



The impact of Entrepreneurial Orientation and Digitalization on Performance Sustainability with the Mediation of Knowledge Management in Digital Start-Ups

Abolghasem Arabiun^{1*} | Elahe Hosseini² | Babak Ziyae³ | Seyedeh Mahla Tahami⁴

1. Corresponding Author, Department of Technological Entrepreneurship, Faculty of Entrepreneurship, University of Tehran, Tehran, Iran. Email: arabiun@ut.ac.ir
2. Department of Business Administration, Faculty of Economics, Management & Accounting, Yazd University, Yazd. Iran. Email: elahe.hosseini@stu.yazd.ac.ir
3. Department of technological Entrepreneurship, Faculty of Entrepreneurship, University of Tehran, Tehran, Iran. Email: bziyae@ut.ac.ir
4. Department of Entrepreneurship Development, Faculty of Entrepreneurship, University of Tehran, Tehran, Iran. Email: tahami.mahla@gmail.com

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ABSTRACT

Sustainability enables a company to carry on its activities while taking advantage of their effect on human and environmental capital management. Although many studies have focused on entrepreneurial orientation and digitalization of business procedures, so far not much attention has been paid to the role of digitalization of business procedures in the development of digital startups, and at the same time, to its role as the mediating factor of knowledge management. Therefore, the current research aims to investigate whether entrepreneurial orientation and digitalization of business procedures affect performance sustainability with the mediating role of knowledge management in Iranian digital startups or not. For this purpose, the researchers used a quantitative method in digital start-ups at Tehran's Science and Technology Park. The study population entails 555 managers. Subsequently, based on Cochran's formula, 227 sample managers were selected for this study. The target Iranian start-ups were evaluated during in June and July 2023. The data were collected using a 24-item questionnaire, which was scored based on a 5-point Likert scale. Eventually, the data were analyzed using PLS4 software. The findings indicated that entrepreneurial orientation and digitalization of business procedures have a significantly positive impact on performance sustainability. Moreover, Knowledge management mediate the relationship between entrepreneurial orientation and digitalization of business procedures. The study suggests that digital startups can enhance their products, services, and internal processes by focusing on entrepreneurial orientation, digitalization, and effective knowledge management to navigate competitive market challenges effectively.

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Introduction

Digital start-up development is a crucial factor in commercialization and economic profitability within innovation, science, and technology transmission processes (Hatak et al., 2021). Hence, the development of digital start-ups will lead to a change in knowledge and new economic findings, which can be used in the systematic implementation of economic knowledge (Moghaddam et al., 2015). Previous studies have highlighted the impact of knowledge management on attaining competitive advantage and promoting performance sustainability in digital start-ups (Castellani et al., 2021). Nonetheless, it is necessary to identify the influential factors in knowledge management in such companies (Salamzadeh et al., 2023). Entrepreneurial orientation and digitalization of business processes are among these crucial factors. These days, the entrepreneurial practice has been affected by various newly developed measures, such as providing digital products and services, developing digital platforms to perform entrepreneurial activities, and digital infrastructures and tools (Elia et al., 2020). Technological advancements have led to the digitalization of the economy during the past two decades; besides, the Covid-19 pandemic has also expedited and necessitated the development of the digital economy (Bloom et al., 2020). In 2018, IranTalent, a digital start-up company, reported that Iranian digital start-ups expanded by almost 46% and were also supported by the government. Meanwhile, it is crucial to conduct studies on the sustainability of digital start-ups, given the high failure rate among these companies (Tajpour et al., 2023). Moreover, the resource-based view (RBV) theory emphasizes that rare, inimitable, and non-substitutable resources enable business firms to gain a competitive advantage. A firm is said to have a competitive advantage “if it is able to create more economic value than the marginal (breakeven) competitor,” and firms are positioned to sustain such advantages when isolating mechanisms hinder rivals from acquiring key resources (Tajeddini et al., 2023). Thus, digital start-up companies can support their employees’ opinions by removing organizational barriers, training adept employees, communicating with entrepreneurs, and promoting investment procedures, including culture and entrepreneurial networks (Bischoff et al., 2018). Consequently, the universal experience asserts that entrepreneurial companies are more likely to address employees’ opinions, innovative demands in society, education, and exploration in entrepreneurship, as well as research and economic centers (Tayauova & Bektas, 2018). In addition, managers’ entrepreneurial orientation can help adopt knowledge management and the implementation of knowledge-based capacities in an organization. The business environment has gone through critical alterations, including fast-paced technological changes, a shorter life-cycle of goods, and the globalization of markets and competitors. Hence, companies need to employ appropriate strategies to develop a sustainable competitive advantage and a more efficient performance, leading to success and adoption to the challenging work environment (Talari et al., 2021). Since digital start-ups are interacting with fluctuating and complicated external environments to obtain new knowledge, they can attain and distribute the necessary information in the organization promptly. Thus, such companies will become more innovative and risk-taking compared to their opponents (Fan et al., 2021).

