Journal of Industrial Integration and Management
(2023) 1–32

DOI: 10.1142/S2424862223500045

Exploration of Technological Challenges and Public Economic Trends Phenomenon in the Sustainable Performance of Indonesian Digital MSMEs on Industrial Era 4.0

Muhammad Alfarizi*,‡, Tika Widiastuti† and Ngatindriatun*

*Department of Management
Binus Online Learning, Bina Nusantara University
Jakarta 11480, Indonesia

†Department of Sharia Economics
Faculty of Economic and Business Airlangga University
Surabaya 60115, Indonesia
‡muhammad.alfarizi@binus.ac.id

Received 22 June 2022
Revised 25 August 2022
Accepted 13 January 2023
Published 14 April 2023

Abstract. Digital Transformation creates new potential for MSMEs in developing businesses, especially with Indonesia's business climate as ASEAN's largest digital economy country. However, the challenges of digital adoption, especially infrastructure and trends in public economics, need further study, for exploring deeper and more complex factors of small business sustainability from big technical dimensions of technology and business management. Empirical research was conducted to explore empirically the factors of implementing Industrial Advancement Technology 4.0 and Community Economic Trends from External Perspective of Indonesian MSMEs in building sustainable digital business performance. The questionnaires were distributed to 231 respondents who met requirements of Indonesian MSME owners obtained from online survey using purposive sampling technique. This study shows support for all hypotheses proposed as exploration of the supporting factors for sustainable digital business performance. Digital SME mindset needs to be developed by making small businesses on global scale. Integration Big Data and IoT in MSME business resolve all business problems and build innovative business culture, empowering MSME employees to use technology. The internal challenges of business units can be overcome by strategic efforts and utilizing external roles in building sustainable MSME digital business. Collaboration with Quintuple Helix actors can be an option to further build a sustainable digital business.

Keywords: Big Data; digital adoption; internet of things; MSMEs; sustainable digital business.

1. Introduction

The environment of business and profit industry organizations has changed dramatically due to digital technology, especially in accessing information, communicating with each other, and obtaining products or services. Indeed, digitalization is

‡Corresponding author.

not a new phenomenon, but it continues to grow and produce new effects that continue to change on an ongoing basis. The combination of business, information technology and internet digitization is part of the industrial revolution 4.0 (Matt *et al.*, 2020). This is indeed in line with global demands that want a competitive advantage in building innovative and digital business strategies.

Industry 4.0 research in the development of small businesses has emerged a lot, this is because Small and Medium Enterprises (SMEs) can adopt technology in business operations, especially competitor intelligence collection, cost reduction, and consumer expansion. (Quinton *et al.*, 2017). The COVID-19 pandemic situation has increasingly pushed all small businesses in the world, especially Indonesia, to be more involved in the digitalization-based business ecosystem. In addition, there is great potential for business development through digital channels, this is because Indonesia is the country with the largest digital economy in ASEAN with a market share of the digital economy in ASEAN reaching 40%, or US$70 billion (Purbasari *et al.*, 2021).

Indonesia's economic growth comes partly from the contribution of MSME income of 61.7% in Gross Domestic Product (GDP). The condition of Indonesian MSMEs is still dominated by the micro sector with a total of 63.9 million businesses, or 99.62% of the total MSME businesses. The small business sector recorded 193,959 units, or 0.30%, medium businesses 44,728 units, or 0.07%, and large businesses 5,550 units, or 0.01%. Currently, 16.9 million MSME players have gone digital (Sari and Kusumawati, 2022). The condition has doubled than before.

The good news from the "forced" adoption of technology shows its role in Indonesia's economic growth after the COVID-19 pandemic. The release of State Statistics shows that the economic growth in the fourth quarter of 2021 compared to the same period of the previous year (year-on-year/yoy) was 5.06% — much better than the previous quarter which grew 3.51% yoy (Yacob *et al.*, 2021). In addition, MSMEs can absorb 97% of the total workforce and can collect up to 60.42% of the total investment in Indonesia. The factor of digitizing MSMEs is one of the keys to Indonesia's economic growth which is getting better day by day. This is indeed in line with the statement of the Organization for Economic Co-Operation and Development (OECD) Secretary-General Angel Gurriá "*There will be no sustainable digital transformation without our SMEs!*" (Kergroach, 2020). The achievement of economic growth and labor absorption thanks to the digitization of MSMEs encourages the achievement of SDGs 8 for an inclusive and sustainable economy, full and productive workforce, and decent work for all.

Economic Globalization recognizes the existence of MSMEs as engines of sustainable economic development in both developed and developing countries. All small businesses are expected to achieve sustainable business performance. Technology is one of the indicators for measuring sustainable business performance, but there is still a large "middle" of MSMEs that is lagging. Technological problems that occur in MSMEs include MSME broadband which is still not high-speed plus the scope of data-based economic participation or the use of cloud computing is not

optimal (Prasanna *et al.*, 2019). The lack of attention by MSMEs to data privacy puts their businesses at risk of becoming victims of very large cybercrimes and puts businesses at risk of weak nodes in technology infrastructure systems and supply chains that should be efficient with technology (Lee *et al.*, 2012). Barriers to access information and awareness of new digitalization are still a problem for MSMEs to identify the right technology options for their business and to manage change (Chege and Wang, 2020). Too few of the MSME owners engage their employees in ICT training, and too many continue to face deficiencies in the management, communication, or problem-solving skills that are critical to technology innovation and adoption (Franco *et al.*, 2021).

Empirically, MSMEs have a role as the backbone of the country's economy with business owners in the millions, almost in all rural and urban areas, there are MSMEs that really depend on business progress in the community as consumers (Al Asheq *et al.*, 2019). The trend of public economics as a new paradigm of the view of the economic situation based on popularity whichis always updated following human tastes as economic's trend centered. The value of economic opportunities derived from the passions of human trends and the influence of digitalization is relied upon to become a source of economic growth for the community, including MSME owners (Saviotti and Metcalfe, 2018). This statement is an important note, especially in determining the marketing strategy of MSMEs and targeting markets based on the tastes and needs of consumers (Kiškis, 2009).

Digital Transformation as part of the trend of public economics gives MSMEs the opportunity to develop with new digital processes and tools, including developing a global and sustainable small business with technology (Burinskien, 2011). However, as with any change management initiative, there are internal challenges that businesses will face during the transformation process ranging from people-centred issues, structural issues, technical barriers, and everything in between that makes adopting business digitization difficult (Ruiz-Real *et al.*, 2021). On the other hand, sustainable business development must look at the public, economic and sociocultural situation which is the catalyst for current business trends. Small businesses as part of the creative economy see the community's economy, especially the purchasing power of products and sociocultural trends as drivers of consumer behavior in the digital era (Vila-Henninger, 2021).

Technology integration research (Big Data and IoT) in a business has been widely researched. Javaid *et al.* (2021) stated in their research that Big Data is the main key to business competitive advantage (Javaid *et al.*, 2021). Meanwhile, Zhang and Chen (2020) stated that IoT and Big Data are industry trends operating, especially in business analytical power (Zhang and Chen, 2020). However, business technology research is only limited to general discussions and does not further discuss micro-business because it is considered simple (Gorkhali, 2022). The research study of industrial trend technology states that advancing trends accompanied by transitional progress from the socio-economic side of society are driving changes in the flow of business unit service systems in encouraging sustainable business growth through

the role of understanding the external situation (Xu, 2011) and the failure of the Industrial Revolution in the MSME Industry (Gorkhali, 2022). Efficient and effective integration of AI and IoT in MSMEs can make companies respond faster in the midst of market competition through the exchange of a perfectly implemented data transfer system as conveyed by DES (data exchange standards) integration research in the global business industry (Jelisic *et al.*, 2021). Da Xu (2022) stated in his research that an industry must be sensitive to the industrial revolution 4.0 including the use of technology that is increasingly complex in the future (Da Xu, 2022). The small industrial sector is one of the beneficiaries of the existence of the Industry 4.0 trend through the incorporation of three interrelated components: the industrial sector, CPS (Cyber Physical System), and analytical methods with interconnected physical and computing components (Duan and Da Xu, 2021).

Systems integration processes of Industrial 4.0 need to become more efficient and effective to enable companies to be more agile and more responsive in today's dynamic marketplace. However, the role of consumer behavior and external situations (Economic and Sociocultural) is very important in considering the impact of technology adoption in business for sustainable growth and access to MSME products in the midst of market share (Xu, 2020). However, some previous research has not been able to clarify the effects of internal barriers and external business situations in the implementation of business digitization to encourage sustainable MSME digital business growth. Priyono *et al.* (2020) in his research found that the capabilities of business organizations in the development of technology infrastructure and operations encourage increased benefits of business digitization (Priyono *et al.*, 2020). Pelletier and Cloutier (2019) in their research mention that in the digital business ecosystem, socio-economic influences around business units drive the successful implementation of technology (Pelletier and Cloutier, 2019). However, to the knowledge of the researchers in the investigation of the study, there has been no further research that shows the direction of the hypothesis for the sustainable digitization of MSMEs.

The challenges of technology adoption and community economic trends in the advancement of sustainable small businesses in Indonesia are very interesting to review, especially in exploring deeper and more complex factors of small business sustainability from the large technical dimensions of technology and business management. This study was conducted to explore the Implementation of Industrial Technology Advancement 4.0 and Community Economic Trends from the Inter-External Perspective of Indonesian MSMEs in building sustainable digital business performance by developing new thinking in business development based on cross-disciplinary scientific studies. This research encourages new contributions to the opportunities for SMEs to strive for sustainable digitalization, assessing the adoption of Big Data and IoT within SMEs by considering the position of the internal and external business situations to find out whether they are a "stumbling block" in the adoption of Big Data and IoT or other technology features.

2. Literature Review

2.1. *Big data*

Currently, technology is developing rapidly and is still developing. Big Data is one of the technologies that is still developing today. Big Data is defined by the National Institute of Standards and Technology as a large data set composed primarily of volume, speed and variability characteristics with a scalable infrastructure for efficient storage, manipulation and analysis (Sen *et al.*, 2016). Big data greatly drives productivity, makes efficiency improvements, and drives innovation in sustainable use.

