

# Digital Technology's Role in Sustainable Business Models and Performance Enhancement

**Abstract** – This study investigates the role of digital technology in enhancing sustainable business models, collective intelligence, and scaling to improve business process performance. Conducted as qualitative research, it employs a Systematic Literature Review (SLR) method, analyzing 20 Scopus-indexed journals ranked in Quartile 1 (Q1) to Quartile 2 (Q2) from 2019 to 2024. The data were processed using content analysis, focusing on digital technologies such as big data, the Internet of Things, cloud computing, cyber-physical systems, machine learning, artificial intelligence, and digital platforms. The findings demonstrate that digital technology supports businesses in understanding evolving customer needs, facilitating efficient and accurate decision-making, and enhancing customer engagement, crucial for business growth and scalability. Key benefits include improving customer experience, segmentation, retention, and engagement, reducing operational costs, increasing team collaboration, and evaluating environmental risks. These advantages provide businesses with a competitive edge by fostering sustainable practices and effective customer engagement. The advantages derived from the implementation of digital technologies can be felt from various economic, social, and environmental aspects. However, the study acknowledges limitations, including restricted data collection due to limited relevant research and variations in technological literacy across regions. Despite these challenges, the research underscores the transformative role of digital technology in advancing sustainable and competitive business processes.

**Keywords:** Digital Technology, Sustainable Business Model, Collective Intelligence, Scaling, Business Process Performance

## I. INTRODUCTION

Along with the fast growing of internet, the technology used in daily life are integrated with that network system. Various aspects of our life are experiencing the rapid development due to the switch to digital. Governments, citizens, and companies are adapting to digital at varying speeds (Corrales-Garay et al., 2020). Life is getting easier with this digital technology so that the demands for practicality and modernization are also increasing. Various digital technologies have emerged in the last decade (Jafari-Sadeghi et al., 2021), causing the previous way of pursuing business opportunities are rethought and reorganized (Antonizzi & Smuts, 2020; Nambisan, 2017). Conventional methods are no longer effective to be applicated in this digital era. The goal of a business in the era of the industrial revolution 4.0 is to achieve a higher level of operational

effectiveness and productivity, as well as a level of automation (Thames & Schaefer, 2016). New business models should be considered to improve process efficiency (Frank et al., 2019).

Startup companies are considered as key players in global economic development. Startups contribute to job creation and increase economic growth at the regional, national and industry levels (Petru et al., 2019). Even so, statistical results show that in the first stage of operation, which is in the first 3-5 years, almost more than 60% of startups could not survive, in other words failed (Lai & Lin, 2015; Melegati et al., 2019; Mukti et al., 2019). In general, failure is caused by fierce competition, the inability to manage complex operations, and the uncertainty that constantly changes while the resources are limited (Passaro et al., 2020). The advent of technology supports new ways for organizations to collaborate,

manage resources, design products, meet the complexities of demand and supply, as

well as develop new levels of standards and solutions (Elia et al., 2020).

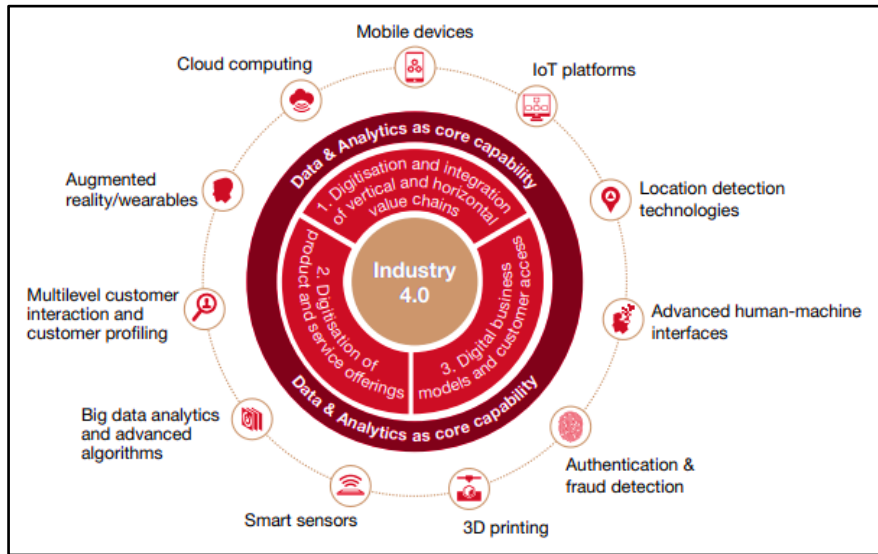


Figure 1. Industry 4.0 Framework and Contributing Digital Technologies

Industry 4.0 framework and features as well as digital technology contribution presented by Reinhard et al. (2016) in his research shows in Figure 1. New technologies are driving the need for rapid business transformation in the work environment. In facing this transformation, most businesses have started to change their strategies and actions to embed sustainability issues (Brehmer et al., 2018). Digital transformation interprets the integration of digital technology into all business processes in developing business models, increasing the efficiency of business operations, and increasing competitiveness by meeting customer expectations. A combination of new technologies, changes in behavior and new business models is required to be more sustainable (Bradley et al., 2020). “Sustainability” consists of economic, social and environmental aspects, which need to be implemented holistically. The complexity of sustainability challenges the ability in making decisions (Von Kutzschenbach & Daub, 2021). In this internet era, we can easily access data and information related to customers, employees and stakeholders. In this way,

