly, two typical entrepreneurial mechanisms related to (i) market opportunities and (ii) the logic of entrepreneurial decision-making.

The act of transforming an idea or invention into a product or service that generates value for the consumer is referred to as innovation (Wach, 2019). Innovation is an essential element of entrepreneurship, regardless of whether the start-up is an established company or a brand-new one (Trimi & Berbegal-Mirabent, 2012). A crucial aspect of technological entrepreneurship is the commercialisation of scientific and technological achievements, *i.e.* the transfer of these achievements to the market, which involves the transfer of technical and organisational knowledge for economic purposes. An essential element in the transfer and diffusion of innovations from research centres to firms are innovation intermediaries, who undertake various activities in the innovation process, *i.e.* they diagnose the need for technology, purchase technology and new adaptations of technological solutions, process knowledge, broker the purchase of technology, legally commercialised knowledge, or technology (Howells, 2006).

Four prominent researchers in the field of international entrepreneurship (Onetti *et al.,* 2012) perceive that three characteristics of companies determine technological entrepreneurship in a global context. Contemporary businesses are characterised by multilocalisation but with a strong globalisation bias, meaning that expensive technological solutions can be profitable due to their ability to operate globally. Nowadays, more and more companies are using different types of intermediaries, keeping only the key areas of activity for themselves. Hence, there has been room to specialise and play

the role of a so-called technology broker for other market players, which is an excellent niche for companies based on new technologies. Finally, the development of technology entrepreneurship is fostered by external and internal relationships, *i.e.* networking, and thus network-based companies, which is a specific entrepreneurial characteristic of them.

The two classic entrepreneurial mechanisms used in technology entrepreneurship are related to market opportunities on the one hand (spotting and exploiting opportunities vs creating opportunities) and to the logic of entrepreneurial decision-making on the other hand (causation and effectuation).

It is well known that there is no entrepreneurship without opportunity (Short *et al.,* 2010). Numerous empirical studies show that perceived entrepreneurial window and entrepreneurial opportunity lead to better firm performance, because entrepreneurial firms (with higher entrepreneurial orientation) are better at recognising, creating, and discovering existing or emerging opportunities (Linton, 2016). Sarasvathy *et al.* (2005) distinguish between three views of entrepreneurial opportunity, namely (i) opportunity recognition, (ii) opportunity creation, and (iii) lucky discovery (*i.e.* accidental opportunity discovery).

From the perspective of entrepreneurship theory, the decision-making process is considered through the concept of effectuation as opposed to causation. Sarasvathy (2001) introduced the effectuation process concept into entrepreneurship theory. Effectuation processes use a set of given agents and focus on the choice between possible effects that can be created from this set of agents (Sarasvathy, 2001). In other words, it is a set of entrepreneurial decision rules that can be applied in situations of uncertainty. In contrast, causation processes exploit a given partisan effect and focus on the choice between the means creating that effect (Sarasvathy, 2001), which in simple terms, describes decision-making using heuristics rooted in foresight. This concept equates the entrepreneur with the effectuator (Karri & Goel, 2008).

According to Pilkova *et al.* (2022), digitalisation affects the contemporary face of entrepreneurship and the everyday practice of entrepreneurship in two different ways. First of all, it introduces new perspectives for business start-ups inside the economy, *i.e.* the digital economy. Secondly, it is about modifying and adapting currently used traditional business procedures to new digital business models. Antoncic and Prodan (2008) identified a positive and significant relationship between technical corporate entrepreneurship and organisational success in growth and profitability. Their study was based on a sample of 226 companies from Slovenia. Furthermore, there is a positive and strong relationship between a company's number of partnerships and the degree of commitment to corporate technological entrepreneurship. As noted by Hauke-Lopes *et al.* (2022), specific entrepreneurial characteristics (such as willingness to learn and self-develop, risk-taking, and trust-building) help minimise barriers and enable the same digital platform business model to be copied in a new industry.

Digital entrepreneurship transformation is a kind of analogy to the definition of digital business transformation but taking into account the differences between digital entrepreneurship and digital business (Morabito, 2021; Lacarcel & Huete, 2023). Digital entrepreneurship is a relatively new term, especially concerning the term digital business (Nambisan, 2017; Fernandes *et al.*, 2022). Thus, the digital transformation of entrepreneurship refers to the process of adapting and using digital technologies and digital strategies to innovate, develop, and succeed in the field of entrepreneurship. This will be about creating a digital entrepreneurial mindset, digital entrepreneurial orientation, digital partnership and collaboration or data-driven decision-making (Corvello *et al.,* 2022). Meanwhile, digital transformation of business refers to the broader adoption of digital technologies and strategies across all areas of a business, regardless of its entrepreneurial nature (Table 1).

Digital Competences in the Era of Industry 4.0.