Big data is a very valuable asset, and its volume will always increase which is described by 3V (Volume, Variety and Velocity). The volume referred to by Big Data is the amount of data that is very large and wide, the variety or diversity of data is very wide in type and the velocity or speed in processing the existing data (Iqbal *et al.*, 2018). All sectors of the world's business including MSMEs use Big Data to make significant business growth. Business organizations, both small and large, need valuable and accurate information in making decisions. Big Data encourages MSMEs to follow up on handling target audiences and customer needs and preferences (Mbassegue *et al.*, 2016). Simply, there is an urgent need for MSMEs to adopt Big Data in business adoption.

The existence of Big Data amid MSMEs today cannot be separated from the trend of internet literacy which is increasing rapidly in Indonesian society. Big Data has a very important and promising potential for MSMEs that can maintain MSME alliances by creating real-time solutions to the challenges of every industry (Andretti Abdillah *et al.*, 2018; Coleman *et al.*, 2016). However, there are several things that MSMEs must be wary of in the use of big data such as storage, the company's ability to process and generate information that makes sense from it, and last but not the least, security and privacy (Han and Trimi, 2022). Therefore, micro, small and medium enterprises (MSMEs) also need to be encouraged to get assistance on data science to support their business development.

The strategic use of big data must align with the organization's business strategy and embrace a long-term strategic plan. Applications used by MSMEs in business operations, including business data analysis, must be accompanied by different knowledge and skills (Maroufkhani *et al.*, 2020). To manage big data, business organizations must establish strategic plans for computing infrastructure, organizational procedures, policies, and rules relevant to big data (Wang and Wang, 2020).

2.2. *Internet of things (IoT)*

The Internet of Things over the last few years has become a special jargon in the technology realm. In fact, the technology is also often referred to by the abbreviation "IoT". It is not just a cool term. More than that, the existence of IoT in the era of digital transformation as it is now is needed by businesses in various industrial sectors (Krotov, 2017). Thanks to IoT, finally many businesses can evolve

successfully, creating advanced innovations and services with smart and integrated technology.

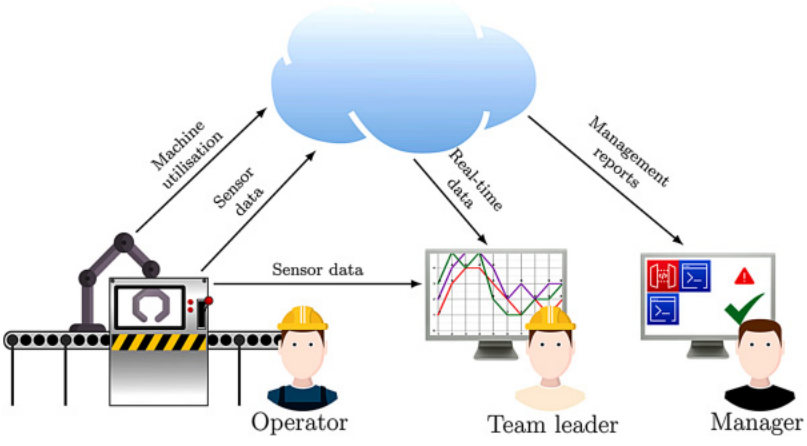
Internet of Things (IoT) is a concept where an object could transfer data over a network without requiring human-to-human or human-to-computer interaction. The development of IoT can be seen starting from the level of convergence of wireless technology, microelectromechanical (MEMS), internet, and QR (Quick Responses) Code. IoT is also often identified with RFID (Radio Frequency Identification) as a communication method (Sestino *et al.*, 2020).

"A Things" on the Internet of Things can be defined as a subject such as a person with an implanted heart monitor, a farm animal with a biochip transponder, a car that has built-in sensors to alert the driver when tire pressure is low. By far, IoT is most closely related to machine-to-machine (M2M) communications in manufacturing and electricity, oil and gas (Ghanbari *et al.*, 2017). Products built with M2M communication capabilities are often referred to as intelligent or "smart" systems. For example, smart cables, smart meters, smart grid sensors. In addition, it also includes sensor-based technologies, such as wireless technology, QR Code which we often encounter (Attaran, 2017). The ability of IoT itself is unquestionable. There are so many technologies that have implemented IoT systems, for example light sensors, sound sensors from the latest Google technology, namely Google Ai, and Amazon Alexa (Routh and Pal, 2018).

The Internet of Things is a key driver of Industry 4.0, enabling real-time communication and decision-making between processes and enabling new insights into production and decision-making (Hansen and Bøgh, 2021). The investigative study of Moeuf *et al.* (2017) shows that 90% of experts agree that IoT is the key to the performance of the SME industry. Moreover, more than 55% agree that big data is also the key to improve their performance. From the expert group, 75% agreed that the research team should promote the implementation of Industry 4.0 in SMEs (Moeuf *et al.*, 2017).

The implementation of IoT on a large scale helps contribute to increased levels of engagement from employees, which leads to increased productivity, business performance satisfaction and customer service. The application of IoT in Indonesian MSMEs is most often found in the QR Code Payment-based payment transaction process, marketing through the Automatic Chat Whatsapp/Marketplace Application and the use of barcodes in displaying various product information (Anshari and Almunawar, 2021; Fridayani and Atmojo, 2021; Widyastuti and Irwansyah, 2018). But actually, the use of IoT is more than just what is used today. There have been a lot of IoT research developments in the production of SMEs outside Indonesia which is described as follows.

Figure 1 describes the future of IoT in machine operations in the process of making MSME products that can be applied in Indonesia. In the figure, IoT data from production will flow to the cloud and local operator monitoring stations. This local monitoring station will show the operator and team leader the current state of the machine. Managers can get manager reports from the cloud with information on



Source: Hansen and Bøgh (2021).

Fig. 1. IoT devices at the production sending data to a local monitor station as well as the cloud.

production machine usage along with predictive maintenance reports. However, a more in-depth exploration of technological systems is needed through cross-disciplinary testing. In addition, the understanding of MSME owners must also be improved with the workforce in a deeper IoT adoption.

2.3. *Internal digital business challenge*

Technology has developed rapidly into a new era that accommodates changes in business transformation into the digital business era, where companies are currently optimizing the use of digital tools (Schwertner, 2017). The existence of technology also affects consumer demand to be more varied, this is certainly a challenge in itself in running a digital business. Digital transformation which is getting more advanced and sophisticated every day has many benefits for the development of the business world, including the presence of this technology that can save time, energy, and costs with maximum results (Alla Vasilevna and Chernikova, 2019).

Digital Transformation is a running business topic in the Industry 4.0 era that builds business foundations in the digital market space using various technologies. All sectors, both small and large scale, are required to switch or innovate in the use of more modern technology, but not just transition or innovation, but also about how this technology is adopted and used. Digital transformation is said to be successful if it is able to optimize the company's business processes and minimize (or even eliminate) inefficiencies, risks, and obstacles (Lenkenhoff *et al.*, 2018).

There are three internal challenges faced by MSME owners in running their business, namely the large cost of business digitization, the time in the business implementation design process and the knowledge/learning curve needed to implement or maintain business digitization (Faridi and Malik, 2020; Hulla *et al.*, 2021;

Idah and Pinilih, 2020; Lenkenhoff *et al.*, 2018). This adoption process does require strategy and planning in overcoming the problems that occur.

A vigilant small business will take advantage of technological advances as a form of digital strategy. However, with the advancement of digital technology, MSME owners will be able to find whatever we want very quickly and efficiently (Shatrevich and Zvanitajs, 2012). Business models using digital strategies give birth to new businesses in the form of platforms and give birth to a different ecosystem, so that businesses can continue to survive and develop along with rapid technological developments (Broekhuizen *et al.*, 2021). The inability of MSMEs to adapt and be "literate" with this change will, of course, threaten the continuity and going concern of the business (Soluk *et al.*, 2021).

2.4. *Economics and sociocultural public factors*

The economic environment is the economic conditions in the country in which a business operates. Economic conditions have a strong impact on the performance of any business because they can affect the income or expenses of that business. The measurement of the economic level of the business environment is assessed based on the history of real business profit growth, sales volume growth, Break Even Point (BEP) achievements and evidence of improving the welfare of employees and business owners (Belas *et al.*, 2018; Čepel, 2019; Chittithaworn *et al.*, 2011; Turkyilmaz *et al.*, 2020).

When the economy is strong, the employment rate is high, and the compensation paid to employees is also high (Holienka *et al.*, 2016). Because people have relatively good incomes under these conditions, they buy a large number of products. Companies that produce these products benefit from the huge demand (Van Buren *et al.*, 2020). The company employs a large number of employees to ensure that it can produce sufficient quantities of product to meet demand. Companies can also pay high wages to employees. The implementation of technology in supporting business operations can also be carried out optimally in the economic conditions, especially in the good business environment (Eling and Schaper, 2017).

When the economy is weak, companies tend to lay off some of their employees and are unable to pay high wages. Because people have relatively low incomes in this condition, they buy products in small quantities. Companies that produce these products are hit hard because the company cannot sell all the products it produces. Consequently, the company may need to lay off some employees (Blahová *et al.*, 2015). In this condition, several companies fail, and all of their employees lose their jobs, causing the unemployment rate to increase. Adoption of technology is very difficult to do optimally, especially if the economic situation of the business environment alone is not able to meet the needs of digital marketing which has incurred considerable costs (Tran and Nguyen, 2019).

Meanwhile, socio-cultural factors are a group of people who jointly consider closely the similarities in status or community awards which are formally and informally accompanied by local cultural customs. Social factors can be seen from the

relationship with friends, family and parents in influencing purchasing decisions. The higher the relationship with friends, family and parents, the higher the consumer's decision to make a purchase (Qazzafi, 2020). Likewise with the high cultural justification for use. Consumers buy certain products based on awareness of membership in a cultural community regarding lifestyles (shared beliefs, attitudes, activities, and behaviors) that tend to distinguish their customs from other communities (Danish *et al.*, 2019).

Social class is a hierarchical and natural form of segmentation, because the hierarchical aspect of social class is so important for marketers and producers to determine which consumers will be the targets of the products that have been created, whether for higher, middle or lower classes. Indeed, here it looks so real injustice and distance to consumers, but it is all a natural segmentation because everything has happened and is created by itself (Pantano, 2011). Technology adoption in business also requires consumer acceptance in order to support the business being run, considering that consumers will also use the technology either directly or indirectly. Various research studies and theories of technology acceptance were born to examine the use of technology, especially in business. The measurement of sociocultural factors is seen from the appreciation of the existence and contribution of MSMEs to the career social status of MSME owners (Kiraz *et al.*, 2020).