we can gain insights with greater accuracy and depth. However, this is not enough in making decisions because of individual limitations in making decisions (Boimabeau, 2009). Therefore, technological support is needed in the form of artificial intelligence (AI) combined with humans, known as collective intelligence (Gavriushenko et al., 2020). The MIT Center for Collective Intelligence combines "collective" and "intelligence" into "collective intelligence" which means a group of individuals collaborate together in a way that appear more intelligent. The combination enables to experiment with a number of different mechanisms by leveraging collective decision-making capabilities (Boimabeau, 2009). Elia & Margherita (2016) in her research provide a collective intelligence system based on paradigm collaboration and socialization to increase the potential of business and social communities in realizing technology-based innovation and entrepreneurship processes. The other challenge besides business model is how to scale the business? (O’reilly & Binns, 2019). Scaling a company like General Motors (GM) requires high upfront

investment in building the infrastructure that will later support the company's scaling efforts (Kelestyn et al., 2017). Scaling a business model or a disruptive business, moving from an experiment to a fully operational business is a moment of commercial and organizational vulnerability as it has climbed one level higher in investment (O'reilly & Binns, 2019).

It is widely recognized that going digital opens up more opportunities for businesses to penetrate wider markets and increase their customer base (Audretsch et al., 2016). The entrepreneurial process with digital has supported crossing boundaries in different phases and pushing to higher levels of uncertainty and non-linearity until how it revealed (Kelestyn et al., 2017). Technology resources are an important component for startups because technology allows businesses to grow quickly and efficiently. Digital technology enables

## II. METHODS

This study uses a Systematic Literature Review (SLR) which is a term that refers to a research methodology in the form of a combination of various systematic, clear, and comprehensive literature studies. Data analyzing technique used in this study is the Content Analysis method. This analytical method allows researchers to analyze textual information and identify its characteristics systematically such as the presence of words, concepts, themes, characters, even certain sentences (Uma & Roger, 2016).

The population in this study is Q1 and Q2 Scopus-indexed journals which have gone through an intensive selection process. Scopus (scopus.com) is a comprehensive abstract and citation database that includes peer-reviewed literature such as scientific journals, books, and conference proceedings. It offers a broad overview of global research output across various disciplines, including science, technology,

entrepreneurial activity (Briel et al., 2017) and enhances productivity through technology adoption (Prasanna et al. 2019). Elia et al. (2020) examine how digital technologies and collective intelligence shape the entrepreneurial process. However, further research is needed to understand how digital technologies can enhance entrepreneurship performance, offering valuable insights for practitioners and policymakers.

While current studies lay the groundwork for digital adoption in entrepreneurship, they often overlook the integration of sustainable business models, collective intelligence, and scaling strategies. This research aims to fill this gap by focusing on the role of digital technology in these areas to improve business process performance. This study is crucial for early-stage startups in the digital era, as its findings will support the development of sustainable business models and enhanced performance.

medicine, social sciences, as well as arts and humanities. Using Scopus-indexed journals with Q1 and Q2 rankings in research journal ensures that the research is rooted in highly credible, peer-reviewed sources known for their rigorous academic standards and high impact. Q1 and Q2 journals are recognized for their quality and prestige within the academic community, as they typically undergo stringent review processes and are cited frequently, reflecting their influence and relevance in their respective fields. By referencing methodologies from these top-tier journals, researchers can leverage well-established, validated methods, enhancing the reliability of their studies. Figure 2 shows the whole steps for data collection. The criteria set by the researchers are listed in Table 1. The number of samples, which is the journals that will be used by researchers, is 20 journals.

Table 1. Criteria of Data Selection

Selection	Criteria
Type of journal Period	Scopus indexed journal within Q1-Q2 2019 – 2024
Keywords	“sustainability business model”, “sustainable business modeling”, “sustainable business model”, “sustainable business”, “sustainability business model in startup”, “sustainable entrepreneurship business models”, “SBMs”, “collective intelligence”, “ collective intelligence crowd wisdom”, “scaling”, “scale”, “scaling business”, “scaling of startup”, “scale up” “scalable”, “business process performance”, “business process key performance indicators”, “business process improvement”, “performance of startup business process”, dan “business process performance optimization”
Language	English
Pra-selection	Scopus indexed publisher
Relevance of journal	Title and abstract of each journal Scan the entire contents of the journal if it is not clear