The first three industrial revolutions were based on the use of technologies such as mechanisation, electricity, and computerisation. Their introduction resulted in significant improvements in the manufacturing process and increased productivity. Industry 1.0 was about replacing manual labour with steam-powered machines. The essence of Industry 2.0 was mass production using electricity. Industry 3.0 was based on automation processes created using computer systems.

Finally, Industry 4.0 is characterised by using a range of modern technologies that integrate people, machines, and production systems into a single network. The most important of these technologies include cloud computing, the internet of things (IoT), big data, augmented reality (AR), and virtual re-

ality (VR). The use of cloud computing involves sharing resources stored in large external data centres accessible from any device to multiple entities via the Internet. Cloud computing reduces data collection costs, facilitates access to data, and improves communication efficiency (Rymarczyk, 2020).

The technology used in Industry 4.0 is also cyber-physical systems based on the internet of things, which enable connectivity between the physical and virtual worlds and data collection and analysis. These systems offer mechanisms for communication and interaction between devices without human intervention. Their application in production and logistics allows for real-time condition monitoring, forecasting, remote diagnostics, remote control, and continuous optimisation (Müller, 2019). This enables equipment to operate more efficiently and prevents production system failures.

Big data are datasets characterised by high volume, variety and velocity, making their management beyond the capabilities of traditional software. Their development and use require advanced analytical approaches such as data mining and statistical analysis. Today's global business is characterised by data flows in huge volumes, so the effective creation of applicable value from them requires the analysis of large data sets (Ahi *et al.,* 2022). The use of big data positively influences changes in production and improves decision-making processes. It also allows for more efficient coordination of relationships within and between companies, thus enhancing the quality of communication between manufacturers and customers, both in the sales process and through the individualisation of orders (Glomb, 2020).

Augmented reality and VR allow for interaction with the created digital world in real-time but differ in their reference level to the real world. Augmented reality is a set of technologies that superimpose virtual elements on top of the real world, which can support everyday work activities. Virtual reality replaces the real world with a fully digitally created environment and can be used as a simulation environment for training (Di Pasquale *et al.,* 2021), especially when there is limited contact with the real object. The use of augmented and virtual reality in the enterprise leads to improved cognitive, problem-solving and decision-making abilities.

According to Korzyński *et al.* (2023), some management ideas and concepts that may impact managerial activity at the strategic, functional, and administrative levels must be investigated in the context of generative artificial intelligence (GAI). In the future, robo-advisors such as ChatGPT might be very popular in business practice, despite their current limitations.

However, the Fourth Industrial Revolution cannot be identified solely with the modern technological solutions applied in the equipment, software, and communication links used. Success in effectively implementing modern technology depends on the specific personality traits and competencies of the people who will implement and use Industry 4.0 solutions. Indeed, the essence of the Fourth Industrial Revolution is the collaboration of machines with humans in working systems, designed not to replace human abilities and capabilities, but to coexist and help humans be more efficient and effective (Di Pasquale *et al.,* 2021). Therefore, the Fourth Industrial Revolution will result in transformations in the functioning of the labour market and priorities in developing human capital in terms of specific skills related to new types of human-machine interactions. Implementing Industry 4.0 solutions reduces the need for workers' competencies related to routine tasks that can be automated and taken over by machines. This will increase the efficiency of these processes by making them independent of the human factor. Instead, there is a growing demand for the kind of skills that cannot be taken over by machines and are related to human creativity, intelligence, and the ability to interpret information (Ujwary-Gil & Godlewska-Dzioboń, 2022). Modern workers perform their tasks with the support of machines, interact with robots and advanced sensors, use augmented and virtual reality, and have the ability to analyse data.

Effective use of internet of things technologies requires appropriate engineering skills, related to application development and operation of digital devices. Large data sets (big data) are of no significant value without the knowledge of analytical techniques to make them usable. Thus, only the right analytical skills make data a key value for the business and the economy. The ability to use AI tools to convert data into useful information is also essential (Glomb, 2020). The potential benefits associated with the use of AR and VR can only be realised if the employee has the right competencies to use these technologies. These include skills related to the use of new digital interfaces and ways of iterating with

holograms and the ability to interpret data provided in real time, make the right decision, and solve complex problems quickly (Di Pasquale *et al.,* 2021).

Workers and employees 4.0 should have confidence in the technology and a high level of acceptance of its solutions. This is a prerequisite for implementing the Fourth Industrial Revolution in the workplace. The key competencies of today's employees include the ability to act quickly, think logically, analyse and interpret data, and use digital tools and technologies to support the automation of business processes (Almerich *et al.,* 2020; Gorzelny-Dziadkowiec *et al.,* 2022). At the same time, they are subject to constant change, which requires employees to continuously learn, improve their qualifications, and acquire new skills.

