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

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Abstract **-** The research investigated 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, which is 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 give businesses a competitive edge by fostering sustainable practices and effective customer engagement. The advantages of implementing digital technologies can be felt from various economic, social, and environmental aspects. However, the research 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 is integrated with that network system. Various aspects of our lives are experiencing 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 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 to be 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 key players in global economic development. Moreover, startups create jobs and increase regional, national, and industry economic growth (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

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than 60% of startups could not survive or fail (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, and develop new levels of standards and solutions (Elia et al., 2020).

Reinhard et al. (2016) present the Industry 4.0 framework, features and digital technology contribution (see Figure 1). New technologies drive 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, behavior changes, and business models is required to be more sustainable (Bradley et al., 2020). Sustainability consists of economic, social, and environmental aspects that must be implemented holistically. The complexity of sustainability challenges the ability to make decisions (von Kutzschenbach & Daub, 2021).

In this internet era, accessing data and information related to customers, employees, and stakeholders is easy. With easy access, people can gain insights with greater accuracy and depth. However, this is insufficient for making decisions because of individual limitations (Bonabeau, 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 in a way that appears more intelligent (About, n.d.). The combination enables to experiment with several different mechanisms by leveraging collective decision-making capabilities (Bonabeau, 2009). Elia and Margherita (2016) 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 the 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 is revealed (Kelestyn et al., 2017). Technology resources are important component for startups because technology allows businesses to grow quickly and efficiently. Digital technology enables entrepreneurial activity (von Briel et al., 2017) and

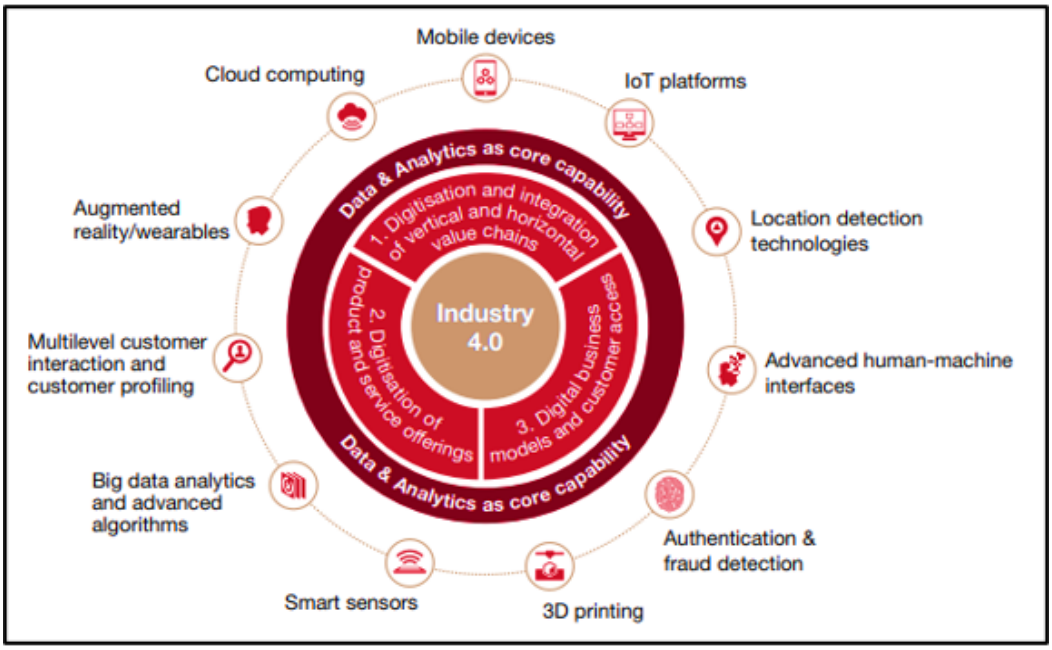

Figure 1 Industry 4.0 Framework and Contributing Digital Technologies (Reinhard et al. , 2016)

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 research 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. Furthermore, this research is crucial for early-stage start-ups in the digital era, as its findings will support the development of sustainable business models and enhanced performance.

II. METHODS

The research uses a Systematic Literature Review (SLR). It refers to a research methodology in the form of a combination of various systematic, clear, and comprehensive literature studies. The data analyzing technique uses 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, and even specific sentences (Uma & Roger, 2016).

The population in the research is Q1 and Q2 Scopus-indexed journals which have undergone an intensive selection process.