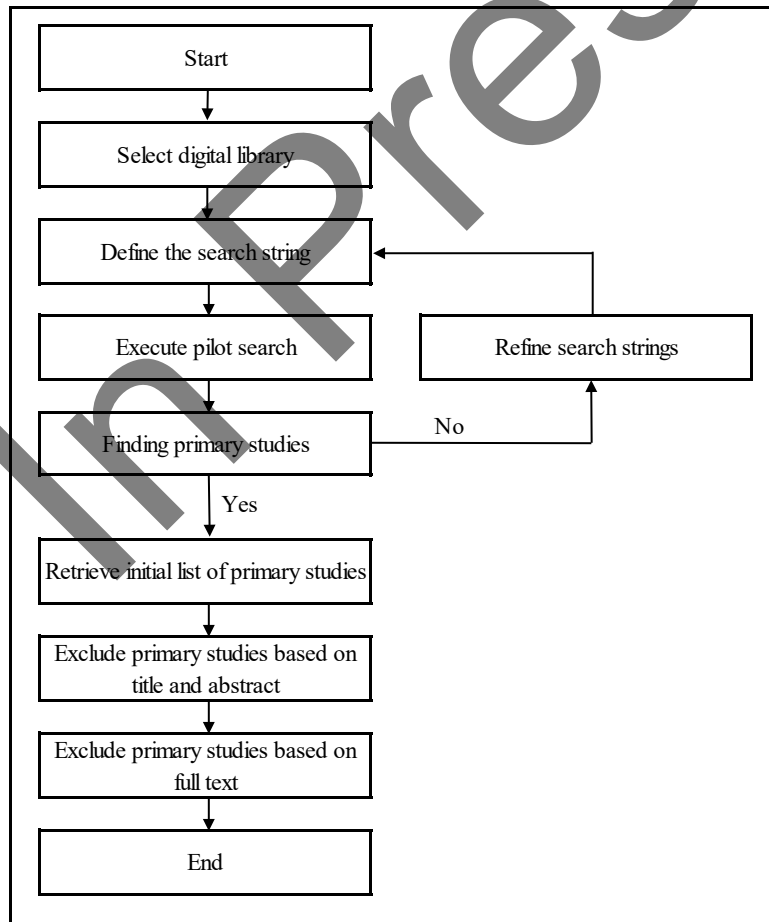


Figure 2. Data Collection

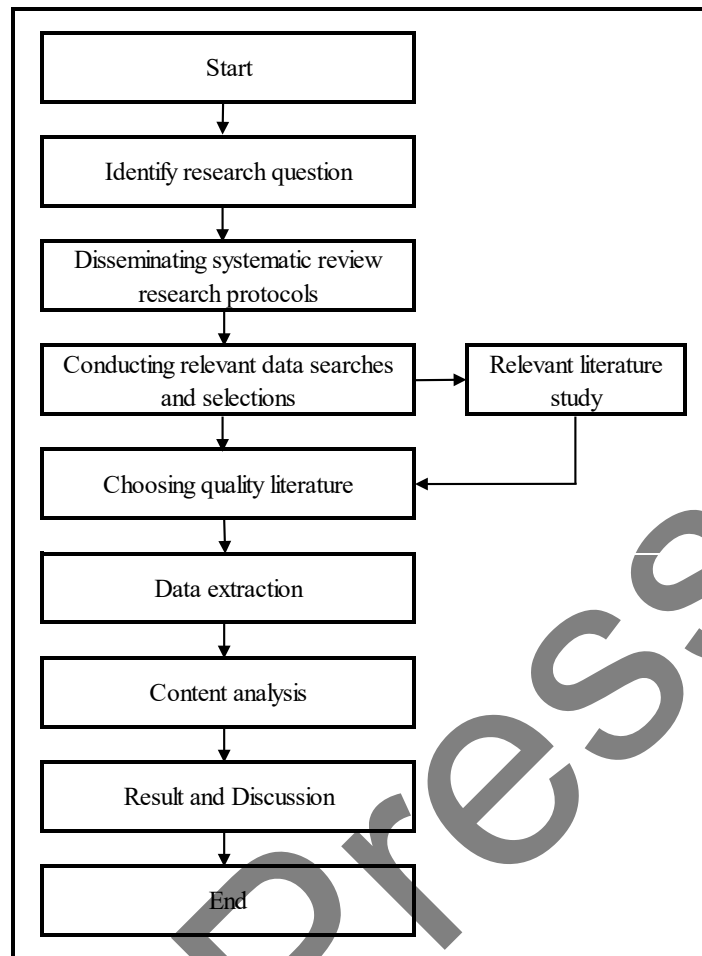


Figure 3. Research Methodology

Figure 3 shows the steps in conducting systematic literature review. The initial step in this method is to identify research questions, in this case the focus of research. Research questions can be found from previous studies that still need further research. At this stage, existing problems or phenomena are transformed into research questions. Next is to develop a systematic review research protocol. The next step is to conduct a data search and select relevant data, then from the collected data, inclusion

and exclusion of the literature based on quality is carried out as data. After quality data has been collected, the next step is to extract the data and then synthesize the extracted results using content analysis. Content-analysis is a data integration technique to obtain new theories, concepts, and achieved more intensive and comprehensive understanding of the subject matter (Perry & Hammond, 2002). The final step is to present the results of the research.

### III. RESULTS AND DISCUSSION

*The role of digital technology in sustainable business model* – Along with people's awareness of sustainability, the current business model leads to a sustainable

business model which is an extension of the conventional business model. Conventional business models only pay attention to aspects in terms of economic sustainability, while sustainable business models include social sustainability and

ecological/environmental sustainability. Businesses are constantly trying to adopt a sustainable business model by innovating in the use of digital technology. Choosing the right digital technology can increase the effectiveness and efficiency of a business (Gregori & Holzmann, 2020). Utilization of technology in this business model can be a powerful tool in catalyzing business processes (Li et al., 2023).