Covid-19 as an Accelerator of Digital Transformation

The significance of digital transformation has acquired a new dimension in light of the Covid-19 pandemic, which has fundamentally altered the global community's thinking, behaviour, production, consumption, entrepreneurship, and business practices (Corvello *et al.,* 2022). The pandemic conditions enforced a change in the functioning of individuals, organisations, economies, and societies and digital technologies played a crucial role in sustaining the continuity of the designated entities. The literature highlighted the need for global change in economies, societies, and social sciences a long time ago (Toleb, 2008; Banaszyk *et al.,* 2021). The effects of the Covid-19 pandemic intensified thinking about the global change in many areas of life and highlighted the importance of digital transformation as an agent of such change. Admittedly, the process of digitalisation had been progressing for a long time. Negroponte (1995) was the first to use the term, describing the history of the technology's development and making predictions about its future. Long before the Covid-19 pandemic, researchers grew interested in the knowledge economy, the digital economy, the information society, and the application of digital technologies in business. Although digital transformation was one of the biggest trends in business in the pre-pandemic period, in retrospect, its implementation was not very successful. The Covid-19 pandemic accelerated these processes and even forced the use of digital technologies in many economic and social functioning areas. However, it seems that the most significant change was not in the technological progress itself, but in the way we think about technology and its application. The change brought about by the Covid-19 pandemic was more about certain mental and cultural areas than the technologies themselves, resulting in a considerable progression in the digitalisation of business activities and beyond. Therefore, the pandemic crisis is a manifestation of the black swan theory described by Toleb (2008) and digital transformation is the agent of global change.

Digital transformation has become very popular in the literature, but many articles emphasise that there is no clear position on what this process actually involves and what its effects are (Warner & Wäger, 2019; Wessel *et al.,* 2020; Kraus *et al.,* 2021). To provide an insight into this issue in entrepreneurship, we propose a three-part model of digital transformation in entrepreneurship, the conceptual framework of which is presented in Figure 1. This is not an exhaustive and definitive model, especially since digital transformation is a multidimensional and dynamic process.

In our approach, the digital transformation of entrepreneurship can be described based on three components 1) conditions, 2) mechanisms, and 3) effects. The creation of the right conditions, *e.g.* environmental (*e.g.* micro and macro) conditions, determines the start of the digital entrepreneurial transformation. The starting point is the Internet and digital solutions that can be used by companies. It is also necessary to create the appropriate infrastructure and legislation to regulate the operation and use of these solutions. The digital ecosystem for entrepreneurship has been part of the public debate for many years (Etemad, 2023b; Das, 2023). Many countries, especially developed ones, take actions to digitise the economy. At the EU level, a process has been undertaken to implement a common digital policy and a digital single market (Digital Europe, 2020). It is also essential to create the conditions for digital transformation within the organisation itself. This concerns the implementation of digital solutions offered by the ecosystem and the creation of own initiatives in this area. The second component of digital entrepreneurial transformation is defined as mechanisms that take certain conditions, and factors (*e.g.* from the ecosystem) and turn them into tangible results. These mechanisms boil down to leveraging a company's existing resources or creating new ones (Bhandari *et*