2.5. *Information technology (IT) implementation*

The era of globalization has shaped the challenges of various sectors, including the adoption of information and communication technology that cannot be separated from the business world, especially in the face of increasingly competitive business competition. The need for information technology is a basic need for companies to survive in a competitive business world. Information technology has driven advances in product and process technology, as well as the formation of an information society (Cong *et al.*, 2021). Changes that occur due to globalization have an impact on changes in the business environment which include changes in technology, changes in consumer perceptions and product competition. As a result, business units are required to be able to improve product quality, service, efficiency, production costs and increase company productivity. Finally, mastery of information technology is a demand that must be owned by companies (Dube *et al.*, 2020).

In addition, the development of information technology has a major impact on the competitive advantage of business units. The competitive advantage of a company can be assessed based on economic criteria using measures such as effectiveness, efficiency and productivity. The development of information technology creates products with large capacities, is energy saving and can perform more and more functions and types of work and with information technology it can process, store, display data and information (Premkumar, 2009; Tran and Nguyen, 2019).

To achieve the desired goals of the company, every organization is formed from three main pillars, namely process, human resources and technology. In designing, a

series of processes, these three elements must be integrated according to market (customer) needs. It should be noted that human resources operate the process, technology is also used to support the process, especially information technology which plays a major role, along with processes and human resources. Technology implementation is measured at least from three aspects, namely in financial, operational and business marketing practices (Dahnil *et al.*, 2014; Nguyen, 2009; Premkumar, 2009; Sukarsih *et al.*, 2019).

2.6. *Digital business perceived benefits*

The Industrial Revolution 4.0 encourages reforms in various aspects of human life, we can now clearly observe how these changes have become a powerful phenomenon that cannot be dammed (Udovita, 2020). All business units, both small and large in the world and also in Indonesia, are competing to innovate to win market competition amidst increasingly fierce competition. The innovations carried out include a digital transformation strategy, carrying out comprehensive changes to every process, competency, and business model with the implementation of digital technology, in line with the recommendations of various global research institutions that make digital transformation a mainstream organization in winning global competition (Muafi *et al.*, 2021).

Massive innovation has spread to all lines of life amidst the dynamics of increasingly dynamic world relations, there have been some radical changes that have recently been seen moving very fast, one of which is through digitization, which is marked by characteristics, among others, the implementation of vertical networking, the network no longer has barriers or hierarchies. Vertical networking is then followed by horizontal integration as a concrete form of collaboration that prioritizes output, innovation inherent in digitalization, giving birth to new phenomena with the increasingly massive concepts of sharing economy, internet of things, e-commerce, financial technology, artificial intelligence in various fields, life, especially competition (Arvindhan, 2021; Szedlak *et al.*, 2021).

The adoption of business digitalization has proven to have brought various changes, at least providing benefits in achieving efficiency in business operational governance, effectiveness in managing business finances, reducing production costs, collaboration, connecting one party to another and growing a business competitive advantage. In addition, technology plays a role in growing business profits and expanding target markets, including consumer affordability. Therefore, digital transformation in business should be used as an alternative solution as a new business growth engine (Akpan *et al.*, 2020; Chen *et al.*, 2021; Ho, 2022; Jain, 2015; Li *et al.*, 2018; Suuronen *et al.*, 2022; Zolkover *et al.*, 2022).

2.7. *Sustainable digital business performance*

Sustainable business, commonly known as business sustainability, is the ability of a company to achieve business goals and increase long-term value and can consistently

and stably improve business performance while implementing economic, social and environmental values as a business strategy (Haseeb *et al.*, 2019). A sustainable company or business unit is usually based on the 3P, namely people, profit and planet. These three factors are the pillars for measuring the success value of a company or business unit, namely economic, social and environmental (Dyllick and Muff, 2016).

Through the implementation of a sustainable company, the company's performance will automatically increase because it can control the use of Natural Resources (SDA) effectively. This will facilitate long-term business strategy planning. Companies or business units can be assessed as sustainable not only based on their involvement in the environment, but also covering the fields of technology, law, finance, industry, social, material and behavior. Viewed from a business perspective, sustainability is how to reduce costs now and costs that will arise in the future so as to increase profitability, reduce competitiveness and extend the life of the business (Bican and Brem, 2020; Kautonen *et al.*, 2020).

The term sustainability is closely related to sustainable development, Corporate Social Responsibility (CSR), and long-term planning. With the issue of sustainability, creating awareness of sustainable handling efforts and giving birth to the concept of CSR are part of a sustainable business strategy (Maas and Reniers, 2014).

Companies or business units that run sustainable businesses will benefit from increased productivity, sustainable business development, work processes will be simpler and inefficient activities and costs will be reduced. In addition, business units that run sustainable businesses indirectly encourage good corporate governance and have sustainable human resources (Agrawal *et al.*, 2022; Rakhmawati *et al.*, 2020). Increased profits will be obtained by the company in maintaining a sustainable business. Employees who work for companies that care about the environment and the welfare of their employees will remain loyal and try to work their best to achieve mutual benefits. This will give birth to quality workforce resources. Sustainable business units will always follow business developments including technology adoption in order to encourage sustainable business management efficiency (Gregurec *et al.*, 2021).

2.8. *Aims and hypotheses*

Technological developments have become an Industrial 4.0 alarm that business units must face in the future, even though they are currently still entangled in the COVID-19 pandemic situation. Big Data is one of the technology outputs that is useful in shaping business insights including better decision making. However, the Big Data analytical process must be carried out systematically and carefully because the data in it is not structured. There are many platform devices or services that contain Big Data, including smartphones, online transactions, social networks, electronics, and machine communication. Consumer behavior can be captured through a collection of device sensors that are processed in business activities that are integrated with big

data in supporting efforts to implement business unit technology, including MSMEs (Jonny and Toshio, 2021). An investigative study of the mediating role of "Big Data Analytics" played between "Project Performance" stated Big Data as a driver of environmental technology in Indian Manufacturing MSMEs (Mangla *et al.*, 2020). The results of the quantitative analysis of Big Data Analytics Capabilities (BDAC) at Firms in the UK also state Big Data as a sign of technology implementation to support innovation in sustainable renewable business models (Ciampi *et al.*, 2021).

H1. Big Data Indonesian MSME has a significant positive effect on Information Technology Adoption.

The digital transformation of business units must also be supported by the Internet of things (IoT) in order to keep up with the times. The superiority of the IoT trend in business will drive a revolution in values, concepts, and business unit development strategies to advance. Ignoring digital transformation can lead to unfavorable consequences, especially the possibility of being left behind by tech-savvy competitors (Utami, 2021). Fintech innovation research on Indonesian Food MSMEs shows the influence of IoT in supporting technology adoption, especially in supporting open business innovation (Najib *et al.*, 2021).

H2. Internet of Things (IoT) Indonesian MSME has a significant positive effect on Information Technology Adoption.

Facing the development of the digital economy, even small businesses need to adopt technology, especially digital tools. Businesses may need cloud-based cashier applications, social media applications, tools for data analysis, and so on. Unfortunately, most small businesses are faced with challenges especially in terms of knowledge and costs related to digital trends and business opportunities. Business internal challenges in the digitization process will affect the perception of the benefits of business digitization (Priyono *et al.*, 2020). The study of E-Commerce Adoption by SME Travel Agents in Egypt states that the success of the strategy to overcome internal business challenges will determine the benefits of business digitization generated, especially in supporting strategy and development, and the benefits of business efficiency (Abou-Shouk *et al.*, 2012).

H3. Internal Digital Business Challenge has a significant positive effect on Digital Business Perceived Benefits.

Economic and sociocultural factors are very likely to be some of the failure factors in a business unit because of their potential which may become a threat if it cannot be predicted properly, and can be an advantage if it can be faced appropriately. The best managerial and strategy will be needed in controlling these factors (Chittithaworn *et al.*, 2011). The business economy is very important to determine the buying and selling ability of the surrounding community (Altayyar and Beaumont-Kerridge, 2016). Sociocultural factors are important because in carrying out a process one must understand the existing market. In this case, the level of

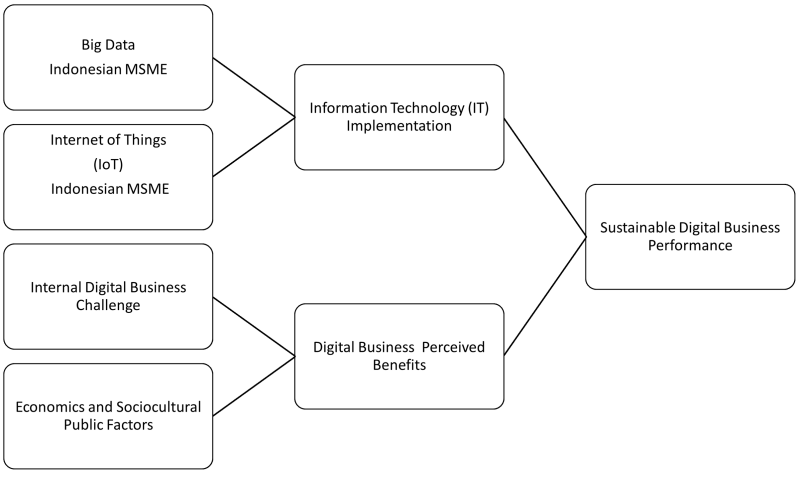


Fig. 2. The assumed research framework.

culture, needs, demographics of the community is one of the determining factors that must be analyzed (Pramono *et al.*, 2021). The results of research on the E-Commerce electronic business strategy show that economic and social factors are some of the determinants of marketing success and increasing business profits (Nadeem *et al.*, 2018).

H4. Economics and Sociocultural Public Factors have a significant positive effect on Digital Business Perceived Benefits.

Currently, not many people are aware of the benefits of sustainable business, especially in sustainable digital transformation. Fortunately, the idea of a sustainable business is increasingly being applied by companies in Indonesia. Although the figure is still below 40%, the upward trend is still there. The implementation of Technology and Digital Business Benefits obtained is one of the benchmarks for Sustainable Digital Business Performance. Artificial Intelligence research in the Italian SME Agri-Food System shows the adoption of technology and the benefits of digital transformation to encourage the Agrifood business to remain sustainable, especially in the growth of business profits and customer value (Di Vaio *et al.*, 2020).

H5. Information Technology Adoption has a significant positive effect on Sustainable Digital Business Performance.
H6. Digital Business Perceived Benefits has a significant positive effect on Sustainable Digital Business Performance.