He & Ortiz, (2021) in his research stated that it is necessary to apply design thinking in a sustainable business model to overcome business complexity. Design thinking must be combined with the use of wireless technologies to analyze big data and increase business agility in innovation. The use of algorithms can support the design thinking process in expressing customer characteristics more accurately, knowing and understanding customer needs in depth and complementing human deficiencies. Big data, Cyber-Physical Systems (CPSs), Internet of Things (IoT), Cloud Computing, and other recent technologies are sparking new developments in increasing productivity and resource efficiency in various organizations (Chen et al., 2024; Khan et al., 2021; Zhang et al., 2023). As a result, the use of big data can improve resource and energy efficiency (Siedschlag et al., 2024). Cyber-physical systems lead to the existence of an integrated system of computing, communication, and control of processes on physical devices so as to generate a response.

This CPS technology connects the digital world or internet network with the physical which can increase productivity in business processes. The internet of things allows an object to send data over a network connection. Connectivity brought by IoT in

*The role of digital technology in collective intelligence in improving the business process performance* - The term “collective” refers to a collection of people or

integrating the entire network can save resources, minimize operational costs, increase productivity and can improve customer experience (customer experience). Meanwhile, cloud computing can consolidate cloud infrastructure on a large scale which can reduce the negative impact on the environment. In addition, cloud computing can also improve collaboration between teams who both have access to data. Data mining can support businesses in finding potential customers, customer segmentation, and can increase customer retention (Hajishirzi et al., 2022). Data can be used to find out which customer segments require more attention and can help adjust communication relationships with customers. Hajishirzi et al., (2022) research shows that data-driven has a significant effect on customer engagement, where customer engagement has a significant effect on social sustainability. In addition, the data-driven contribution to customer engagement also has a significant effect on competitive advantage (Böttcher et al., 2024). Competitive advantage itself has a significant impact on economic sustainability. Competitive advantage will increase satisfaction with business performance in sales, profit and cash flow. Competitive advantage also contributes to the development of more environmentally friendly products that involve less resources and reduce pollution. That way, the use of data is considered to be able to reduce costs and improve the quality of business processes in responding to customer needs. The explanation above supports the proposition that the researcher built, namely the role of digital technology in the sustainability business model in improving business process performance.

stakeholders who do not necessarily share the same views or points of view, but collaborate to solve a problem. “Intelligence” refers to the ability to use

knowledge to learn, understand and adapt to new situations (Secundo et al., 2021). Collective intelligence in its broadest sense synthesizes how people or stakeholders and technology can be linked so that collectively they act more intelligently than any individual, group or computer has ever done before.

New opportunities in this digital era are unpredictable and require extensive interaction with various stakeholders. Thus, opportunities are not considered as an objective that can be found in the market, but are endogenous actions that are actively carried out to design new products/services. Opportunity creation is not only limited to designing new products/services but also the development of the entire company. In the process of creating new opportunities, the situation in making decisions is indecisive. The outcome of this opportunity creation process is completely unpredictable and a priori observable. While these opportunities must be implemented in the market and observed the reactions of other stakeholders. Moreover, beliefs, behaviors, resources, and skills needed are dynamic so that it Verifies the ways of thinking how to apply them to receive feedback that can trigger learning.

Dellermann et al., (2020) in his research identified processes in creating opportunities and linked collective intelligence as a solution in implementing it. The process of creating consists of conceptualization of opportunity ideas, opportunity objectification, objectified opportunity channel behavior, and opportunity enactment. The starting point of each of these processes contains an element of uncertainty. Opportunity creation theory suggests three central concepts to reduce uncertainty in the above process, namely social interaction, iterative development and learning. The concept of collective intelligence and crowdsourcing mechanisms mediated by technology

enable interaction with potential customers and stakeholders.

The opportunity realization process relies heavily on a business's access to nearby partners in obtaining feedback. If access in this process is blocked, feedback, both criticism and suggestions from the social environment, will not be fulfilled. This can make these opportunities difficult to realize. But with crowdsourcing, it allows access to social resources with the use of technology such as platforms. The use of this technology can save costs and speed up access. In fact, crowdsourcing supports testing assumptions related to ideas against potential markets which can later be used as feedback regarding the feasibility of opportunities.

The realization of opportunities will continue to be repeated until the opportunity reaches the point of feasibility. To reach that point, there needs to be continuous modification. Crowdsourcing in this case provides support in developing ideas and testing opportunities in the market by collecting data related to customer needs and customer perspectives regarding the solutions offered.

Apart from platforms (Broccardo et al., 2023), collective intelligence is also supported by the use of digital technology such as Artificial Intelligence (AI), machine learning, cloud computing, IoT, big data, and other digital technologies. AI refers to machines with cognitive functions like the human mind, such as decision making, which are increasingly being used to support various business processes. In solving critical and difficult challenges in today's world, it is necessary to work together with a team consisting of humans and artificial intelligence. Peeters et al., (2021) in his research presented three perspectives on AI, including the technology-centric perspective, the human-centric perspective, and the collective intelligence perspective. The technology-centric perspective states that ultimately,

true intelligence can only be found in AI systems. This is due to the limitations of human reasoning and the many cognitive biases, while computers are without limits capable of developing rational intelligence beyond human capabilities. Meanwhile, the human-centric perspective states that real intelligence can only be found in humans. With the existence of AI, the full potential of humans will be achieved except for certain essential qualities such as moral reasoning or empathy. Due to this exception, AI is considered to pose a danger to the welfare of society. Meanwhile, from a collective intelligence perspective, true intelligence can ultimately only be found in entities that collectively interact. The intelligence of both an individual and artificial intelligence is definite, therefore, when the two intelligences collaborate over a long period of time, true intelligence will form. Then, Peeters et al., (2021) also presents several major developments in AI, which include games, intelligent conversational agents and personal assistants, semi-autonomous cars, arts and social media, stock trading agents and fintech (stock trading agents and fintech), logistics and decision support, to military systems and robotics.