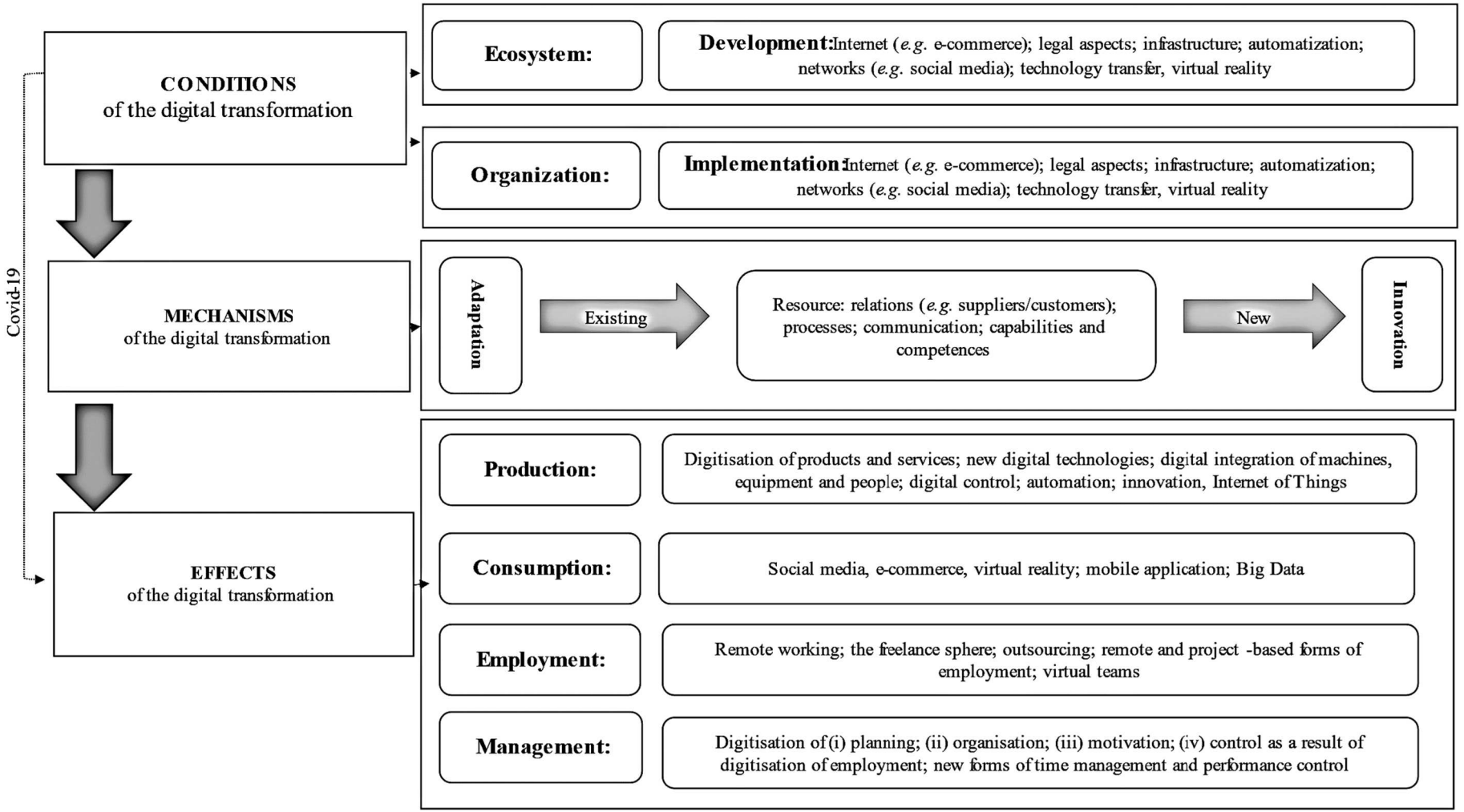

Figure 1. Conceptual framework for the digital transformation of entrepreneurship and business in the post-pandemic period

Source: own elaboration based on Hanelt *et al.* (2021) and Alekseieva *et al*. (2021).

al., 2023). The use of existing resources is labelled as adaptation, *i.e.* integration with digital conditions, while the creation of new resources is labelled as innovation. The digital competencies, dynamic capabilities, and technological entrepreneurship described above are relevant to digital transformation from an entrepreneurial perspective.

The third component shown in Figure 1 is the digital transformation effects of entrepreneurship. These effects are multidimensional (Dutra *et al.,* 2018). In pandemic circumstances, everyone was forced to encounter these effects. This includes the spread of remote work and the acceleration of automation processes in companies, which has also entailed new forms of organisational management. This also applies to production management, for example, through technological innovation but not only. Digital transformation enables intelligent production management systems based on online communication, visualisation, advanced analysis, and the use of large data sets to make accurate decisions. The demand is also rapidly adapting to or enforcing the changing reality and new mobile solutions (Giza & Wilk, 2021). In the literature, the effects of digital transformation are assessed positively, although some risks associated with the process are also indicated (Rymarczyk, 2021). Digital transformation enables the creation of innovative business models, enhances the ability to use external knowledge in the organisation and at the same time develops innovation through internal knowledge, allows for decision-making conditioned by multiple factors, increases rationality, provides wider networking opportunities, develops channels for information and interaction with stakeholders, and merges real and virtual reality (Kraus *et al.,* 2021). The Covid-19 pandemic has highlighted the need for change that can occur through digital transformation.

CONCLUSIONS

In the contemporary world, digitalisation ranks amongst the most significant ongoing transformations in business (Hagber & Jonsson, 2022). Business digitalisation or digital transformation of business will get more and more impact. The younger generation is more technologically optimistic than older managers and entrepreneurs (Venkatesh *et al.,* 2003), so optimism will be a more relevant driver of the desire to utilize robo-advisors and to promote digital transformation for younger users.

Responding to the first research question, we should note that innovation is an immanent feature of modern start-ups, *i.e.* mainly new technology-based companies. Technology transfer, technology commercialisation, and diffusion of innovations play an important role here. Technological entrepreneurship is fostered by entrepreneurial characteristics of companies such as their multilocation, the presence of technology brokers, and the operation of networks and relationship building. Two typical entrepreneurial mechanisms related to market opportunities (spotting and exploiting opportunities vs. creating opportunities) and the logic of entrepreneurial decision-making (causation and effectuation) are equally important.

Answering the second research question, it is essential to state that the Fourth Industrial Revolution both transforms manufacturing technology and business management, affecting the labour market and the demands placed on the workforce. Success in the effective implementation of modern technology is determined by the specific personality traits and competencies of the people who use Industry 4.0 solutions. These include a range of soft skills, such as creative and logical thinking, but also digital competencies related to new types of interaction between man and machine.