The results of the scientific study of the literature evidence above form a hypothesis path with the research model in Fig. 2 for further analysis in the context of this research.

3. Research Methods

The application of quantitative research is Cross-Sectional in order to analyze and explore the factors that shape and influence the performance of a sustainable digital business. The target population of this research is MSME owners in Indonesia who adopt technology in their business at least in marketing. Indeed, the number of MSMEs in Indonesia is known to be 16.9 million Indonesian MSMEs, but due to a very large population and limited time, to create opportunity and means to make sampling decisions, the Purposive Sampling technique is used. The decision to use the purposive sampling technique is defined as a type of sampling design based on certain considerations (judgmental sampling), where sampling is limited to certain types of people who can provide the desired information based on certain considerations (Etikan, 2016). The characteristics that must be possessed by respondents as a consideration for sampling in this study are that MSMEs have adopted technology for at least one year in marketing. Determination of the minimum sample size in this study refers to the statement by Hair *et al.* (2019) that the number of samples as respondents must be adjusted to the number of question indicators used in the questionnaire, assuming $n \times 5$ observed variables (indicators) up to $n \times 10$ observed variables (indicators) (Hair and Brunsveld, 2019) which are given in more detail in Table 1.

Table 1. Research variable indicator.

Variable	Indicator	Source
Big Data Indonesian MSME	Big Data Plays a Role in Business Prediction and Optimization Big Data Plays a Role in Understanding Consumers Big Data Plays a role in building the right business strategy Big Data Plays a Role in Adding Customer Experience Big Data Plays a role in increasing productivity in business workflows Big Data plays a role in retaining customers Big Data plays a role in reducing costs and minimizing losses	(Andretti Abdillah *et al.*, 2018; Hadi, 2020; Mbassegue *et al.*, 2016; Sampurno *et al.*, 2021; Wang and Wang, 2020)
Internet of Things (IoT) Indonesian MSME	Payment Efficiency (QR Code Payment) Communication Efficiency and Online Order (Automatic Chat Whatsapp/Marketplace Application) Ease of Access to Information (Barcode Information)	(Haseeb *et al.*, 2019; Jaafreh, 2018; Widyastuti and Irwansyah, 2018)

Table 1. (*Continued*)

Variable	Indicator	Source
Information Technology (IT) Implementation	Implementation in Business Finance (Transactions and/or Income Recording) Business Operation Marketing and Business Communication	(Dahnil *et al.*, 2014; Nguyen, 2009; Premkumar, 2009; Sukarsih *et al.*, 2019)
Internal Digital Business Challenge	Business Digitization Fee Business Digitization Duration/Time Knowledge/learning curve needed to implement or maintain Digitalization Implementation	(Faridi and Malik, 2020; Hulla *et al.*, 2021; Idah and Pinilih, 2020; Lenkenhoff *et al.*, 2018)
Economics and Sociocultural Factors	Good society nation economic growth Increasing people's purchasing power of Business Products Break Even Point (BEP) Achievement in Market Supply and Demand Balance The State Economic Inflation Situation does not affect business significantly Improving the Welfare of Employees and Business Owners Appreciating the existence of SMEs Understanding the Contribution of SMEs to Society Establishing a Good Business Environment through Good Business Practices Family Support in Business Support Mass Media Channels and Social Media Business Owner Social Status Career Growth and Future of Business	(Belas *et al.*, 2018; Čepel, 2019; Chittithaworn *et al.*, 2011; Turkyilmaz *et al.*, 2020)
Digital Business Perceived Benefits	Business Governance including finance has been improved with the implementation of business digitization Operational efficiency has been improved by implementing business digitization Operational flexibility has been enhanced by the application of business digitization Product quality has been improved by applying this technology Marketing efficiency and Business Promotion have been improved by applying this technology Competitive advantage has been enhanced by applying this technology	(Akpan *et al.*, 2020; Chen *et al.*, 2021; Ho, 2022; Jain, 2015; Li *et al.*, 2018; Suuronen *et al.*, 2022; Zolkover *et al.*, 2022)

Table 1. (*Continued*)

Variable	Indicator	Source
	Business Profit has been increased by implementing business digitization	
	Number of Consumers has been increased with the implementation of business digitization	
Sustainable Digital Business Performance	Business Performance and Digital Adoption Development	(Agrawal *et al.*, 2022; Bican and Brem, 2020; Djalic *et al.*, 2021)
	Achievement of 3P Sustainable Business Value (Triple Bottom Line)	
	The Future of Sustainable Digital Business	

In this study, the number of items was 38 items used to measure 7 variables, so the minimum number of respondents was 190 respondents. The entire questionnaire in this study was then measured using the 5-point Likert scale method — between strongly disagree (1) to strongly agree (5). The research project started in April 2022 and was completed in May 2022 in terms of data collection. All participants were informed about the purpose of this study and consent of each participant was ensured by asking them to sign a checklist of consent to fill out a questionnaire compiled online via Google Forms.

The analysis technique used is Structural Equation Model-Partial Least Squares (SEM-PLS) using SmartPLS 3.0 software. EM with PLS is an alternative technique in SEM analysis, where the data used does not have to have a multivariate normal distribution. In SEM with PLS, the value of the latent variable can be estimated according to the linear combination of the manifest variables associated with a latent variable and treated to replace the manifest variable (Hair *et al.*, 2018). PLS SEM analysis will go through two stages, namely the measurement model test (Measurement Outer Model) and the structural model test (Inner Structural Model). The analysis of the measurement model was carried out using a measure of reliability and internal validity. After the measurement model is analyzed, the bootstrapping procedure is carried out using the results of the t-test and path values for hypothesis verification plus the support for the R-Square results to see the strength of the research model being tested as a whole (Hair Jr. *et al.*, 2017; Rigdon *et al.*, 2017).

4. Result and Discussion

4.1. *Characteristics of respondents*

The questionnaire was filled in by 247 MSME Owner Respondents from various parts of Indonesia, but not all respondents met the criteria so they had to go through the screening stage. So that the data collection of respondents observed was 231

Table 2. Demographic information.

Control		Variant
Gender	Male	69 (30%)
	Female	162 (70%)
Age	20–30 Years	103 (45%)
	31–40 Years	51 (22%)
	41–50 Years	49 (21%)
	>50 Years	28 (12%)
Industry	Manufacturing	137 (59%)
	Services	94 (41%)
Experience Business	1–2 Years	119 (52%)
	3–4 Years	58 (25%)
	5–6 Years	31 (13%)
	>6 Years	23 (10%)

respondents. The majority of respondents who own MSMEs in this study are women (70%), while 30% are men. From the point of view of age, the largest proportion of subjects were in the age range of 20–30 years (45%) and 31–40 years (22%). The MSME Industry in the Manufacturing Category dominates (59%) compared to the MSME in the service category, although the figure is not too far off. In terms of business history, half of the total population has only been in business for 1–2 years (59%) although 58 respondents from MSME owners stated that they had been in business for 3–4 years. Table 2 describes in detail the profile of the respondents who participated in this research. The process of data analysis will be continued in SEM PLS analysis.

4.2. *Measurement outer model*

The outer model is a model that specifies the relationship between the latent variable and its indicators, or it can be said that the outer model defines how each indicator relates to the latent variable. The outer model testing in this study used convergent validity, AVE (Average Variant Extracted) validity, Composite Reliability (CR) and Cronbach's Alpha (CA) (Hair *et al.*, 2019). Rule of thumb validity with two subtests of convergent validity by loading factor with a minimum value of 0.7 and the AVE value must be higher than 0.5. While the reliability criteria rules through two sub-tests, Composite Reliability (CR) and Cronbach's Alpha (CA) must meet the minimum value of 0.7 but get better if it pass the minimum number (Hair *et al.*, 2019). Testing the validity and reliability through the Measurement Outer Model Test procedure shows that all items have met the requirements. Based on the results of the validity test in Table 3, the loading factor value for all items is above 0.7 and the AVE value is higher than 0.5. While the reliability test shows the CR value > 0.7 on all constructs and Cronbach's alpha > 0.7. Thus, it can be stated that all constructs in this study are reliable.

Table 3. Summary of construct validity and reliability of all constructs.

No.	Construct	Items	Outer loadings	AVE	CR	CA
1	Big Data Indonesian MSME	7	0.785 0.693 0.752 0.776 0.857 0.862 0.804	0.627	0.921	0.900
2	Internet of Things Indonesian MSME	4	0.827 0.796 0.822 0.775	0.649	0.881	0.819
3	Information Technology (IT) Implementation	3	0.756 0.830 0.867	0.670	0.859	0.753
4	Internal Digital Business Challenge	3	0.718 0.853 0.846	0.609	0.821	0.772
5	Economics and Sociocultural Public Factors	11	0.795 0.784 0.819 0.816 0.791 0.794 0.796 0.768 0.753 0.820 0.719	0.518	0.921	0.906
6	Digital Business Perceived Benefits	8	0.728 0.708 0.767 0.889 0.764 0.784 0.830 0.825	0.584	0.918	0.898
7	Sustainable Digital Business Performance	3	0.828 0.801 0.824	0.669	0.858	0.756

4.3. *Inner model structural*

Testing of the inner model or structural model is carried out to see between constructs through the significance value of the path coefficient and R-square of the

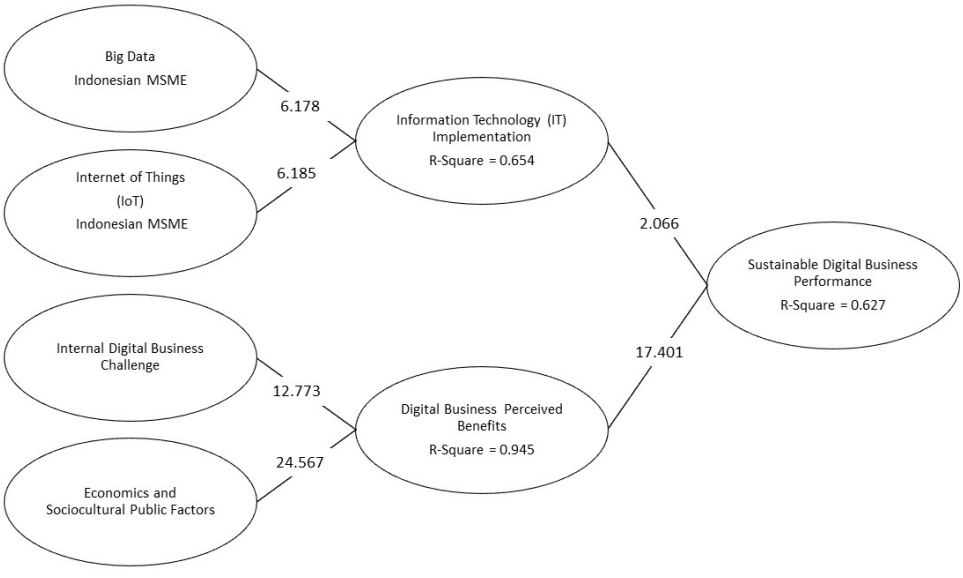


Fig. 3. The structural model hypothesized.

research model. The structural model was evaluated using R-square with criteria values of 0.67 (strong), 0.33 (moderate) and 0.19 (weak) (Hair Jr. *et al.*, 2017). Hypothesis testing is indicated by the path coefficient value (inner model). The rule of thumb is the coefficient score indicated by the*t*-statistic value above 1.64 on hypothesis testing with an alpha of 5%. Hypothesis testing in this study is accepted if it shows a p-value < 0.05 (Hair *et al.*, 2019).