Empirical evidence from prior studies demonstrates that entrepreneurship can lead to positive results for the sustainability performance of companies. For instance, Jiang et al. (2018) have shown that green entrepreneurial orientation has a positive impact on financial and environmental performance after carefully collecting data from Chinese companies. The study by Habib et al., conducted among Bangladesh textile manufacturers in 2020, also demonstrated the impact of green entrepreneurship on a company's sustainable performance. The case studies carried out by Erista et al. (2020), in Indonesia, illustrate the substantial effect of entrepreneurship orientation and innovation risk-taking dimensions on performance.

A similar study conducted by Okangi (2019) has shown that a favorable impact on the profitability of construction undertakings in Tanzania is associated with an entrepreneurial orientation for risk-taking, innovation, and proactiveness. The review of existing literature has shown that digital start-ups are being studied in terms of their financial performance and profitability. Nonetheless, the sustainable performance of digital start-ups has not been addressed by many studies. It means that, for the time being, there has been a separation of digital start-up economy and sustainable performance, which was pursued as an individual field with little attempt at incorporating sustainability concepts into business performance. Although the literature on digital development has highlighted a growing body of research in this field, there are still scientific gaps about the impact that digitalization can have on

sustainability improvement for digital start-ups (Cooper & Adams, 2023). Due to the constant change and increasing competitive pressures on today's firms, managers strive to maximize business results through growth and increasing profit margins. Hence, they face more demanding customers, new regulations, globalization, and the destabilizing effects of technological advancement. All of these critical factors change the firms' landscape significantly and are introducing new challenges and generating new requirements for managers (Tajeddini, 2010). In different studies, it has been indicated that innovation is considered as the main source of competitive advantages. It is assumed that innovation did not occur due to having a single source. Rather, it derives from the combination of tangible and intangible resources (such as finances, routines, skills, knowledge, information, systems, and technologies) and capabilities that digital start-ups possess. However, theoretical and empirical research on how the combination of firm resources and capabilities enables innovation is scarce (Tajeddini et al., 2024). Therefore, this research is groundbreaking because it ventures into unexplored territory by examining the impact of entrepreneurial orientation and digitalization on performance sustainability in digital start-ups, with knowledge management serving as a mediating factor. This study breaks new ground as previous research has not thoroughly investigated this intricate relationship and its implications for the long-term success of digital start-ups. By exploring the dynamic interplay between entrepreneurial orientation, digital technologies, and knowledge management, this research illuminates the crucial factors that contribute to the sustainability and growth of digital ventures in today's competitive landscape.

This study may add to the extant literature in two ways: First, by broadening the scope of performance sustainability considerations and relating them to entrepreneurial orientation and digitalization. It also emphasizes the managers' role in implementing entrepreneurial orientation and digitalization in digital start-ups; second, the aspects of entrepreneurship orientation, digitalization, and performance sustainability are also affected by an examination of the mediating effects of knowledge management. As a result, the current study aims to examine the impact of entrepreneurial orientation and digitalization on performance sustainability through the mediation of knowledge management in digital start-ups. The second section of the manuscript can be outlined like this: After looking at existing ideas in the literature review, we came up with some hypotheses and created a conceptual framework to fit them. We then used a research method to analyze the data. Finally, we made sure to clearly state our conclusions and suggest areas for further research.