Answering the third research question, we may see now that the digitalisation of entrepreneurship has been gradually taking place for many years. The pandemic crisis has accelerated this process in companies and thus influenced the pace of digital transformation in society. Moreover, it has created a certain landscape that encourages digitalisation, innovation, and the incorporation of technology in the broadest sense. Entrepreneurial digital transformation can have different dimensions and levels depending on whether it is related to processes within the organisation, external relationships, or business models. There are many indications that entrepreneurs are attempting to digitise holistically.

In our study, we take up the topic of digitization, which is an inevitable process affecting every sphere of our lives. It has a huge impact on the development of business and entrepreneurship. In fact, we may say that today we are witnessing excellent changes that are faster than ever before. It seems

that the more we know about these processes and the better we understand them, the more we can adapt to them and use them. Our study contributes to the development of literature in the field of digital transformation in the face of the Covid-19 pandemic and focuses on technological entrepreneurship and digital competencies. Our study can also broaden the practical perspective on the examined aspects, especially paying attention to the role of the entrepreneurs – along with their mindsets, skills, and competencies – which are very important for the development of entrepreneurship.

The study is not without limitations. This is a conceptual study based on arbitrarily selected materials, which may result in some risk of subjectivity. Future studies should conduct empirical research on the multidimensional influence of digital transformation on business and entrepreneurship.

REFERENCES

Ahi, A.A., Sinkovics, N., Shildibekov, Y., Sinkovics, R.R., & Mehandjie, N. (2022). Advanced technologies and international business: A multidisciplinary analysis of the literature. *International Business Review*, *31*(4). https://doi.org/10.1016/j.ibusrev.2021.101967

Ajide, F.M. (2022). Impact of tourism development on latent entrepreneurship in BRICS. *Entrepreneurial Business and Economics Review, 10*(4), 143-154. https://doi.org/10.15678/EBER.2022.100409

Alekseieva, K., Novikova, I., Bediukh, O., Kostyuk, O., & Stepanova, A. (2021). Technological orders' change caused by the pandemics: Digitalization in the internationalization of technology transfer. *Problems and Perspectives in Management*, *19*(3), 261-275. https://doi.org/10.21511/ppm.19(3).2021.22

Almerich G., Suárez-Rodríguez J., Díaz-García I., & Cebrián-Cifuentes S. (2020). 21st-century Competences: The Relation of ICT Competences with Higher-order Thinking Capacities and Teamwork Competences in University Students. *Journal of Computer Assisted Learning, 36*(4), 468-479. https://doi.org/10.1111/jcal.12413

Antoncic, B., & Prodan, I. (2008). Alliances, corporate technological entrepreneurship and firm performance: Testing a model on manufacturing firms. *Technovation*, *28*(5), 257-265. https://doi.org/10.1016/j.technovation.2007.07.005

Babbie, E. (2012). *The Practice of Social Research*. 13th ed. Belmont, CA: Wadsworth Cengage Learning.

Badzińska, E. (2016). The Concept of Technological Entrepreneurship: The Example of Business Implementation. *Entrepreneurial Business and Economics Review*, *4*(3), 57-72. https://doi.org/10.15678/EBER.2016.040305

Bailetti, T. (2012). Technology entrepreneurship: Overview, definition, and distinctive aspects. *Technology Innovation Management Review*, *2*(2), 3-12.

Banaszyk, P., Deszczyński, P., Gorynia, M., & Malaga, K. (2021). The Covid-19 pandemic as a potential change agent for selected economic concepts. *Entrepreneurial Business and Economics Review, 9*(4), 35-50. https://doi.org/10.15678/EBER.2021.090403

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly, 37*, 471-82.

Bhandari, A.R., Zámborský, P., Ranta, M., & Salo, J. (2023). Digitalization, internationalization, and firm performance: A resource-orchestration perspective on new OLI advantages. *International Business Review, 32*(4), 102135. https://doi.org/10.1016/j.ibusrev.2023.102135

Carlsson, B., Braunerhjelm, P., McKelvey, M., Olofsson, C., Pearson, L., & Ylinenpää, H. (2013). The evolving domain of entrepreneurship research. *Small Business Economics, 41*(4). 913-930.

Cetindamar Kozanoglu, D., & Abedin, B. (2021). Understanding the role of employees in digital transformation: conceptualization of digital literacy of employees as a multi-dimensional organizational affordance. *Journal of Enterprise Information Management*, *34*(6), 1649-1672. https://doi.org/10.1108/JEIM-01-2020-0010

Collis, J., & Hussey, R. (2009). *Business Research: A Practical Guide for Undergraduate & Postgraduate Students*. 3rd ed. London: Palgrave Macmillan.