From the financial sector, AI has long been used in stock trading, for example Kavout, an investment platform based on artificial intelligence. AI is also widely used in determining whether potential customers qualify for loans, insurance or mortgages. The use of AI has proven to be very useful in performing complex analysis and predictions based on large volumes of data as is often encountered in the financial sector. Next is the use of AI in logistics and decision making. Today, more and more companies are using intelligent systems in the form of AI-based scheduling algorithms in optimizing the transfer of goods between locations where humans are the actors. This of course can help humans in carrying out their duties which in turn can improve the

performance of business processes. The utilization of AI in making decisions is currently widely used in human resource management. In this case, AI is used to support the prediction of the performance of newly recruited employees, such as in HireVue. In other words, AI helps companies reduce time to recruit and increase retention, assisting companies in selecting the right employees by screening quickly, fairly and consistently with AI-driven pre-employment hire assessments.

Based on the results of the analysis from the research of Wamba-Taguimdje et al., (2020), AI and its technology provide various types of options and benefits that can improve organizational performance. The application of AI and the support of several other technologies has updated existing processes to be smarter, optimized and automated so that they are more effective and efficient. The value gained by implementing AI in a business can span many aspects of an organization, from research and development, maintenance, operations, sales/marketing, planning and production, to demand and service forecasting. Some of the AI potentials described include (1) being able to increase the efficiency of operations, maintenance and supply chain operations, (2) optimizing and enhancing the customer experience, products/services with new functionality, automation, even optimizing the sales process, (3) enhancing adaptability and automation to changing market conditions, creating new business models, (4) creating a balance between supply and demand by improving forecasting and planning capabilities, (5) detect fraud and embezzlement in the banking sector and the like, (6) have an automated monitoring system for threats and information, and (7) can diagnose disease, help minimize medical errors, and improve the quality of patient care in the world of health.

Peeters et al., (2021) in his research identified four important components in



order to achieve effective collective intelligence, namely Observability, Predictability, Explainability, and Directability. Observability indicates that an actor's status, knowledge of the team, task, and environment can be observed or observed by others. Predictability indicates that an actor must have predictable behavior so that others can rely on them when considering their actions. The ability to explain leads to the ability to explain their behavior to others. And directionality means that an actor must have the opportunity to (re)direct one another's behavior. These four components must be present in both AI and teams.

Cricelli et al., (2021) in his research discusses the characterization of the meeting point between Open Innovation (OI) and crowdsourcing. OI is an innovation capability that comes from external interactions between organizations. Crowdsourcing is an effective practice and has great potential in operationalizing open innovation strategies. Cricelli et al., (2021) evaluates four different but complementary aspects, namely strategy, managerial, behavior, and technology. The strategy dimension represents the strategic objectives to be achieved. Through crowdsourcing, companies can get support in solving problems, generating ideas, designing, developing, testing, and commercializing. The managerial dimension centers on the level of the organization and its processes. From an organizational perspective, crowdsourcing provides an innovative way of getting work done that makes the flow of operations more flexible and dynamic. Managers are guided in acting on managerial matters including maintaining value creation, sharing value captured, building crowd culture, and aligning company goals with the crowd itself. The behavioral dimension refers to the behavior of the stakeholders involved and the interactions that occur. Human essence in this dimension is more

influential in crowdsourcing dynamics. The technology dimension, in this case, is oriented towards information systems and digital technology used to support processes. The technological aspect in this dimension is represented by the platform and the web. The platform is becoming an important tool in exploiting collective intelligence to acquire, innovate, develop new ideas for products/services and create new knowledge and opportunities.

For the successful implementation of AI in a collective intelligence system, Brock & von Wangenheim (2019) provide guidelines for implementing AI in a business. D-I-G-I-T-A-L are the seven areas required for action and implementation. "D – Data" is fundamental to implementing AI. AI requires data, high-quality digital data, especially AI with deep learning methods. Without data for training, AI cannot create value for the business and without the skills to acquire, manage, and analyze data, new valuable and actionable knowledge cannot be acquired. "I - Intelligent", as described earlier that requires skills to operate existing data. The lack or absence of skilled and knowledgeable employees regarding digital technology is a challenge in implementing AI. Therefore, the availability of employees who are skilled in this field is one of the key factors for successful implementation of AI. "G – Grounded", there needs to be a grounded approach so as to increase supply, revenue and operational efficiency. Being grounded means starting small first, testing, learning, and then applying. When experience is sufficient and accumulated, then the business will move on to a more complex and difficult stage. "I – Integral", an integral and holistic approach is required in AI implementation to be successful. Data, even though there are many, complete, consistent, accurate, and timely, but if it is isolated, not integrated, not connected with other relevant data, then it is still limited. Hence, all data must be connected and

integrated so as to support maximum value capture and knowledge creation. Integral in this regard includes strategy, process, data management, technology alignment, employee engagement, and culture. Alongside integration, there needs to be technology alignment, employee engagement, and a supportive culture. Technology alignment means integrating new technologies, including AI itself, with existing technologies. Then, integral in this case must also pay attention to employee involvement and have a supportive culture. Having these two aspects can help overcome internal barriers, both lack of skills and knowledge.