Scopus is a comprehensive abstract and citation database with peer-reviewed literature, such as

Table 1 Criteria of Data Selection

Selection	Criteria
Type of journal	Scopus indexed journal within Q1-Q2
Period	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
Relevantion of journal	• Title and abstract of each journal • Scan the entire contents of the journal if it is not clear

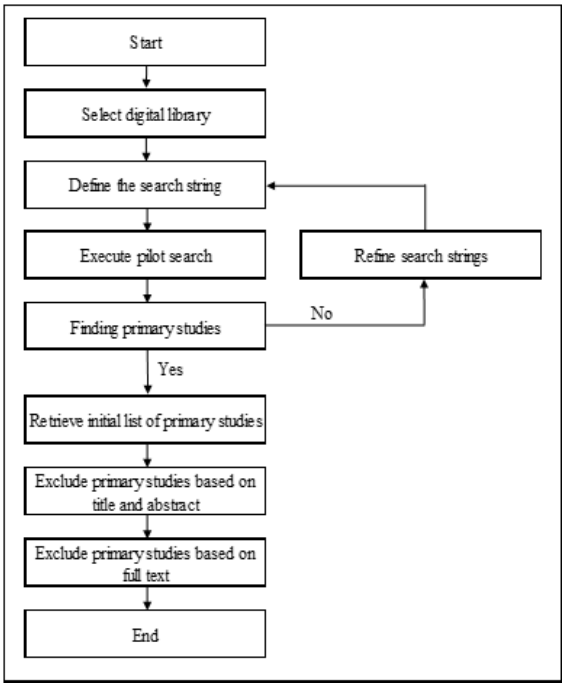

Figure 2 Data Collection

scientific journals, books, and conference proceedings. It offers a broad overview of global research output across various disciplines, including science, technology, medicine, social sciences, as well as arts and humanities. Using Scopus-indexed journals with Q1 and Q2 rankings in research journals 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. The criteria set by the researchers are listed in Table 1. The number of samples used by researchers is 20 journals as shown in Appendix. Then, Figure 2 shows all the steps for data collection.

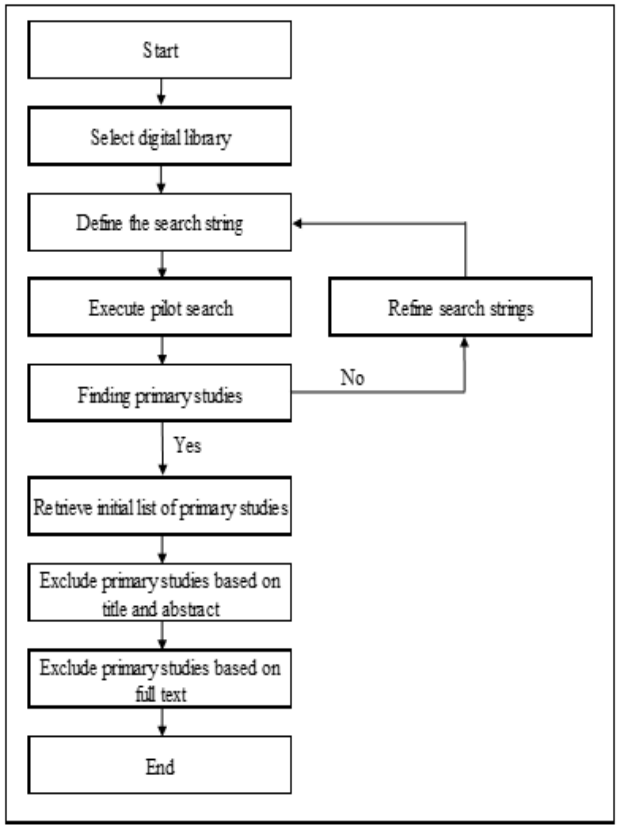

Figure 3 Research Methodology

Figure 3 shows the steps in conducting a systematic literature review. The initial step in this method is to identify research questions, which is the research focus. Research questions are from previous studies that still need further research. At this stage, existing problems or phenomena are transformed into research questions. The next stage is to develop a systematic review research protocol. After that, this research conducts a data search and selects relevant data; then, from the collected data, the inclusion and exclusion of the literature based on quality is carried out as data. After quality data has been collected, the data is extracted, and then extracted data is synthesized using content analysis. Content analysis is a data integration technique to obtain new theories and concepts and achieve a 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 DISCUSSIONS