Theoretical Background and Research Hypotheses

According to neoclassic economists and several management theories, it is assumed that companies primarily aim to promote their benefits while there is a limited capacity. Shareholders are regarded as the basis of such theories because they can supply the required materials and resources for companies to fulfill their objectives. Nonetheless, companies seek different strategies, such as focusing on long-term objectives, ethical impacts of their economic decisions, consequences of companies' performance on shareholders and stakeholders, and the prominence of shareholders for the company, to enhance their profitability and remain competitive in the market. Existing research indicates that companies may profit in the short-run as a result of the commercial accomplishments; however, other factors, including social activities, ethical correspondence, and considering stakeholders' benefits, can play a crucial role in the long-term profitability and maintenance of companies (Gualandris et al., 2014). Consequently, companies highlight the forthcoming measures in their arbitrary interactions with the stakeholders, which is characterized by their sustainability. Thus, companies realize that responsiveness is necessary to develop profitability, competitiveness, and adoption to prompt global changes. Besides, globalization has deemphasized geographical borders, and technology has removed time and physical distance. Given the significant environmental changes, companies seek to promote their capabilities to manage profit and risk and preserve their brand image. Moreover, globalization has led to extensive competition to recruit and maintain an adept workforce, investors, and loyal customers. Business sustainability can determine companies' attitudes toward meeting the needs of employees, market, and customers (Kamble et al., 2020). Therefore, the concept of sustainability is applicable to globalization and company performance (Hosseini et al., 2020). Stakeholders believe that when companies are able to create, maintain, and promote enduring interactions with them through sustainable accounting and performance management, it can lead to performance sustainability (Taylor

et al., 2017). Hence, sustainable performance refers to the company's long-term engagement in the business environment corresponding to commercial, social, and environmental standards (Hughes et al., 2022). Adoption of digital technologies by start-ups, including social media, AI, big data analytics, IoT, and blockchain, can create both social and economic value, thereby improving start-ups performance. Technological knowledge and entrepreneurial orientation are critical success factors that enable digital start-ups to achieve long-term economic success through innovation and digital transformation (Yun et al., 2024). The interplay between entrepreneurial orientation, digitalization, and disruptive innovation is a key driver of digital entrepreneurship and business performance (Salih et al., 2024). Digitalization facilitates business model experimentation and innovation, which in turn enhances the sustainability performance of digital start-ups (Cenamor et al., 2019). In summary, the evidence suggests that digital start-ups can leverage their entrepreneurial mindset and adoption of digital technologies to create sustainable value and performance advantages in the market. The synergistic effects of these factors are crucial for the long-term success of digital ventures. As a result, the primary objective of the present study is formulated as follows:

H0: Entrepreneurial orientation and digitalization have substantial influences on the sustainable performance of digital start-ups.

This concept focuses on the need for a behavioral orientation, management attitude, and strategy decisions in order to sustain business performance in an evolving economy related to flexibility and strategic performance (Tajpour et al., 2023). The trend towards adopting new techniques to anticipate and perform activities based on future external environmental changes reflects the entrepreneurial orientation. It also refers to investigating uncertain results, particularly for independent industries that encourage creativity, risk-taking, initiatives, and intensive competition in the market. Otherwise, these companies would be associated with poor entrepreneurial orientation (Lee & Peterson, 2000). In addition, entrepreneurial orientation is considered as an intrinsic factor influencing business performance and its interaction with the external environment. It is characterized by indicators such as vitality, aggression, risk-taking, or independence (Crick et al., 2021).