“T - Teaming”, AI alone without cooperation cannot achieve success. Collaboration is critical and goes beyond working with technology partners and business ecosystems, but includes suppliers, competitors, customers and alliance partners from other different industries. The open innovation ecosystem can be a means of developing innovative products/services beyond the company's internal capacities and capabilities. “A – Agile” is an antecedent in the successful implementation of AI. The company's ability to detect change and respond quickly by reconfiguring resources, processes and strategies is at the heart of organizational agility. “L – Leadership”, executive leadership is also one of the success factors in implementing AI in collective

*The role of digital technology in scaling in improving the business process performance* - A business definitely has a life cycle phase in running its business. The business that is built is not only expected to be able to survive, but to continue to grow and climb to a higher level. The terms used to describe this stage are "scaling" or "scale-up". Existing literature highlights four important activities that enable growth in scaling, namely financing, innovation, digitalization, and acquisition (Piaskowska

intelligence. One of the prioritized characters is the effort in digitizing the company. Leadership can be a source of transformational energy in implementing AI so that it can lead to the success of a collective intelligence system that leads to improved business process performance. The higher the D-I-G-I-T-A-L of a business, the higher the probability of successful AI implementation. The use value that can be felt by a company for the use of technology in a collective intelligence system is very much, broad and covers various aspects. The function of AI like the human brain contributes to overcoming the problems being faced and in the decision-making process. This supports the research of Garrido, (2009) and Yu et al., (2018) which describes the application of collective intelligence, one of which is decision support. The quality of decisions rests on five perceptual processes: (1) the goals to be achieved, (2) includes internal organizations and the environment or the decisions are local or global, (3) possible actions to choose one or more effective actions, (4) opportunities for a strategy to be implemented or actions to be taken and (5) alternative values of actions or strategies. The presentation above answers the proposition of the two researchers, namely the role of digital technology in collective intelligence in improving business process performance.

et al., 2021). Meanwhile, the essential resources for scaling include capital, technology, digital infrastructure, reputation, knowledge, and networks.

In essence, to be able to develop a business, it is necessary to improve the performance of business processes. This development can be carried out through various aspects in various ways both in terms of strategy, resources, operations, finance, and so on. In this case, the business can implement the use of digital platforms. Digital platforms

have many attributes that can stimulate companies in the process of business scaling which are considered to have the potential to scale businesses exponentially in terms of innovation, value creation and productivity.

Rangaswamy et al., (2020) summarizes the various types of digital business platforms based on their main objectives, types of users supported, and factors related to their success. The summary is listed in Figure 4.7. The advantages of implementing digital platforms in scaling certain services can improve and direct businesses to fast growth. Digital platforms allow a business to enter new markets and segments that may not have been accessible before. With this breakthrough, companies can offer existing products and services in new markets and offer new products/services that did not exist before. The use of this digital platform can increase sales as well as add value to their customers.

Digital technology also allows data collection to support the business in real-time, analyzing customer data and formulating customer needs. The data is integrated and processed using sophisticated algorithms in order to facilitate platform upgrades and to predict future platform user behavior. Digital business platforms can use data to generate strategic, contextual and transactional insights. This of course will increase the offer that can be given by the company. In addition, companies can exploit network effects due to digital technology, thereby encouraging rapid growth in a short time. However, network effects depend on the degree of openness of the platform, so the platform needs to be defined and adjusted from time to time.

According to Piaskowska et al., (2021), four important activities enable scaling a business, namely financing, innovation, digitization, and acquisition. Financing or funding activities are activities that lead to the collection of capital. Before scaling,

companies need to consider their financial condition, how much funds need to be raised in a given timeframe. This financing activity allows companies to access outside funding such as investors. By having sufficient capital both from funding and company capital, then there is a signal of potential for growth. After having sufficient capital, the next thing that must be considered is how the company develops and upgrades processes and products in terms of technology. Thus, in the process of innovation, digitization activities are needed. Digitalization supports companies in increasing process efficiency, updating business processes that were previously manual to digital. This digitization is considered to be able to stimulate changes in the value proposition. For example, exponentially increasing customer-based growth achieved by building relationships with customers through the use of digital platforms that do not require additional human resources in the process. Therefore, this digital platform relies on developing a broad user network in developing its business. The main sales and communication media that are widely used are web-based media. The use of this media supports a business to connect directly to certain customers and stakeholders. In addition, this can also build brand awareness in the minds of customers, minimize expenses, expand reach and make it possible to enter international markets.

Not only digital platforms, many businesses in developing their business use big data technology to optimize their business performance (Grandhi et al., 2021). To get customers, it is essential to be able to target customers at the right time with the right offers. For this reason, with today's technological advances, a business can obtain data through browsing/search activities by customers. Then the presence of analytical tools can support the process of understanding consumer buying patterns in the future. The knowledge gained can be

used to direct, optimize and automate the decision-making process. Data-based strategic decisions like this are crucial and must be owned and developed in the face of this VUCA business environment.