Structural model testing at Fig. 3 shows that the value of R2 on Information Technology Implementation is 65.4% with a strong category. Meanwhile, the Digital Business Perceived Benefits are 94.5% in the strong category, and the Sustainable Digital Business Performance at 62.7% in the strong category. Of the six hypotheses proposed as an exploration of the supporting factors for sustainable digital business performance, all of them are supported. Technology implementation in MSMEs is influenced by big data (0.383) and Internet of Things (0.381). Internal Digital Business Challenge (0.361) and Economics Sociocultural Public Factors (0.682) affect Digital Business Perceived Benefits. The results of the Path Coefficient test encourage the influence of Information Technology Implementation (0.188) and Digital Business Perceived Benefits (0.742) on Sustainable Digital Business Performance. Based on the results of the path analysis, it shows that the significance level of p-value is below 0.05 so that it supports all hypotheses. This study also recorded that the largest Path value to support Sustainable Digital Business Performance was found in Digital Business Perceived Benefits of 0.742. The results of hypothesis testing using bootstrapping in detail can be seen in Table 4.

Table 4. Hypotheses and *R*-squared testing result.

Hyp.	Direct effect	Path coef.	*T*-statistic	*P*-value	*R*-square
H1	Big Data Indonesian MSME → Information Technology Implementation	0.383	6.178	0.000	0.654
H2	Internet of Things (IoT) Indonesian MSME → Information Technology Implementation	0.381	6.185	0.000	
H3	Internal Digital Business Challenge → Digital Business Perceived Benefits	0.361	12.773	0.000	0.945
H4	Economics and Sociocultural Public Factors → Digital Business Perceived Benefits	0.682	24.567	0.000	
H5	Information Technology Implementation → Sustainable Digital Business Performance	0.188	2.066	0.039	0.627
H6	Digital Business Perceived Benefits → Sustainable Digital Business Performance	0.742	17.401	0.000	

4.4. *Discussion*

This research is intended to comprehensively explore the Implementation of Industrial 4.0 Advancement Technology and Public Economic Trends from the Inter-External Perspective of Indonesian MSMEs in building sustainable digital business performance. The research survey succeeded in testing 231 respondents who met the feasibility of further quantitative exploration of SEM PLS.

Based on the test results, Big Data Indonesian MSME has a positive effect on Information Technology Implementation which indicates support for the first hypothesis. The development of information technology today is no longer something that is limited or only owned by the upper middle class. Small businesses can even benefit from information technology through various devices. Its great impact makes information technology inseparable from the world of business and industry. The adoption of Big Data in small businesses, especially in customer data analysis will encourage deeper technology implementation which will have an impact on business efficiency, increasing market performance and more sustainable business quality. Big data in business studies the relationship between humans, institutions, and entities that can give birth to integrated business data types that will make MSMEs more agile, help solve business problems and achieve sustainable business performance. From this relationship, business units can use data insights to make decisions about financial and strategic considerations. MSME business units can find new insights about trends and what customers want in a product or service. Especially in terms of marketing, this is important, because the use of Big Data is able to provide accurate results about various customer ratings of a product. Moreover, digital activities now dominate the agenda of every person or organization. Therefore, it is important for

today's MSME owners to know Big Data in order to find new strategies to keep interacting with customers. Big Data is considered capital, because it is the key to solving problems quickly, accelerating innovation, and driving business growth. The results of this study support previous research (Ciampi *et al.*, 2021; Mangla *et al.*, 2020). The results of the accepted significance test are also obtained in the second hypothesis which shows the influence of Indonesian MSME Internet of Things (IoT) adoption on Information Technology Implementation. The application of IoT in the micro, small and medium industry sector is carried out by connecting devices that have sensors with controllers. The data collected from these tools is analyzed to optimize products, services, and operations. IoT allows communication between equipment (M2M- Machine to Machine) so that the need for human intervention can be reduced. The information obtained can increase productivity and provide valuable feedback to the engineering design and manufacturing operations teams for continuous improvement. Cloud-based maintenance solutions enable continuous, real-time automated measurement and analysis. The application of IoT in MSMEs can be in the form of ERP and Warehouse system integration that can be connected to hardware through IoT technology that helps manage small-, micro- and medium-scale businesses from procurement, warehouse management to accounting. There are several IoT ERP and Warehouse programs that can be utilized by small businesses, including:

(1) Optimizing warehouse stock management easily with inbound, stock taking, to RFID and barcode features;
(2) Automatic business financial management, including real-time financial reports and payroll;
(3) Supplier Management in payment and stock management for suppliers;
(4) Arrangement of documents and e-approvals along with audit trails to ensure security;
(5) Purchasing and Procurement in facilitating the purchasing process to suppliers, approval, invoice and status tracking;
(6) Sales system with analytic dashboard, starting from cashier system (POS), queue, to billing.

It is not too difficult for MSMEs to take advantage of IoT because there are already many Tech Startups that serve IoT digitization programs for small businesses with minimal risk. The adoption of IoT in MSMEs will encourage technology implementation in small businesses to produce "smart" products and provide customers with more information and the necessary feedback. With the proper application of IoT, it will provide a competitive advantage for small, micro and medium industries that use it. The significance of this hypothesis is in line with the results of previous theoretical studies (Najib *et al.*, 2021).

This study also notes the significance value of H3 *P*-Value 0.000 with a Path Coefficient of 0.361 which indicates that the Internal Digital Business Challenge

simultaneously affects the Digital Business Perceived Benefits. Just as technology requires business owners to be adaptive, today's society demands fast and practical products and services. In addition, the challenges of today's society are always changing trends, both in terms of tastes, desires and even needs. If the business owner cannot adapt to this condition, the consequence is that the business will be abandoned by consumers slowly and make the benefits of digital business not felt optimally. The challenges faced in business digitization must be addressed with strategies including:

(1) Implementation of an overall digital strategy;
(2) Performance acceleration and development of business digitization support platforms;
(3) Synchronization of Digital Connections Between Lines, both Internal and External Business Units;
(4) Develop human resources so that they are proficient in using technology, especially platforms that support business units running.

In this case, the owner needs to cope with the movements that exist in the business unit. If you have decided to move in the digital field, it is important for the business unit owner to also align everything so that it can run effectively. By overcoming the existing challenges, business units, especially MSMEs, are certainly able to move steadily in order to achieve very promising benefits and at the same time become the best in today's digital business. The results of the Path Coefficient H3 test are consistent with the research study of E-Commerce Adoption by SME Travel Agents in Egypt (Abou-Shouk *et al.*, 2012).

The results of the Path Coefficient SEM PLS analysis in Table 4 state the positive significance of Hypothesis 4 which supports the influence of Economics and Sociocultural Public Factors on Digital Business Perceived Benefits. Understanding the economic and sociocultural situation as part of public economic trends will help business owners adjust the air of their business units to external conditions, especially in future decision making and business direction. Economics and Sociocultural Public Factors play a role in determining the dynamics of society including consumer behavior and market direction for all business sectors. Economic factors are very closely related to business because they do not only affect the micro level of business but can reach the world's macroeconomics. The economic situation of the country down to the smallest area around the business unit will be a determining factor in details related to business operations, such as the value of its assets, consumer demand, and even taxes. Meanwhile, socio-cultural factors will be closely related to the acceptance of the operational community and the results of the products offered, including the use of technology in accessing business products. Awareness of the existence of business units and community support are needed to build a digital business that is full of benefits for the business unit itself and the surrounding community. Increasing the welfare of individual internal business units, including increasing social and career status, is an additional benefit and business image to

continue operating. Business environment analysis must be carried out by business unit owners, especially on the MSME scale to identify the minimum socio-cultural economic situation around the business unit to make innovative and adaptive business plans with a digital touch that will increase the business profit graph. Testing this hypothesis has the same perspective value as previous research (Nadeem *et al.*, 2018).

The implementation of technology in business units and the perception of digital business benefits felt by business owners will encourage sustainable digital business performance. This is reflected in the positive significance results of testing the fifth and sixth hypotheses which are in line with the research of Artificial Intelligence in the Italian SME Agri-Food System which states that the adoption of technology and the benefits of digital transformation encourage the Agrifood business to remain sustainable, especially in the growth of business profits and customer value. (Di Vaio *et al.*, 2020). The Asia Pacific region is synonymous with high digital transformation opportunities. This opportunity is further accelerated by the emergence of a pandemic as a source of disruption that changes old ways. The rapid development of technology in the Industrial Revolution 4.0 spurred MSME-scale businesses to continue to innovate in building their business to continue to present various attractive products for their users. The Industrial Revolution 4.0 resulted in a disruption that gave rise to a variety of new products and production methods. Simultaneously, this requires human resources (HR) to innovate and participate in digital developments, so it is necessary to carry out a strategic digital transformation to keep up with current business conditions. Adoption of good technology accompanied by optimizing the acceptance of business digitization benefits will bring the MSME digital business to success and continue to operate in a sustainable manner.