Prior to the establishment of entrepreneurial orientation, related studies were focused on individuals. Thus, there were few instances of entrepreneurship behaviors and activities at the business level (Gupta & Jha, 2015). Business orientation involves enabling enterprises to engage indifferent undertakings, such as prioritizing R&D activities with the use of a variety of technologies, and applying new management methods, manufacturing techniques, and process settings in order to cope with negative perceptions about their products. Developing and making new products with an entrepreneurial view will be a priority for companies that recognize the importance of entrepreneurship orientation. Research findings show that fundamental innovations and their exploratory nature are capable of bringing to light the tacit demands of customers, allowing them to take more risks, which contributes to a firm's long-term sustainability. It is stated that business orientation cannot be treated as an exclusive source, and the integration of entrepreneurship into exploration can lead to a unique strategic resource for the company. Besides, digital start-ups tend to foster learning through experimentation and evaluation. Hence, companies should be committed to learning so that they can benefit from entrepreneurial measures. In addition, companies with higher levels of entrepreneurial orientation highlight experimental learning to integrate the existing knowledge into the internal database and attain a competitive advantage (Sahi et al., 2019). Entrepreneurial orientation refers to a start-up's strategic posture that embodies innovative, risk-taking, and proactive behaviors to pursue new opportunities. In the context of digital start-ups, having a strong entrepreneurial orientation can greatly impact their sustainable performance (Afum et al., 2023). This is because digital start-ups operate in dynamic and competitive environments where innovation and agility are crucial for success (Ameer & Khan, 2020). By being innovative, taking calculated risks, and being proactive in identifying and exploiting market opportunities, digital start-ups can enhance their competitiveness, adaptability, and long-term sustainability (Djalil et al., 2021). In essence, entrepreneurial orientation plays a significant role in shaping the success and longevity of digital start-ups in the fast-paced digital economy. So, here are the first and second research hypotheses that we came up with:

H1: Entrepreneurial orientation has substantial influences on the sustainable performance of digital start-ups.

H2: Entrepreneurial orientation has substantial influences on the sustainable performance of digital start-ups through the intervention of knowledge management.

Digitalization of business processes (based on digital information) aims at making a profit, replacing/moderating business processes, and preparing the ground for digital businesses (Bloom et al., 2020). Therefore, the competition among companies is profoundly reliant on their capacity to use digital technology to fulfill their prospect (Krishen et al., 2021). In addition, the digitalization of business processes affects the sustainable performance of digital start-ups by decreasing transaction costs, bureaucratic procedures, and the rate of error (Gallaugher, 1997), developing comprehensive information for international commercial transactions, and facilitating support and sales (Gregory et al., 2019), establishing constant feedback from the customer to integrate into strategic measures at international level and encouraging companies to find partners in global market (Adomako et al., 2021), improving competitiveness (BarNir et al., 2003), modifying service delivery procedures (Shpak et al., 2020), as well as promoting companies' capabilities in market development (Gümüő & Kütahyalı, 2017). In recent years, digitalization has changed the economic environment of businesses and companies, which highlights the significance of business process management along with digitalization development (Arabiun et al., 2023).

In the context of rapid changes in technology, markets, and competitors, Luo et al. (2023) prove that digitalization can help tech start-ups select suitable strategies for the development of long-term competition advantages and better performance and success within a complicated working environment (Luo et al., 2023). In addition, digitalization is likely to be able to speed up the acquisition and distribution of information in an organization by digital start-ups that will become more innovative and less risky as compared to their competitors (Akpan & Ibidunni, 2023). Furthermore, the development of leadership competencies in digital and sustainability might lead to improving employees' stability, with the aim of maintaining them, along with taking into account their physical and mental health in the long term (Walkowiak, 2023). It also facilitates engagement in new markets (Watson et al., 2018). The digitalization of business processes involves the integration of digital technologies to streamline operations, enhancing efficiency, and improving decision-making within an organization (Gong et al., 2018). When applied to digital start-ups, this digital transformation can have a significant impact on their sustainable performance (Chaudhuri et al., 2024). By leveraging digital tools and platforms to automate processes, access real-time data, and improve communication, digital start-ups can increase their operational efficiency, reduce costs, and enhance their overall performance (Epstein, 2018). Moreover, the integration of knowledge management practices within this digital ecosystem further amplifies the benefits of digitalization for digital start-ups. Knowledge management involves capturing, storing, sharing, and applying knowledge within an organization to drive innovation, improve decision-making, and foster continuous learning (Razzaq et al., 2018). By effectively managing and leveraging knowledge assets through digital technologies, digital start-ups can enhance their competitive advantage, foster a culture of innovation, and adapt to changing market dynamics more effectively (Deng et al., 2023). In summary, the combination of digitalization of business processes and effective knowledge management practices can significantly influence the sustainable performance of digital start-ups by improving operational efficiency, fostering innovation, and enhancing organizational agility in the competitive digital landscape. Consequently, it is required to review such findings in digital start-ups located within the Science and Technology Park to enrich the extant literature. Therefore, let's consider the third and fourth hypotheses in the following way:

H3: Digitalization of business processes has substantial influences on the sustainable performance of digital start-ups.