Some of the methods that are the main contributors that enable advanced analytics so as to achieve these business goals include data mining, text mining, and web mining techniques. Then, significant sources of information include the point of sale, social media, and other publication sources. This shows that data is used to understand what and why customers buy, their consumption patterns, and the factors that make customers satisfied or dissatisfied. These sophisticated data sets and analytical tools can be applied to all sectors of the company, thereby increasing operational efficiency, enhancing and expanding the services provided. Skala, (2019) revealed that it is about finding global market niches which can be fulfilled with algorithms and automation of key tasks. Thus, a business

#### IV. CONCLUSION

With the rapid growth of the internet, daily technologies are now integrated into network systems, rendering conventional methods ineffective in the digital era. Addressing sustainability challenges requires new technologies, behavioral shifts, and innovative business models, supported by technology to enhance collective decision-making. Based on the results of the analysis, it can be concluded that digital technology has a role in the sustainability of business models, collective intelligence, and scaling in improving business process performance. In general, this study supports the research of Prasanna et al., (2019) which states that adopting technology can increase productivity. The results of this study can also contribute to the development of business process performance theory, especially those related to the sustainability business model, collective intelligence, and scaling.

can achieve rapid growth, not only in terms of the number of customers, but also growth and increase in revenue and company value. The results of this study are supported by the study of Passaro et al., (2020) in his research which analyzed several case studies of startup phases. Based on the results of the study, several startup inventors revealed that in the scaling stage, they allocated their financial resources to improve their technology, using platforms such as online channels to improve their business performance, platform development supports visibility. In addition, there are also several startups that adopt digital technology to support their production processes. In general, it can be underlined that digital technology represents all important resources for startups in their development. The explanation above proves the third proposition of this study which says the role of digital technology in scaling in improving business process performance.

The use of technology in a sustainable business model can support these businesses in understanding rapidly changing customer needs with the use of algorithms and big data analysis. Without the use of technology, it will be difficult for a business to read the needs of its customers. Then, a business must be able to make decisions accurately and quickly. This is difficult to achieve without the help of technology. Conventional decision making needs to go through several stages such as problem identification, establishing a decision-making model to evaluating and analyzing decisions taken from various aspects. However, artificial intelligence in this case can replace some of these stages so that it is more efficient and the decisions taken will be more accurate. Then than that, to continue to grow, business people must connect with customers directly (customer engagement) so that businesses can grow or scale quickly. The presence of technology

can support this process, which was previously difficult for businesses to connect directly with their customers.

The results of this study indicate several benefits related to customers, including improving customer experience, customer segmentation, customer retention, and customer engagement. Improvement in customer experience is directly proportional to customer satisfaction which leads to competitive advantage. That way, if a business actor wants to gain and increase the competitive advantage of his business, then he must first be able to provide a good customer experience, one of which is through the use of digital technology in his business processes.

This research has been carried out with established scientific procedures. Nevertheless, the researcher realizes that there are still many limitations in this study,

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including; 1. Limitations of data collection based on established criteria due to limited relevant research to support this research, 2. This research uses data from various parts of the world where people's literacy of technology varies widely. The effectiveness of the results of this study is highly dependent on the level of technological literacy in the area where the business operates. If the use of digital technology to improve business processes is in an area where digital technology literacy is high, then the use of digital technology will probably be effective and business people will feel the role of digital technology, compared to the use of digital technology in businesses operating in areas where there is less technological literacy who may not feel the role of the digital technology used.

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## APPENDIX

No	Authors	Findings
1	He & Ortiz, 2021	Design thinking should be combined with the use of wireless technologies to analyze big data and improve the agility of business model innovation. Algorithms is helpful for design thinking to describe customer characters more accurately, find and understand customer requirements more deeply, and make up for the deficiency that emphasizes too much on the human-being.
2	Khan et al., 2021	Five broad categories were identified in the I4.0 sustainability relationship, namely I4-0 concepts which encompass leading-edge technologies such as Internet of Things (IoT), Cyber-physical systems (CPSs), Big Data (BD), and cloud computing (CC)
3	Hajshirzi et al., 2022	IT capabilities, digital platforms, and technological capabilities increase competitive advantages. Competitive advantage will increase satisfaction with the company's performance in sales, profit, and cash flow, enhance company's social recognition, and empowerment in society. Data mining helps firms find potential customers, define customer segmentation, and improve customer retention. Data-driven and business process innovation significantly affect customer engagement, where the impact of data-driven is higher than innovation. The customer engagement significantly affects competitive advantage. Innovative solutions and technologies to reduce costs and improve quality to respond to customers' needs
4	Dellermann et al., 2020	Assessing collective intelligence through crowdsourcing as a suitable mechanism to opportunity creation by providing access to social resources, reducing uncertainty about the objective value of an opportunity, and ensuring iterative development, learning, and resource support.
5	Peeters et al., 2021	Three perspectives on AI: technology-centric perspective, human-centric perspective, and collective intelligence perspective. Four important requirements for the effective design of collective intelligence: Observability, Predictability, Explainability, and Directability (OPED). Numerous examples of AI applications and its major developments, differ in terms of maturity, simplicity of use, purpose, and added societal value, are (1) games (2) intelligent conversational agents and personal assistants, (3) (semi-)autonomous cars, (4) art and social media, (5) stock trading agents and fintech, (6) logistics and decision support, and (7) military systems and robotics.
6	Pyo et al., 2021	The usefulness of information affects the intention to use the crowdfunding platform involving scientists and engineers. The perceived effect of collective intelligence and the credibility of scientists and engineers affect the perceived quality of information, and trust propensity has a significant impact on the credibility of scientists and engineers. An individual's attitude toward financial risk influences the intention to use the crowdfunding platform.
7	Thomas et al., 2021	The key to understanding whether aggregating behavior in sequential decisions will work well is to test whether the mechanism by which individuals are eliminated from consideration reduces the diversity of the crowd's core psychological properties, which need to be balanced for good decision making. Models of each individual, inferred from available behavioral data, can make predictions about what that individual would have decided under different circumstances. Using these predictions as proxy behavioral data provides a simple way to incorporate the diversity of the crowd in group aggregation and leads to better and more robust performance.