Corvello, V., De Carolis, M., Verteramo, S., & Steiber, A. (2022). The digital transformation of entrepreneurial work. *International Journal of Entrepreneurial Behavior & Research, 28*(5), 1167-1183. https://doi.org/10.1108/IJEBR-01-2021-0067

Das, A. (2023). Developing dynamic digital capabilities in micro-multinationals through platform ecosystems: Assessing the role of trust in algorithmic smart contracts. *Journal of International Entrepreneurship*, 21, 157-179. https://doi.org/10.1007/s10843-023-00332-7

Di Pasquale, V., De Simone, V., Miranda, S., & Riemma, S. (2021). Smart operators: How Industry 4.0 is affecting the worker's performance in manufacturing contexts. *Procedia Computer Science*, *180*, 958-967. https://doi.org/10.1016/j.procs.2021.01.347

Digital Europe. (2020). A stronger digital industrial Europe. Digital Transformation as its focus. Retrived from https://digital-europe-website-v1.s3.fr-par.scw.cloud/uploads/2020/02/DigitalEurope-A-Stronger-Digital-Industrial-Europe.pdf on February 2, 2023.

Dutra, A., Tumasjan, A., & Welpe, I.M. (2018). Blockchain is changing how media and entertainment companies compete. *MIT Sloan Management Review, 60*(1), 39-45.

Etemad, H. (2023a). Digitization and servitization in international entrepreneurship. *Journal of International Entrepreneurship,* 21, 143-149. https://doi.org/10.1007/s10843-023-00339-0

Etemad, H. (2023b). The increasing prevalence of multi-sided online platforms and their influence on international entrepreneurship: The rapid transformation of entrepreneurial digital ecosystems. *Journal of International Entrepreneurship, 21,* 1-30. https://doi.org/10.1007/s10843-023-00331-8

Etzkowitz, H., & Zhou, C. (2017). *The Triple Helix: University–Industry–Government Innovation and Entrepreneurship.* London: Taylor & Francis Group.

Fernandes, C., Ferreira, J.J., Veiga, P.M., Kraus, S., & Dabić, M. (2022). Digital entrepreneurship platforms: Mapping the field and looking towards a holistic approach. *Technology in Society*, *70*, https://doi.org/10.1016/j.techsoc.2022.101979.

Fisher, C. *et al.* (2010). *Researching and Writing a Dissertation*. 3rd edition. Harlow: Prentice Hall.

Galindo-Martín, M.Á., Castaño-Martínez, M.S., & Méndez-Picazo, M.T. (2023). Digitalization, entrepreneurship and competitiveness: an analysis from 19 European countries. *Review of Managerial Science*, *17*, 1809-1826. https://doi.org/10.1007/s11846-023-00640-1

Giza, W., & Wilk, B. (2021). Revolution 4.0 and its implications for consumer behaviour. *Entrepreneurial Business and Economics Review, 9*(4), 195-206. https://doi.org/10.15678/EBER.2021.090412

Gong, C., & Ribiere, V. (2023). A historical outline of digital transformation. In M.D. Lytras, A. Housawi, & B. Alsaywid (Eds.), *Digital Transformation in Healthcare in COVID-19 Times*. Amsterdam: Elsevier.

Gong, C., & Ribiere, V. (2023). Understanding the role of organizational agility in the context of digital transformation: an integrative literature review. *VINE Journal of Information and Knowledge Management Systems*, ahead-of-print. https://doi.org/10.1108/VJIKMS-09-2022-0312

Glomb, K. (2020). *Kompetencje 4.0*. Warszawa: Agencja Rozwoju Przemysłu.

Głodowska, A. (2019). The concept of high-tech firms and their role in the contemporary economy. In N. Daszkiewicz (Ed.), *The internationalization of high-tech firms: Patterns, innovation and research and development* (pp. 6-35). Cambridge: Cambridge Scholars Publishing.

Gorzelany-Dziadkowiec, M., Gorzelany, J., Kosała, M., Smutek, H., & Kubala, S. (2022). People and Technology - Employee Competency Profile in Industry 4.0. *Przegląd Organizacji*, *6*(989), 37-46. https://doi.org/10.33141/po.2022.06.05

Hagberg, J., & Jonsson, A. (2022). Exploring digitalisation at IKEA. *International Journal of Retail & Distribution Management*, *50*(13), 59-76. https://doi.org/10.1108/IJRDM-12-2020-0510

Hagberg, J., Sundstrom, M., & Egels-Zanden, N. (2016). The digitalization of retailing: an exploratory framework. *International Journal of Retail Distribution Management*, *44*(7), 694-712.