Along with people's awareness of sustainability, the current business model leads to a sustainable business model, an extension of the conventional business model. Conventional business models only pay attention to aspects of economic sustainability, while sustainable business models include social and ecological or 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 and Ortiz (2021) state that it is necessary to apply design thinking in a sustainable business model to overcome business complexity. Design thinking must be combined with wireless technologies to analyze big data and increase business agility in innovation. Using algorithms can support the design thinking process in accurately expressing customer characteristics, understanding customer needs in-depth, and complementing human deficiencies. Big data, Cyber-Physical Systems (CPSs), the 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, 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 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 IoT allows an object to send data over a network connection. Connectivity brought by IoT in integrating the entire network can save resources, minimize operational costs, increase productivity, and improve 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 and customer segmentation, and increasing customer retention (Hajishirzi et al., 2022). Data can be used to determine which customer segments require more attention and help adjust customer communication relationships. Hajishirzi et al. (2022) state that data-driven has a significant effect on customer engagement, where customer engagement significantly affects social sustainability. In addition, the data-driven contribution to customer engagement also significantly affects competitive advantage (Böttcher et al., 2024). Competitive advantage has a significant impact on economic sustainability. It also increases satisfaction with business performance in sales, profit, and cash flow. Moreover, competitive advantage also contributes to the development of more environmentally friendly products that involve fewer 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 supports the research's proposition regarding the role of digital technology in the sustainability business model in improving business process performance.

The term collective refers to a collection of people or 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). So, collective intelligence synthesizes how people or stakeholders and technology can be linked. Collectively, they act more intelligently than any individual, group, or computer ever could.

New opportunities in this digital era are unpredictable and require extensive interaction with various stakeholders. Thus, opportunities are not considered an objective that can be found in the market but are endogenous actions that are actively carried out to design new products or services. Opportunity creation is not only limited to designing new products or services but also the development of the entire company. In creating new opportunities, the situation in which decisions are made is indecisive. The outcome is unpredictable and apriori observable. However, 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, this verifies the way of thinking about implementation to receive feedback that can trigger learning.

Dellermann et al. (2020) identity processes for creating opportunities and linked collective intelligence as a solution to implementing it. The process of creating consists of opportunity idea conceptualization, 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: 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 to obtain feedback. If the access is blocked, feedback (criticism and suggestions) from the social environment will not be fulfilled. This condition makes these opportunities challenging to realize. However, crowdsourcing allows access to social resources using technology such as platforms. The use of this technology can save costs and speed up access. Crowdsourcing supports testing assumptions related to ideas against potential markets, which can later be used to provide feedback regarding the feasibility of opportunities.

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

Apart from platforms, collective intelligence is also supported using digital technology such as artificial intelligence (AI), machine learning, cloud computing, IoT, big data, and other digital technologies (Broccardo et al., 2023). AI refers to machines with cognitive functions like the human mind, such as decision-making, which are increasingly used to support various business processes. In solving critical and complex challenges, it is necessary to work with a team of humans and artificial intelligence.

Peeters et al. (2021) presents three perspectives on AI: the technology-centric perspective, the human-centric perspective, and the collective intelligence perspective. The technology-centric perspective states that 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 and capable of developing rational intelligence beyond human capabilities. Then, the human-centric perspective states that real intelligence can only be found in humans. With the existence of AI, humans' full potential 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.

In the financial sector, AI has long been used in stock trading; for example, Kavout is an investment platform based on AI. AI is also widely used to determine whether potential customers qualify for loans, insurance, or mortgages. AI has proven to be very useful in performing complex analysis and predictions based on large volumes of data, which is often encountered in the financial sector. Next is the use of AI in logistics and decision-making. Today, many companies are using intelligent systems in AI-based scheduling algorithms to optimize the transfer of goods between locations. This condition can help humans carry out their duties, which 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 the 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 research of Wamba-Taguimdje et al. (2020), AI and its technology provide various 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 and marketing, planning and production, as well as demand and service forecasting. Some of the AI potentials include (1) increasing the efficiency of operations, maintenance and supply chain operations, (2) optimizing and enhancing the customer experience, products or services with new functionality, automation, even optimizing the sales process, (3) enhancing adaptability and automation to change market conditions and to create new business models, (4) creating a balance between supply and demand by improving forecasting and planning capabilities, (5) detecting fraud and embezzlement in the banking sector, (6) having an automated monitoring system for threats and information, and (7) diagnosing disease, minimizing medical errors, and improving the quality of patient care in health sector.