H4: Digitalization of business processes has substantial influences on the sustainable performance of digital start-ups through the intervention of knowledge management.

Knowledge management facilitates the establishment of a social and technical environment to develop knowledge and share it with others (Moghaddam et al., 2015). Thus, knowledge is assumed to be shared and distributed (Lin et al., 2012). Given that knowledge management is considered a

primary component in the entrepreneurship process, it should lead to improving performance sustainability and attaining a competitive advantage. Hence, companies seek knowledge management to access experts with novel information at an appropriate time (Salamzadeh & Dana, 2021). Moreover, it plays a significant role in transforming social knowledge into personal knowledge, as well as public knowledge into private knowledge (Ma & Chan, 2014). Knowledge management helps digital start-ups maintain quality and sustainability within the company structure. Employees' contribution to decision-making processes is crucial for knowledge sharing in companies (Habib et al., 2019). Furthermore, knowledge management refers to a new paradigm of sustainability, whose purpose is to increase the adoption of the guidelines for economic, environmental, and social sustainability (Tajpour et al., 2023). Companies that invest in sustainability approaches and knowledge sharing are more likely to experience more efficient practical performance, attract and maintain more loyal customers, and become more competitive (Hosseini & Rajabipour Meybodi, 2023).

Regarding digital start-ups, knowledge management could facilitate the achievement of sustainable competition advantages. Besides, knowledge management refers to policies and processes to identify, structure, and share intellectual property (Bagheri Faradonbeh et al., 2022). Knowledge management results in the timely acquisition and distribution of required information in the organization; thus, digital start-ups will become more innovative (Narayanan et al., 2023). Digital start-ups will be able to choose appropriate strategies to develop a sustainable competitive advantage based on knowledge management, leading to success in a challenging work environment with fast-paced changes in technology, market, and competitors (Iqbal & Piwowar-Sulej, 2023). Knowledge management plays a pivotal role in the sustainable performance of digital start-ups (Kordab et al., 2020). In the context of digital start-ups, where innovation, agility, and adaptation are crucial for success, effective knowledge management practices can have a profound impact on various aspects of the business (Corvello et al., 2023). By capturing, storing, sharing, and applying knowledge effectively within the organization, digital start-ups can enhance their decision-making processes, foster innovation, and improve operational efficiency. Knowledge management enables digital start-ups to leverage their intellectual capital, learn from past experiences, and capitalize on best practices, thereby driving continuous improvement and sustainable growth (Bloem & Salimi, 2023). Furthermore, in the fast-paced and dynamic digital environment, the ability to access and utilize relevant knowledge in a timely manner can provide digital start-ups with a competitive edge. By creating a culture that values knowledge sharing, collaboration, and learning, digital start-ups can enhance their organizational capabilities, adapt to market changes more effectively, and stay ahead of the competition (Lim et al., 2017). In summary, knowledge management is instrumental in shaping the sustainable performance of digital start-ups by enabling them to leverage their knowledge assets, drive innovation, improve decision-making, and enhance their overall competitiveness in the digital marketplace. Consequently, knowledge management can respond to future challenges to accomplish learning of new capabilities and adjust attitudes. Since knowledge management leads to higher novelty and organizational learning, it can help improve and maintain personal and organizational performance. Thus, the fifth hypothesis is formulated as follows:

H5: Knowledge management has substantial influences on the sustainable performance of digital start-ups.

Research Methodology

This applied research is descriptive-correlational in nature. It was conducted based on structural equation modeling and the partial least squares using SmartPLS4 software, which is considered a robust approach when there are limited samples and questionnaire items and the data distribution is not normal. A list of active companies shall be published on the Science Park's website every year. The research population was made up of firms that had faced several crises during the first three years and were able to cope with them. Digital start-ups, including the design and manufacture of goods and services in high technology, are considered private companies or institutions to expand and apply innovation and commercialize research and development results (Hosseini & Ferreira, 2023). Prior studies have focused on companies that provide services, develop new products or technologies, and carry out applied research. Sustainability has also been considered as a necessity by managers of the

sample digital entrepreneurs to prevent destruction, reduce energy consumption, and protect the environment.