No	Authors	Findings
8	Wamba-Taguimdje et al., 2020	AI can allow any organization to achieve the following: (1) increase the efficiency of operations, maintenance and supply chain operations, optimize and improve the customer experience, improve products and services (with new features), as well as item recommendation processes (retail and other industries)
9	Brock & von Wangenheim, 2019	Seven areas of AI application success factors for managerial and implementation: Data- Intelligence-Grounded-Integral-Teaming-Agile-Leadership (D-I-G-I-T-A-L).  Four dimension of intersection between open innovation and crowdsourcing are strategic, managerial, behavioral, and technological. Strategic dimension - Innovation and Product Development. Through the crowdsourcing model, the company can obtain support for problem-solving, idea generation, design, and development, testing, and commercialization. Managerial dimension - Information Management and Data. Crowdsourcing also provides an innovative way to get work done and entails a more flexible and dynamic operations flow. Behavioral dimension - Human and Collaboration. The human "essence" of the crowd has a big impact on the dynamics of crowdsourcing Technological dimension - Platforms and Web. The platforms have become the essential tools that can be used to exploit collective intelligence to gain and develop new ideas for products and services and to generate new knowledge.
11	Piaskowska et al., 2021	Four high growth-enabling activities for scale-ups: financing, innovation, digitization, and acquisitions. Firms with digital products and processes face lower adjustment costs during growth and can integrate new activities into the firm more readily than non-digital firms. Digital platforms rely on building extensive user networks to grow their business.
12	Skala, 2019	It is about finding a global market niche in which the needs can be met by algorithmisation and automation of key tasks. Thanks to this, startups achieve a rapid growth —first in the number of users (customers), then in the revenues, and, finally, in the company's value.
13	Grandhi et al., 2021	Insights derived from such analysis are then used to direct, optimize and automate the decisionmaking process. Data, text and web mining techniques are some of the key contributors to making advanced analytics possible and eventually achieving business goals. The significant sources of information are point-of-sales data, social media and other published sources. They use data to understand what and why customers are buying, what their consumption patterns are and what makes them satisfied or dissatisfied.
14	Chen et al., 2024	Deploying these digital capabilities is more than just the ability to design the firms' assets to gain sustainable results. Digital exploitation and exploration capabilities are vehicles for sustainable performance and market-driven business model innovation. The digital transformation is essential for upgrading and improving the firm's sustainable performance. It also empowers the firms to broaden their business model innovations. By configuring the business model, the digital transformation makes the enterprise maximize the market potential, thus leading to the firm's sustainable performance

No	Authors	Findings
15	Zhang et al., 2023	All these transformations flow from the foundation of big data, the internet, and other digital technologies. Digital technologies contribute to products and services that are more efficient and responsive to customer needs, thus help firms attain significant competitive advantage. A product or service innovation based on digital technologies such as ICT (Information and Communications Technology), is a strategic consideration based on the use of big data and internet thinking to seek new competitive advantages. It can help firms to increase the value of products.
16	Broccardo et al., 2023	IT is a set of tools with agility and flexibility features shaping data processing systems (e.g., IT, big data, cloud computing). The positive relationship between digitalization and SBMs has been identified in sophisticated, technologically advanced contexts, such as Internet of Things services, Industry 4.0, and "digital twins" for industrial innovation.
17	Böttcher et al., 2024	Digital sustainable platforms are purely digital BMs that leverage multi-sided markets and apply them to a sustainability context to co-create ecological sustainable value with their complementors. This value proposition enables individuals and companies to behave or do business sustainably. Digital sustainable platforms are completely digital BMs that enable their ecosystem to cocreate sustainable value. Digital sustainable platforms orchestrate multi-sided markets and connect complementors and customers to make their respective BMs more sustainable.
18	Li et al., 2023	Five characteristics of digital platform ecosystems (generativity, convergence, share-ability, modularity, and complementarity) have a positive impact on the five dimensions of sustainable business model innovation. Using digital platform ecosystems is a positive solution for companies to promote business model innovation. To successfully update their business models, companies should consider which digital platforms they can embed in their systems and which strategies they need to adapt to their various production and operational processes
19	Siedschlag et al., 2024	The role of digitalisation in enhancing economic sustainability by optimizing resource management, increasing resource efficiency, and lowering operational costs. The role of digitalisation in supporting environmental sustainability by improving energy efficiency, reducing carbon footprints minimizing waste, decreasing paper consumption, and encouraging sustainable behaviours
20	Gregori & Holzmann, 2020	The selective use of digital technology can enhance convenience and efficiency, while lowering costs in concert with more sustainable ways of living, ultimately providing more balanced value propositions. Digital technologies can enable the parallel growth of socioenvironmental and financial value. This unravels the importance of digital technologies and their supportive function for sustainable business models