Peeters et al. (2021) identify four important components 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 by others. Predictability indicates that an actor must have predictable behavior so that others can rely on them when considering their actions. Explainability refers to the ability to explain their behavior to others. Directionality means that an actor must have the opportunity to direct or redircet one another's behavior. Thus, these four components must be present in both AI and teams.

Cricelli et al. (2021) discuss 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 with great potential in operationalizing open innovation strategies. Moreover, Cricelli et al. (2021) evaluate four different aspects but complementary to each others: strategy, managerial, behavior, and technology.

The strategy aspect 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 aspect centers on the level of the organization and its processes. From an organizational perspective, crowdsourcing provides an innovative way of getting work done, making the operations flow more flexible and dynamic. Managers are guided in their actions, including creating value, sharing value, building crowd culture, and aligning company goals with the crowd. The behavioral aspect refers to the stakeholders' behavior and the interactions that occur. The human element in this aspect is more influential in crowdsourcing dynamics. The technology aspect is oriented towards information systems and digital technology used to support processes. Moreover, the technological aspect 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 or services, and create new knowledge and opportunities.

For the successful implementation of AI in a collective intelligence system, Brock and von Wangenheim (2019) provide guidelines for implementing AI in a business. It is called DIGITAL. DIGITAL consists of seven areas for action and implementation. “D or Data” is fundamental to implementing AI. AI requires high-quality digital data, especially AI with deep learning methods. Without data for training, AI cannot create value for the business. Then, without the skills to acquire, manage, and analyze data, valuable and actionable knowledge cannot be acquired. "I or Intelligent" 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 skilled employees in this field is one of the key factors for the successful implementation of AI.

“G or Grounded” is a need for a grounded approach. It is to increase supply, revenue, and operational efficiency. Being grounded means starting small, testing, learning, and then applying. When sufficient experience is accumulated, the business will move on to a more complex and challenging stage. “I or Integral” refers to an integral and holistic approach required in AI implementation to succeed. Even though data are many, complete, consistent, accurate, and timely, if it is isolated, unintegrated, and disconnected from other relevant data, then it is still limited. Hence, all data must be integrated to support maximum value capture and knowledge creation. Moreover, integral includes strategy, process, data management, technology alignment, employee engagement, and culture. Technology alignment means integrating new technologies, including AI, with existing ones. Then, integral in this case must also be paying attention to employee involvement and having a supportive culture. These two aspects can help overcome internal barriers, both lack of skills and knowledge.

“T or Teaming” means AI alone, without collaboration, cannot achieve success. Collaboration

is critical and goes beyond working with technology partners and business ecosystems. It includes suppliers, competitors, customers, and alliance partners from other different industries. The open innovation ecosystem can be a means of developing innovative products or services beyond the company's internal capacities and capabilities. "A or 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 or Leadership" is also one of the success factors in implementing AI in collective intelligence. One of the prioritized characteristics is the effort to digitize the company. Leadership can be a source of transformational energy in implementing AI to lead to the success of a collective intelligence system that leads to improved business process performance.

The higher the business's DIGITAL, the higher the probability of successful AI implementation. The use-value that a company can feel for using technology in a collective intelligence system is numerous and broad, covering various aspects. The function of AI, like the human brain, contributes to decision-making and overcoming problems. The finding 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) include internal organizations and its environment or the decisions are local or global, (3) the possible action to choose one or more effective actions, (4) the opportunities for the strategy to be implemented or the action to be taken, and (5) the alternative values of the action or strategy. Thus, this research's proposition is the role of digital technology in collective intelligence in improving business process performance.

A business has a life cycle phase in running its business. The business is not only expected to survive but continue to grow and rise to a higher level. "Scaling" or "scale-up" are used to describe this stage. Existing literature highlights four important activities that enable growth in scaling: financing, innovation, digitalization, and acquisition (Piaskowska et al., 2021). Meanwhile, the essential resources for scaling include capital, technology, digital infrastructure, reputation, knowledge, and networks.

In developing a business, improving the performance of business processes is necessary. The development can be carried out in various ways, such as strategy, resources, operations, and finance. 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) summarize the various types of digital business platforms based on their main objectives, types of users supported, and factors related to their success. 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. With this breakthrough, companies can offer existing products and services in new markets and new products and 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 to facilitate platform upgrades and predict future user behavior. Digital business platforms can use data to generate strategic, contextual, and transactional insights. This will increase the number of offers that the company can give. In addition, companies can exploit network effects due to digital technology, encouraging rapid growth quickly. However, network effects depend on the degree of platform openness, so the platform needs to be defined and adjusted occasionally.