5. Conclusion

This study succeeded in proving the hypothesis of a positive significance relationship. Small business competition during globalization has encouraged the adoption of technology in expanding market share. The mindset of business digitization needs to be pursued in the operations of Indonesian MSMEs and even the Southeast Asia Region as a country that dominates the populist economy. MSME scale business units experience limited resources in market affordability. Big Data and the Internet of Things can become new drivers of digital transformation of Indonesian MSME businesses and the Southeast Asia Region. The operational, financial and marketing interests of MSMEs can be accommodated through digital transformation, so that competitive advantages can be achieved and encourage sustainable MSME business growth. However, the opportunity for digitizing MSMEs with sustainable growth will be lost if the internal and external challenges of the business are not addressed. Strengthening technology infrastructure, especially IoT and AI functions in the operations of MSMEs in the Southeast Asia Region, especially Indonesia, is needed

to encourage sustainable Digital MSMEs so that the mission of Indonesia's digital economy can be achieved on a micro scale.

This study has limitations on "Single Country" research, which in the future can be conducted in cross-country Digital MSME research by paying attention to the peculiarities of each country's MSME system. In addition, this research raises academic implications where research is needed on system development interventions or prototype designs for the adoption of Digital MSMEs, especially in the Duet Big Data and the Internet of Things that are more real and in-depth, such as batik clothes. Production machines with print connections, wireless automation design via IoT, if necessary, are tested in MSME business activities to build a broader sustainable digital business optimization. Collaboration between disciplines is needed to build technological manufacturing innovations that will support Indonesian MSMEs to be more adaptive to the Industrial Revolution 4.0.

6. Research Implications

This study provides managerial implications for MSMEs to be able to design digital transformation strategies in a more updated manner through the identification of technology needs, operational design in business and IT infrastructure development priorities to satisfy customers who are increasingly proficient with technology. Connectivity between divisions is not only present in product marketing but also strives to automate all business operations. Optimizing the use of Big Data and IoT in the MSME digital business will able to solve all business problems and encourage an innovative business culture. The role of business unit HR is very crucial in the success of digitalization, so IT training is needed to support them when working side by side with technology. The internal challenges of business units can be overcome by strategic efforts as well as utilizing external roles in building a sustainable MSME digital business. Collaboration with Quintuple Helix players can be an option to further build a sustainable digital business. Efforts to increase literacy for the benefits of entering the digital ecosystem and incubation to be able to accelerate MSMEs need to be carried out intensively. This step is needed to be able to realize things which of course require synergy and collaboration between stakeholders. Consideration of the obstacles to the adoption of digital technology in MSMEs is an important concern so that the literacy strategy and the development of Adaptive human resources technology is an absolute effort while preparing the technology system infrastructure in MSMEs.

The government as a driver of the country's economy and protecting the sustainability of MSMEs is expected to not only encourage MSMEs to adopt digital technology, but also to develop four important things needed by business actors, such as digital literacy, encouraging and assisting solutions for production capacity readiness, encouraging product quality and improvement, and open market access for MSME actors. The Government of the Republic of Indonesia as the leading sector is currently realizing the transformation of Industry 4.0 through the Making

Indonesia 4.0 roadmap and seeks to encourage the implementation of digital technology, including for MSMEs. The Making Indonesia 4.0 roadmap strives for small and medium industries to have technology ranging from digital marketing, internet of things, cloud computing, automation, solar panels to nanotechnology.

The convergence of government factors, MSMEs and other stakeholders such as suppliers, investors and private parties, allow the emergence of strategic resources that support business sustainability, namely the objective of the raw material network and information network. Stakeholders play more of a role in a personal approach, initially more on product discussions, then guidance on clinical coaching, so that from this they are then interested in the collaboration carried out by MSMEs and the cooperation system. There are aspects where MSMEs provide intangible benefits to them with suggestions and ideas in increasing the production value of their products in addition to helping them in marketing these products. Meanwhile, the investors, the private sector and other secondary roles. Therefore, fostering good relations through communication is needed where they strive to make this relationship a mutually supportive and beneficial cooperative relationship. Economic and sociocultural public factors encourage technology alignments to serve customers as the only source of MSME income towards business success. In addition, understanding the economic situation both internally and publicly can determine the adaptive direction of current technology. It is very necessary to understand the social-economic situation when building a technology system in the operation of MSMEs so as not to reduce product or service results.

Acknowledgments

We express our gratitude for the support of Bina Nusantara University (Jakarta, Indonesia) and Airlangga University (Surabaya, Indonesia) for supporting this research, our special thanks and respect to Management Study Program BINUS Online Learning and Department of Sharia Economics Faculty Economics and Business.

References

Abou-Shouk, M, P Megicks and WM Lim (2012). Perceived benefits and e-commerce adoption by SME travel agents in developing countries: Evidence from Egypt. *Journal of Hospitality and Tourism Research*, 37(4), 490–515, doi: 10.1177/1096348012442544.

Agrawal, R, VA Wankhede, A Kumar, A Upadhyay and JA Garza-Reyes (2022). Nexus of circular economy and sustainable business performance in the era of digitalization. *International Journal of Productivity and Performance Management*, 71(3), 748–774, doi: 10.1108/IJPPM-12-2020-0676/FULL/PDF.

Akpan, IJ, EAP Udoh and B Adebisi (2020). Small business awareness and adoption of state-of-the-art technologies in emerging and developing markets, and lessons from the COVID-19 pandemic. *Journal of Small Business & Entrepreneurship*, 34(2), 123–140, doi: 10.1080/08276331.2020.1820185.

Al Asheq, A, U Hossain, B Sheikh and M Rahman (2019). Sme performance: Impact of market, customer and brand orientation. *Academy of Marketing Studies Journal*, 23(1), 1528–2678.

Alla Vasilevna, C and NM Chernikova (2019). Innovative approaches to determination of economic digitization in the modern stage of enterprise development. *Intellectual Economics*, 13(2), 116–121, doi: 10.13165/IE-19-13-2-02.

Altayyar, A and J Beaumont-Kerridge (2016). External factors affecting the adoption of e-procurement in Saudi Arabian's SMEs. *Procedia — Social and Behavioral Sciences*, 229, 363–375, doi: 10.1016/j.sbspro.2016.07.147.

Andretti Abdillah, L, D Napitupulu, J Simarmata, R Rahim, D Abdullah and A Pranolo (2018). The role of big data and cloud computing for technology based business. 144, 183–187, doi:10.2991/icedutech-17.2018.36.

Anshari, M and MN Almunawar (2021). Adopting open innovation for SMEs and industrial revolution 4.0. *Journal of Science and Technology Policy Management*, doi: 10.1108/JSTPM-03-2020-0061.

Arvindhan, M (2021). Possibilities of industrial trends and business benefits with industry 4.0 technology: A survey. In *Artificial Intelligence for a Sustainable Industry 4.0*, pp. 1–18, doi: 10.1007/978-3-030-77070-9_1.

Attaran, M (2017). The internet of things: Limitless opportunities for business and society. *Journal of Strategic Innovation and Sustainability*, 12(1), 10–29.

Belas, J, L Smrcka, B Gavurova and J Dvorsky (2018). The impact of social and economic factors in the credit risk management of sme. *Technological and Economic Development of Economy*, 24(3), 1215–1230, doi: 10.3846/tede.2018.1968.

Bican, PM and A Brem (2020). Digital business model, digital transformation, digital entrepreneurship: Is there a sustainable "digital"? *Sustainability (Switzerland)*, 12(13), 1–15, doi: 10.3390/su12135239.

Blahová, M, P Haghirian and P Pálka (2015). Major factors affecting contemporary Japanese business environment. *International Journal of Productivity and Performance Management*, 64(3), 416–433, doi: 10.1108/IJPPM-09-2014-0138.

Broekhuizen, TLJ, M Broekhuis, MJ Gijsenberg and JE Wieringa (2021). Introduction to the special issue — Digital business models: A multi-disciplinary and multi-stakeholder perspective. *Journal of Business Research*, 122, 847–852, doi: 10.1016/j.jbusres.2020.04.014.

Burinskien, A (2011). The application of e-commerce technologies in the development of international trade. *Intelektine Ekonomika/Intellectual Economics*, 8011(1), 7–22.

Čepel, M (2019). Social and cultural factors and their impact on the quality of business environment in the SME segment. *International Journal of Entrepreneurial Knowledge*, 7(1), 65–73, doi: 10.2478/ijek-2019-0005.

Chege, SM and D Wang (2020). The influence of technology innovation on SME performance through environmental sustainability practices in Kenya. *Technology in Society*, 60, 101210, doi: 10.1016/j.techsoc.2019.101210.

Chen, CL, YC Lin, WH Chen, CF Chao and H Pandia (2021). Role of government to enhance digital transformation in small service business. *Sustainability (Switzerland)*, 13(3), 1–26, doi: 10.3390/su13031028.

Chittithaworn, C, A Islam, T Keawchana and DHM Yusuf (2011). Factors affecting business success of small & medium enterprises (SMEs) in Thailand. *Asian Social Science*, 7(5), 180–190, doi: 10.5539/ass.v7n5p180.

Ciampi, F, S Demi, A Magrini, G Marzi and A Papa (2021). Exploring the impact of big data analytics capabilities on business model innovation: The mediating role of entrepreneurial orientation. *Journal of Business Research*, 123, 1–13, doi: 10.1016/j.jbusres.2020.09.023.

Coleman, S, R Göb, G Manco, A Pievatolo, X Tort-Martorell and MS Reis (2016). How can SMEs benefit from Big Data? Challenges and a path forward. *Quality and Reliability Engineering International*, 32(6), 2151–2164, doi: 10.1002/QRE.2008.

Cong, LW, Y Li and N Wang (2021). Tokenomics: Dynamic adoption and valuation. *The Review of Financial Studies*, 34(3), 1105–1155, doi: 10.1093/RFS/HHAA089.

Da Xu, L. (2022). Emerging enabling technologies for Industry 4.0 and beyond. *Information Systems Frontiers* 2021, doi: 10.1007/s10796-021-10213-w.

Dahnil, MI, KM Marzuki, J Langgat and NF Fabeil (2014). Factors influencing SMEs adoption of social media marketing. *Procedia — Social and Behavioral Sciences*, 148, 119–126, doi: 10.1016/j.sbspro.2014.07.025.

Danish, RQ, J Asghar, Z Ahmad and HF Ali (2019). Factors affecting "entrepreneurial culture": The mediating role of creativity. *Journal of Innovation and Entrepreneurship*, 10(1), 1–12.

Di Vaio, A, F Boccia, L Landriani and R Palladino (2020). Artificial intelligence in the agri-food system: Rethinking sustainable business models in the COVID-19 scenario. *Sustainability (Switzerland)*, 12(12), doi: 10.3390/SU12124851.