Hanelt, A., Bohnasack, R., & Marz, D. (2021). A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change. *Journal of Management Studies, 58*(5), 1159-1197. https://doi.org/1 doi:10.1111/joms.12639

Hauke-Lopes, A., Wierzeczycki, M., & Ratajczak-Mrozek, M. (2022). Extra-industry imitation of digital platform business models. *Entrepreneurial Business and Economics Review*, *10*(4), 91-105. https://doi.org/10.15678/EBER.2022.100406

Howells, J. (2006). Intermediation and the role of intermediaries in innovation. *Research Policy*, *35(*5), 715-728

Jacobson, M. (2021). Digitization of Business: What Is This Digital Transformation?. Boomfire.com Retrieved from https://bloomfire.com/blog/what-in-the-world-is-digitization/ on March 31, 2023.

Karri, R., & Goel, S. (2008). Effectuation and Over-Trust: Response to Sarasvathy and Drew. *Entrepreneurship: Theory & Practice*, *32*(4), 739-749.

Kirzner, I.M. (1979). *Perception, opportunity, and profit.* Chicago: University of Chicago Press.

Korzyński, P., Mazurek, G., Altman, A., Ejdsys, J., Kazlauskaite, R., Paliszewska, J., Wach, K., & Ziemba, E. (2023). Generative Artificial Intelligence as a New Context for Management Theories: Analysis of ChatGPT. *Central European Management Journal*, *31*(1). https://doi.org/10.1108/CEMJ-02-2023-0091

Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N. (2021). Digital Transformation: An Overview of the Current State of the Art of Research. *SAGE Open, 11*(3). https://doi.org/10.1177/21582440211047576

Kraus, S., Vonmetz, K., Orlandi, L.B., Zardini, A., & Rossignoli, C. (2023). Digital entrepreneurship: The role of entrepreneurial orientation and digitalization for disruptive innovation. *Technological Forecasting and Social Change*, *193*, 122638. https://doi.org/10.1016/j.techfore.2023.122638

Lacarcel, F.J., & Huete, R. (2023). Digital communication strategies used by private companies, entrepreneurs, and public entities to attract long-stay tourists: a review. *International Entrepreneurshipo and Management Journal, 19,* 691-708. https://doi.org/10.1007/s11365-023-00843-8

Linton, G. (2016). *Entrepreneurial orientation: reflections from a contingency perspective*. Örebro: Örebro University.

Maciejewski, M., Wach, K., & Głodowska, A. (2023). Is innovativeness influenced by proactiveness and risk-taking? Evidence from Poland based on structural equation modelling. *Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego*, *37*(1), 83–99. https://doi.org/10.24917/20801653.371.5

Morabito, V. (2022). Digital Entrepreneurship, Management, Systems and Practice. In V. Morabito (Ed.), *Digital Entrepreneurship* (pp. 5-27). Cambridge: Cambridge University Press. https://doi.org/10.1017/9781108979917.002

Müller, J.M. (2019). Assessing the barriers to Industry 4.0 implementation from a workers' perspective. *IFAC PapersOnLine*, *52*(13), 2189-2194. https://doi.org/10.1016/j.ifacol.2019.11.530

Nambisan, S. (2017). Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. *Entrepreneurship Theory and Practice, 41*(6), 1029-1055.

Negroponte, N. (1995). *Being digital.* London: Greener Books.

Onetti, A., Zucchella, A., Jones, M.V., & McDougall-Covin, P. (2012). Internationalization, innovation and entrepreneurship: business models for new technology-based firms. *Journal of Management Governance, 16*, 337-368 https://doi.org/10.1007/s10997-010-9154-1

Petti, C. (2009). Introduction. In C. Petti (Ed.), *Cases in technological entrepreneurship: Converting ideas into value*. Northampton, MA: Edward Elgar Publishing.

Pilková, A., Holienka, M., & Mikuš, J. (2022). Drivers of SME Digital Transformation in the Context of Intergenerational Cooperation in Slovakia. In B. Barbosa, S. Filipe, & C.A. Santos (Eds.), *Handbook of Research on Smart Management for Digital Transformation* (pp. 357-381). Hershey: IGI Global.

Ratten, V. (2023). *Research Methodologies for Business Management*. London: Reutledge.

Rymarczyk, J. (2020). Technologies, Opportunities and Challenges of the Industrial Revolution 4.0: Theoretical Considerations. *Entrepreneurial Business and Economics Review*, *8*(1), 185-198. https://doi.org/10.15678/EBER.2020.080110

Rymarczyk, J. (2021). The impact of industrial revolution 4.0 on international trade. *Entrepreneurial Business and Economics Review, 9*(1), 105-117. https://doi.org/10.15678/EBER.2021.090107

Sarasvathy, S.D. (2001). Causation and Effectuation: Towards a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *Academy of Management Review*, *26*(1), 243-263.

Sarasvathy, S.D., Dews, D., Ramakrishna Velamuri, S., & Venkataraman, S. (2005). Three Views of Entrepreneurial Opportunities. In Z.J. Acs & D.B. Audretsch (Eds.), *Handbook of entrepreneurship research* (pp. 141-160). Amsterdam: Kluwer.