According to Piaskowska et al. (2021), our important activities enable business scaling. Those are financing, innovation, digitization, and acquisition. Financing is an activity that leads to the collection of capital. Before scaling, companies must consider their financial condition regarding the amount of funds that need to be raised in each timeframe. This financing activity allows companies to access outside funding, such as from investors. By having sufficient capital from funding and company capital, there is a signal of growth potential. After securing sufficient capital, the next thing to consider is how the company develops and upgrades processes and products in terms of technology. Thus, in the process of innovation, digitization activities are needed.

Digitization supports companies in increasing process efficiency and updating business processes that were previously manual to digital. This digitization is likely to stimulate changes in the value proposition. For example, exponentially increasing customer-based growth is achieved by building relationships with customers through digital platforms that do not require additional human resources. Therefore, this digital platform relies on developing a broad user network to develop its business. The main sales and communication media that are widely used is 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 customers' minds, minimize expenses, expand reach, and make it possible to enter international markets.

Besides digital platforms, many businesses use big data technology to optimize business performance (Grandhi et al., 2021). In gaining customers, targeting customers at the right time with the right offers is essential. For this reason, with today's

technological advances, a business can obtain data through customer's browsing activities. 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 Volatility, Uncertainty, Complecity, and Ambiguity (VUCA) business environment.

Main contributors that enable advanced analytics to achieve business goals include data mining, text mining, and web mining techniques. Moreover, significant sources of information include point of sale, social media, and other publication sources. This shows that data is used to understand what and why customers buy, customer consumption patterns, and the factors that make customers satisfied or dissatisfied. These sophisticated data sets and analytical tools can be applied to all company sectors, thereby increasing operational efficiency and enhancing and expanding services. Skala (2019) reveals that it is about finding global market niches that can be fulfilled with algorithms and automation of key tasks. Thus, a business 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 the research are supported by Passaro et al. (2020), which analyzes several case studies of startup phases. Several startup inventors revealed that they allocated their financial resources to improve their technology in the scaling stage, using platforms such as online channels to improve their business performance and platform development support visibility. In addition, several startups 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 proves the research's third proposition, which is the role of digital technology in scaling and improving business process performance.

IV. CONCLUSIONS

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 analysis results, digital technology has a role in the sustainability of business models, collective intelligence, and scaling in improving business process performance. The results of the research can also contribute to the development of business process performance theory, especially those related to the sustainability business model, collective intelligence, and scaling.

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 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 decision 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, and 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 will be more accurate. Then, 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 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. Therefore, if businesses want to gain and improve their competitive advantage, they must first be able to provide a good customer experience, one of which is using digital technology in their business processes.

The research has been carried out with established scientific procedures. Nevertheless, the research still has several limitations. First, the limitations of data collection based on established criteria are due to the limited relevant research to support this research. Second, the research uses data from various parts of the world where people's literacy of technology varies widely. The effectiveness of the results of the research is highly dependent on the level of technological literacy in the area where the business operates. Suppose the use of digital technology to improve business processes is in an area where digital technology literacy is high. In that case, the use of digital technology is likely effective. Business people will feel the role of digital technology, compared to the use of digital technology in businesses operating in areas with less technological literacy, which 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	Hajishirzi et al., 2022	IT capabilities, digital platforms, and technological capabilities increase competitve advantages. Competitive advantage will increase satisfaction with the company's performance in sales, profit, and cash flow, enhance company's a 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 repsond to customers' needs
4	Dellermann et al., 2020	Accessing 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.
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).
10	Cricelli et al., 2021	Four dimension of intersection between open innovation and crowdsourcing are strategic, managerial, behavioral, and technological. Startegic 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.

APPENDIX

No	Authors	Findings
		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
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 an 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

APPENDIX

No	Authors	Findings
19	Siedschlag et al., 2024	The role of digitalization in enhancing economic sustainability by optimizing resource management, increasing resource efficiency, and lowering operational costs. The role of digitalization in supporting environmental sustainability by improving energy efficiency, reducing carbon footprints minimizing waste, decreasing paper consumption, and encouraging sustainable behavior.
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