Djalic, N, M Nikolic, M Bakator and Z Erceg (2021). Modeling the influence of information systems on sustainable business performance and competitiveness. *Sustainability (Switzerland)*, 13(17), 1–24, doi: 10.3390/su13179619.

Duan, L and L Da Xu (2021). Data analytics in Industry 4.0: A survey. *Information Systems Frontiers*, doi: 10.1007/s10796-021-10190-0.

Dube, T, R Van Eck and T Zuva (2020). Review of technology adoption models and theories to measure readiness and acceptable use of technology in a business organization. *Journal of Information Technology and Digital World*, 2(4), 207–212, doi: 10.36548/jitdw.2020.4.003.

Dyllick, T and K Muff (2016). Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability, *Organization and Environment*, 29(2), 156–174, doi: 10.1177/1086026615575176.

Eling, M and P Schaper (2017). Under pressure: How the business environment affects productivity and efficiency of European life insurance companies. *European Journal of Operational Research*, 258(3), 1082–1094, doi: 10.1016/j.ejor.2016.08.070.

Etikan, I (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1, doi: 10.11648/j.ajtas.20160501.11.

Faridi, MR and A Malik (2020). Digital transformation in supply chain, challenges and opportunities in SMEs: A case study of Al-Rumman Pharma. *Emerald Emerging Markets Case Studies*, 10(1), 1–16, doi: 10.1108/EEMCS-05-2019-0122/FULL/XML.

Franco, M, L Godinho and M Rodrigues (2021). Exploring the influence of digital entrepreneurship on SME digitalization and management. *Small Entreprise Research*, 28(3), 269–292, doi: 10.1080/13215906.2021.1938651.

Fridayani, HD and Atmojo, ME (2021). Internet of things for smart city. A case study: SMEs project in sleman regency. *IOP Conference Series: Earth and Environmental Science*, 717(1), doi: 10.1088/1755-1315/717/1/012014.

Ghanbari, A, A Laya, J Alonso-Zarate and J Markendahl (2017). Business development in the internet of things: A matter of vertical cooperation. *IEEE Communications Magazine*, 55(2), 135–141, doi: 10.1109/MCOM.2017.1600596CM.

Gorkhali, A (2022). Industry 4.0 and enabling technologies: Integration framework and challenges. *Journal of Industrial Integration and Management*, doi: 10.1142/S2424862222500075/ASSET/IMAGES/LARGE/S2424862222500075FIGF2.JPEG.

Gregurec, I, MT Furjan and K Tomičić-pupek (2021). The impact of covid-19 on sustainable business models in smes. *Sustainability (Switzerland)*, 13(3), 1–24, doi: org/10.3390/su13031098.

Hadi, MZ (2020). Peluang implementasi teknologi big data dan block chain untuk peningkatan kinerja perdagangan pada sektor UMKM di Indonesia pada era industri 4.0. *Cendekia Niaga*, 3(1), 71–80, doi: org/10.52391/jcn.v3i1.463.

Hair, JF and N Brunsveld (2019). Essentials of business research methods. In *Essentials of Business Research Methods*, 4th edn., Vol. 1. New York: Taylor and Francis, doi: 10.4324/9780429203374/ESSENTIALS-BUSINESS-RESEARCH-METHODS-JOE-HAIR-MICHAEL-PAGE-NIEK-BRUNSVELD.

Hair, JF, JJ Risher, M Sarstedt and CM Ringle (2018). The results of PLS-SEM article information, *European Business Review*, 31(1), 2–24.

Hair, JF, JJ Risher, M Sarstedt and CM Ringle (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24, doi: 10.1108/EBR-11-2018-0203.

Hair, JF Jr., LM Matthews, RL Matthews and M Sarstedt (2017). PLS-SEM or CB-SEM: Updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, 1(2), 107, doi: 10.1504/ijmda.2017.10008574.

Han, H and S Trimi (2022). Towards a data science platform for improving SME collaboration through Industry 4.0 technologies. *Technological Forecasting and Social Change*, 174, 121242, doi: 10.1016/J.TECHFORE.2021.121242.

Hansen, EB and S Bøgh (2021). Artificial intelligence and internet of things in small and medium-sized enterprises: A survey. *Journal of Manufacturing Systems*, 58, 362–372, doi: 10.1016/j.jmsy.2020.08.009.

Haseeb, M, HI Hussain, B Ślusarczyk and K Jermsittiparsert (2019). Industry 4.0: A solution towards technology challenges of sustainable business performance. *Social Sciences*, 8(5), doi: 10.3390/socsci8050154.

Ho, J (2022). Research on the benefits of digital marketing for enterprises in the post-covid period: A case of Vietnam's small and medium sized enterprises development. *International Journal of Mechanical Engineering*, 7(2), 3288–3294.

Holienka, M, A Pilková and N Ostapenko (2016). Entrepreneurial environment and economic growth: What affects the productiveness of business activity at macro level? *Springer Proceedings in Business and Economics*, 79–95, doi: 10.1007/978-3-319-21139-8_6/TABLES/3.

Hulla, M, P Herstätter, M Wolf and C Ramsauer (2021). Towards digitalization in production in SMEs — A qualitative study of challenges, competencies and requirements for trainings. *Procedia CIRP*, 104, 887–892, doi: 10.1016/j.procir.2021.11.149.

Idah, YM and M Pinilih (2020). Strategi pengembangan digitalisasi UMKM. *Prosiding Seminar Nasional Dan Call for Papers "Pengembangan Sumber Daya Pedesaan Dan Kearifan Lokal Berkelanjutan IX,"* 9(1), 195–204.

Iqbal, M, Kazmi, SHA, Manzoor, A, Soomrani, AR, Butt, SH and Shaikh, KA (2018). A study of big data for business growth in SMEs: Opportunities & challenges. In *2018 Int. Conf. Computing, Mathematics and Engineering Technologies: Invent, Innovate and Integrate for Socioeconomic Development, ICoMET 2018 — Proc.*, 2018-January, 1–7, doi: 10.1109/ICOMET.2018.8346368.

Jaafreh, AB (2018). The effect factors in the adoption of internet of things (IoT) technology in the SME in KSA: An empirical study. *International Review of Management and Business Research*, 7(1), 135–148, doi: 10.30543/7-1(2018)-13.

Jain, R. (2015). Impact of social media marketing on SME business SME marketing obstacles digital marketing — a great opportunity for SME's. *SAMVAD International Journal of Management*, 8(1).

Javaid, M, A Haleem, RP Singh and R Suman (2021). Significant applications of big data in Industry 4.0. *Journal of Industrial Integration and Management*, 6(4), 429–447, doi: 10.1142/S2424862221500135.

Jelisic, E, N Ivezic, B Kulvatunyou, P Milosevic, S Babarogic and Z Marjanovic (2021). A novel business context-based approach for improved standards-based systems integration — a feasibility study. *Journal of Industrial Information Integration*, 30, 100385, doi: 10.1016/j.jii.2022.100385.

Jonny, K and M Toshio (2021). Building an implementation model of IoT and Big Data and its improvement. *International Journal of Technology*, 12(5), 1000–1008, doi: 10.14716/ijtech.v12i5.5178.

Kautonen, T, SJD Schillebeeckx, J Gartner, H Hakala, K Salmela-Aro and K Snellman (2020). The dark side of sustainability orientation for SME performance. *Journal of Business Venturing Insights*, 14, e00198, doi: 10.1016/j.jbvi.2020.e00198.

Kergroach, S (2020). Giving momentum to SME digitalization. *Journal of the International Council for Small Business*, 1(1), 28–31, doi: 10.1080/26437015.2020.1714358.

Kiraz, A, O Canpolat, C Özkurt and H Taşkın (2020). Analysis of the factors affecting the Industry 4.0 tendency with the structural equation model and an application. *Computers & Industrial Engineering*, 150, 106911, doi: 10.1016/J.CIE.2020.106911.

Kiškis, M. (2009). Direct electronic marketing opportunities for SMEs. *Intelektine Ekonomika/Intellectual Economics*, 2(6), 61–72.

Krotov, V. (2017). The internet of things and new business opportunities. *Business Horizons*, 60(6), 831–841, doi: 10.1016/J.BUSHOR.2017.07.009.

Lee, H, D Kelley, J Lee and S Lee (2012). SME survival: The impact of internationalization, technology resources, and alliances. *Journal of Small Business Management*, 50(1), 1–19, doi: 10.1111/J.1540-627X.2011.00341.X.

Lenkenhoff, K, U Wilkens, M Zheng, T Süße, B Kuhlenkötter and X Ming (2018). Key challenges of digital business ecosystem development and how to cope with them. *Procedia CIRP*, 73, 167–172, doi: 10.1016/j.procir.2018.04.082.

Li, L, Su, F, W Zhang and JY Mao (2018). Digital transformation by SME entrepreneurs: A capability perspective. *Information Systems Journal*, 28(6), 1129–1157, doi: 10.1111/ISJ.12153.

Maas, S and G Reniers (2014). Development of a CSR model for practice: Connecting five inherent areas of sustainable business. *Journal of Cleaner Production*, 64, 104–114, doi: 10.1016/J.JCLEPRO.2013.07.039.

Mangla, SK, R Raut, VS Narwane, Z Zhang and P Priyadarshinee (2020). Mediating effect of big data analytics on project performance of small and medium enterprises. *Journal of Enterprise Information Management*, 34(1), 168–198, doi: 10.1108/JEIM-12-2019-0394.

Maroufkhani, P, ML Tseng, M Iranmanesh, WKW Ismail and H Khalid (2020). Big data analytics adoption: Determinants and performances among small to medium-sized enterprises. *International Journal of Information Management*, 54, 102190, doi: 10.1016/J.IJINFOMGT.2020.102190.

Matt, DT, V Modrák and H Zsifkovits (2020). Industry 4.0 for smes: Challenges, opportunities and requirements. In *Industry 4.0 for SMEs: Challenges, Opportunities and Requirements*, doi: 10.1007/978-3-030-25425-4.

Mbassegue, P, ML Escandon-Quintanilla and M Gardoni (2016). Knowledge management and big data: Opportunities and challenges for small and medium enterprises (SME). *IFIP*

Advances in Information and Communication Technology, 492, 22–31, doi: 10.1007/978-3-319-54660-5_3/FIGURES/2.