Schildt, H. (2022). The Institutional Logic of Digitalization. In T. Gegenhuber, D. Logue, C.R. Hinings, & M. Barrett (Eds.), *Digital Transformation and Institutional Theory* (Research in the Sociology of Organizations, Vol. 83)(pp. 235-251). Bingley: Emerald Publishing Limited. https://doi.org/10.1108/S0733-558X20220000083010

Schumpeter, J.A. (1934). *The Theory of Economic Development*. Cambridge: Harvard University Press.

Schumpeter, J.A. (1976). *Capitalism, Socialism and Democracy*. London: Unary University Press.

Seibt, D., Schaupp, S., & Meyer, U. (2019). Toward an analytical understanding of domination and emancipation in digitalizing industries. In U. Meyer, S. Schaupp, & D. Seibt (Eds.), *Digitalization in Industry - Between Domination and Emancipation* (pp. 1-25). London - New York: Palgrave.

Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review, 25*(1), 217-226

Shane, S., & Venkataraman, S. (2007). The promise of entrepreneurship as a field of research. In A. Cuervo, D. Ribeiro, & S. Roig (Eds.), *Entrepreneurship Concepts, Theory and Perspectives* (pp. 171-184). Berlin: Springer.

Short, R.P., Ketchen, D.J., Shook, C.L., & Ireland, R.D. (2010). The concept of "opportunity" in entrepreneurship research: Past accomplishment and future challenges. *Journal of Management, 36*(1), 40-65. https://doi.org/10.1177/0149206309342746

Sieja, M., & Wach, K. (2019). The use of evolutionary algorithms for optimization in the modern entrepreneurial economy: interdisciplinary perspective. *Entrepreneurial Business and Economics Review*, *7*(4), 117-130. https://doi.org/10.15678/EBER.2019.070407

Taleb, N. (2008). *The Black Swan: The Impact of the Highly Improbable*. London: Penguin.

Timmons, J.A. (1989). *The entrepreneurial mind*. Baltimore: Brick House Publishing Company.

Trimi, S., & Berbegal-Mirabent, J. (2012). Business model innovation in entrepreneurship. *International Entrepreneurship Management Journal*, *8*, 449-465.

Tung, R.L., Zander, I., & Fang, T. (2023). The Tech Cold War, the multipolarization of the world economy, and IB research. *International Business Review*, In Press.

Ujwary-Gil, A., & Godlewska-Dzioboń, B. (2022). The two-mode network approach to digital skills and tasks among technology park employees. *Entrepreneurial Business and Economics Review*, *10*(2), 187-204. https://doi.org/10.15678/EBER.2022.100211

Van der Linden, R.W.H., & Łasak, P. (2023). *Financial interdependence, digitalization and technological rivalries. Cham:* Palgrave MacMillan.

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems*, *28*(2), 118-144, https://doi.org/10.1016/j.jsis.2019.01.003

Wach, K. (2019). Innovation and Internationalisation of High-Tech Firms (chapter 3). In N. Daszkiewicz (Ed.), *The Internationalization of High-Tech Firms: Patterns, Innovation, and Research and Development* (pp. 65-97). Newcastle upon Tyne (UK): Cambridge Scholars Publishing.

Wach, K. (2020). A Typology of Small Business Growth Modelling: A Critical Literature Review. *Entrepreneurial Business and Economics Review, 8*(1), 159-184. https://doi.org/10.15678/EBER.2020.080109

Wach, K. (2022). Entrepreneurship – delineation of the concept and the areas of research. In W. Pasierbek & K. Wach (Eds.), *Entrepreneurship*, series „Social Dictionaries". Kraków: Ignatianum University Press.

Wach, K., & Głodowska, A. (2022). Entrepreneurship research in economics and management: Understanding the term and research trends. *International Entrepreneurship Review*, *8*(4), 7-24. https://doi.org/10.15678/IER.2022.0804.01

Wach, K., Maciejewski, M., & Głodowska, A. (2023a). Inside Entrepreneurial Orientation: Do Risk-taking and Innovativeness Influence Proactiveness?. *Economics and Sociology*, *16*(1), 159-175. https://doi.org/10.14254/2071-789X.2023/16-1/11

Wach, K., Duong, C.D., Ejdys, J., Kazlauskaitė, R., Mazurek, G., Korzyński, P., Paliszkiewicz, J., & Ziemba, E. (2023b). The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGTP. *Entrepreneurial Business and Economics Review*, *11*(2), 7-30. https://doi.org/10.15678/EBER.2023.110201

Warner, K., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning, 52*, 326-49. https://doi.org/10.1016/j.lrp.2018.12.001

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind-Jensen, T. (2020). Unpacking the difference between digital transformation and IT-enabled organizational transformation. *Journal of the Association for Information Systems*, *22*(1). https://doi.org/10.17705/1jais.00655

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