Moeuf, A, Pellerin, R, Lamouri, S, Tamayo-Giraldo, S. and Barbaray, R. (2017). The industrial management of SMEs in the era of Industry 4.0. *International Journal of Production Research*, 56(3), 1118–1136, doi: 10.1080/00207543.2017.1372647.

Muafi, M, W Syafri, H Prabowo and SA Nur (2021). Digital entrepreneurship in Indonesia: A human capital perspective. *Journal of Asian Finance, Economics and Business*, 8(3), 351–359, doi: 10.13106/jafeb.2021.vol8.no3.0351.

Nadeem, A, B Abedin, N Cerpa and E Chew (2018). Editorial: Digital transformation & digital business strategy in electronic commerce — The role of organizational capabilities. *Journal of Theoretical and Applied Electronic Commerce Research*, 13(2), i–viii, doi: 10.4067/S0718-18762018000200101.

Najib, M, WJ Ermawati, F Fahma, E Endri and D Suhartanto (2021). Fintech in the small food business and its relation with open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7(1), doi: 10.3390/joitmc7010088.

Nguyen, TUH (2009). Information technology adoption in SMEs: An integrated framework. *International Journal of Entrepreneurial Behaviour and Research*, 15(2), 162–186, doi: 10.1108/13552550910944566.

Pantano, E (2011). Cultural factors affecting consumer behaviour: A new perception model. *EuroMed Journal of Business*, 6(1), 117–136, doi: 10.1108/14502191111130343.

Pelletier, C and LM Cloutier (2019). Conceptualising digital transformation in SMEs: An ecosystemic perspective. *Journal of Small Business and Enterprise Development*, 26(6–7), 855–876, doi: 10.1108/JSBED-05-2019-0144.

Pramono, R, LW Sondakh, I Bernarto, J Juliana and A Purwanto (2021). Determinants of the small and medium enterprises progress: A case study of SME entrepreneurs in Manado, Indonesia. *Journal of Asian Finance, Economics and Business*, 8(1), 881–889, doi: 10.13106/jafeb.2021.vol8.no1.881.

Prasanna, RPIR, JMSB Jayasundara, SKN Gamage, EMS Ekanayake, PSK Rajapakshe and G AKNJ Abeyrathne (2019). Sustainability of SMEs in the competition: A systemic review on technological challenges and SME performance. *Journal of Open Innovation: Technology, Market, and Complexity*, 5(4), 1–18, doi: 10.3390/joitmc5040100.

Premkumar, G (2009). A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce*, 13(2), 91–121, doi: 10.1207/S15327744JOCE1302_2.

Priyono, A, A Moin and VNAO Putri (2020). Identifying digital transformation paths in the business model of smes during the covid-19 pandemic. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 1–22, doi: 10.3390/joitmc6040104.

Purbasari, R, Z Muttaqin and DS Sari (2021). Identification of actors and factors in the digital entrepreneurial ecosystem. *Review of Integrative Business and Economics Research*, 10(2), 164–187.

Qazzafi, S (2020). Factor affecting consumer buying behavior: A conceptual study. *IJSRD-International Journal for Scientific Research & Development*, 8, 2321–0613. www.ijsrd.com.

Quinton, S, A Canhoto, S Molinillo, R Pera and T Budhathoki (2017). Conceptualising a digital orientation: Antecedents of supporting SME performance in the digital economy. *Journal of Strategic Marketing*, 26(5), 427–439, doi: 10.1080/0965254X.2016.1258004.

Rakhmawati, A, A Kusumawati, K Rahardjo and N Muhammad (2020). The role of government regulation on sustainable business and its influences on performance of medium-sized enterprises. *Journal of Sustainability Science and Management*, 15(2), 162–178.

Rigdon, EE, M Sarstedt and CM Ringle (2017). On comparing results from CB-SEM and PLS-SEM: Five perspectives and five recommendations. *Marketing ZFP*, 39(3), 4–16, doi: 10.15358/0344-1369-2017-3-4.

Routh, K and T Pal (2018). A survey on technological, business and societal aspects of Internet of Things by Q3, 2017. In *Proceedings — 2018 3rd International Conference on Internet of Things: Smart Innovation and Usages, IoT-SIU 2018*, pp. 11–14, doi: 10.1109/IoT-SIU.2018.8519898.

Ruiz-Real, JL, J Uribe-Toril, JA Torres and JDE Pablo (2021). Artificial intelligence in business and economics research: Trends and future. *Journal of Business Economics and Management*, 22(1), 98–117, doi: 10.3846/jbem.2020.13641.

Sampurno, W, S Yuyus, S Diana and K Umi (2021). Marketing performance and big data use during the COVID-19 pandemic: A case study of SMEs in Indonesia. *Journal of Asian Finance*, 8(7), 571–0578, doi: 10.13106/jafeb.2021.vol8.no7.0571.

Sari, NTP and A Kusumawati (2022). Literature review: The efforts to strengthening of micro, small and medium-sized enterprises (MSME) in Indonesia. *Asian Journal of Management, Entrepreneurship and Social Science*, 2(01 SE-Articles), 98–115. https://ajmesc.com/index.php/ajmesc/article/view/52.

Saviotti, PP and JS Metcalfe (2018). Present development and trends in evolutionary economics. *Evolutionary Theories of Economic and Technological Change*, 1–30, doi: 10.4324/9781351127707-1.

Schwertner, K (2017). Digital transformation of business. *Trakia Journal of Science*, 15(Suppl. 1), 388–393, doi: 10.15547/tjs.2017.s.01.065.

Sen, D, Ozturk, M. and Vayvay, O. (2016). An overview of Big Data for growth in SMEs. *Procedia — Social and Behavioral Sciences*, 235, 159–167, doi: 10.1016/j.sbspro.2016.11.011.

Sestino, A, MI Prete, L Piper and G Guido (2020). Internet of things and big data as enablers for business digitalization strategies. *Technovation*, 98, 102173, doi: 10.1016/J.TECHNOVATION.2020.102173.

Shatrevich, V and J Zvanitajs (2012). Innovation implementations problems in Latvia. *Intellectual Economics*, 6(1), 730–742.

Soluk, J, I Miroshnychenko, N Kammerlander and A De Massis (2021). Family influence and digital business model innovation: The enabling role of dynamic capabilities. *Entrepreneurship Theory and Practice*, 45(4), 867–905, doi: 10.1177/1042258721998946.

Sukarsih, I, E Kurniati, G Gunawan and R Wulan (2019). Perluasan jangkauan pasar pelaku UMKM di kota bandung melalui implementasi e-commerce. *ETHOS (Jurnal Penelitian Dan Pengabdian)*, 7(2), 170–177, doi: 10.29313/ethos.v7i2.4412.

Suuronen, S, J Ukko, R Eskola, RS Semken and H Rantanen (2022). A systematic literature review for digital business ecosystems in the manufacturing industry: Prerequisites, challenges, and benefits. *CIRP Journal of Manufacturing Science and Technology*, 37, 414–426, doi: 10.1016/j.cirpj.2022.02.016.

Szedlak, C, B Leyendecker, H Reinemann, M Kschischo and P Pötters (2021). Risks and benefits of artificial intelligence in small-and-medium sized enterprises. In *Proceedings of the International Conference on Industrial Engineering and Operations Management*, pp. 195–205.

Tran, TCT and NT Nguyen (2019). Identify factors affecting business efficiency of small and medium enterprises (Smes): Evidence from vietnam. *Management Science Letters*, 9(12), 1987–1998, doi: 10.5267/j.msl.2019.7.007.

Turkyilmaz, A, Dikhanbayeva, D, Suleiman, Z, Shaikholla, S. and Shehab, E. (2020). Industry 4.0: Challenges and opportunities for Kazakhstan SMEs. *Procedia CIRP*, 96, 213–218, doi: 10.1016/j.procir.2021.01.077.

Udovita, PVMVD (2020). Conceptual review on dimensions of digital transformation in modern era. *International Journal of Scientific and Research Publications (IJSRP)*, 10(2), p9873, doi: 10.29322/ijsrp.10.02.2020.p9873.

Utami, ID (2021). Model of e-supply chain by adopting block chain technology in Salt SMEs in Indonesia. In *Second Asia Pacific International Conference on Industrial Engineering and Operations Managemen*, pp. 1386–1394.

Van Buren, HJ, J Syed and R Mir (2020). Religion as a macro social force affecting business: Concepts, questions, and future research. *Business and Society*, 59(5), 799–822, doi: 10.1177/0007650319845097.

Vila-Henninger, LA (2021). A dual-process model of economic behavior: Using culture and cognition, economic sociology, behavioral economics, and neuroscience to reconcile moral and self-interested economic action. *Sociological Forum*, 36(S1), 1271–1296, doi: 10.1111/SOCF.12763.

Wang, S and H Wang (2020). Big data for small and medium-sized enterprises (SME): A knowledge management model. *Journal of Knowledge Management*, 24(4), 881–897, doi: 10.1108/JKM-02-2020-0081.

Widyastuti, D. and Irwansyah, M. (2018). Benefits and challenges of cloud computing technology adoption in small and medium enterprises (SMEs). 41, 241–246, doi:10.2991/bcm-17.2018.46.

Xu, LD (2011). Enterprise systems: State-of-the-art and future trends. *IEEE Transactions on Industrial Informatics*, 7(4), 630–640, doi: 10.1109/TII.2011.2167156.

Xu, LD (2020). The contribution of systems science to Industry 4.0. *Systems Research and Behavioral Science*, 37(4), 618–631, doi: 10.1002/SRES.2705.

Yacob, S, U Sulistiyo, E Erida and AP Siregar (2021). The importance of E-commerce adoption and entrepreneurship orientation for sustainable micro, small, and medium enterprises in Indonesia. *Development Studies Research*, 8(1), 244–252, doi: 10.1080/21665095.2021.1976657.

Zhang, C and Y Chen (2020). A review of research relevant to the emerging industry trends: Industry 4.0, IoT, blockchain, and business analytics. *Journal of Industrial Integration and Management*, 5(1), 165–180, doi: 10.1142/S2424862219500192.

Zolkover, A, I Petrunenko, O Iastremska, O Stashkevych and MM Mehdizade (2022). Benefits and risks of digital business transformation: The example of eastern Europe countries. *Journal of Eastern European and Central Asian Research (JEECAR)*, 9(2), 344–356, doi: 10.15549/jeecar.v9i2.910.