The statistical population encompasses managers of all the digital start-ups located in the Science and Technology Park in Tehran, Iran, which equals 555 managers. Accordingly, a random sampling method, based on Cochran's formula, was used to select 227 managers. In June and July of 2023, we created a 24-question survey using a Likert Scale format. This scale helps us understand people's attitudes by asking them to rate items on a scale ranging from 1 to 5. The Likert scale was originally introduced by Rennes Likert and can vary in the number of degrees utilized, ranging from five to seven to nine. We chose the five-degree scale for our survey, which is the most commonly used form. The survey was designed on the Press Line website, and participants were sent links to complete it. They were also asked to fill out an informed consent form to ensure confidentiality of their responses. Furthermore, they could have left the experiment without any adverse consequences. In addition, PLS4 software was used to analyze the data statistically because a normal distribution of data was not necessary.

Measurement, Reliability, and Validity

Researchers used three criteria of reliability, convergent validity, and divergent validity to evaluate the fit of the measurement model based on the structural equation modeling approach using SmartPLS software. Face validity (based on professors' and managers' opinions) was used to evaluate the validity of the instrument, and the reliability was evaluated using McDonald's omega coefficient. The results of the pilot study with a sample of 20 individuals, evaluated by SPSS software, indicated that questionnaires have acceptable reliability because the obtained Cronbach's alpha coefficient was more than 0.7. Table 1 shows the questionnaire items and respective Cronbach's alpha coefficients.

Table 1. The Relationship Between Variables and Questionnaire Items

Variables	Type of variable	Items	Cronbach's alpha
Entrepreneurial orientation	Independent	1-9	0.828
Digitalization of business process	Independent	10-14	0.868
Knowledge management	mediator	15-20	0.738
Performance sustainability	Dependent	21-24	0.828

The reliability of instruments using the PLS approach is evaluated based on factor loading coefficients, Cronbach's alpha coefficient, and composite reliability (CR). Factor loading refers to the value that determines the relationship between explicit and implicit variables through a path analysis procedure. Greater factor loading of a variable onto a particular construct indicates a higher degree of contribution to explaining that construct. Moreover, negative factor loading values indicate adverse impacts of the variable on explaining the respective construct. In other words, the respective question has been developed inaccurately (Ageli, 2020). According to Table 2, factors with loadings lower than 0.7 were removed. Then, the model was executed for the third time. Finally, all the factor loading coefficients in Table 2 are over 0.7, which indicates its significance at the 99% confidence level. As a result, research variables (indicators) can explain the conceptual variable effectively.

As Table 3 reveals, the obtained values for Cronbach's alpha coefficient, composite reliability, and rho-A are higher than 0.7 for all constructs. Hence, the study constructs demonstrate acceptable reliability. In addition, the assessment of the average variance extracted (AVE) index indicates that all constructs have acceptable convergent validity as the obtained values are over 0.5.

The convergent validity was evaluated using the average variance extracted (AVE) index, and the divergent validity was examined using the square root of the average variance extracted index. Table 4 reveals that the obtained AVE indexes are above the acceptable value of 0.5; hence, the research variables demonstrate convergent validity. Moreover, divergent validity will be acceptable if the values in the main diameter are greater than the values below them in the table. Since the obtained square root of the average variance extracted index is higher than the correlation of the target variable with other variables, the divergent validity of the variables is confirmed.

Table 2. Factor Loadings and T-Values

Variables	Items	Initial factor loading	Revised factor loading	T-value
Entrepreneurial orientation	Digital start-ups have positive attitudes toward new ideas and innovations	0.939	0.939	87.086
	Digital start-ups encourage innovation in production and organization profitability.	0.963	0.963	187.782
	Digital start-ups constantly seek new solutions by experimenting new processes and approaches.	0.949	0.949	147.869
	Digital start-ups tend to invest in high-risk projects (with high profitability estimates).	0.927	0.927	105.956
	“Risk taking” is considered a positive attribute for digital start-up employees.	0.938	0.938	106.173
	Digital start-ups’ strategic business plans allocate resources to projects with uncertain outcomes.	0.919	0.919	78.637
	Digital start-ups try to take initiative in each situation (e.g., in projects, competition, and collaboration).	0.857	0.857	52.309
	Digital start-ups are constantly seeking new opportunities (e.g., new markets and customers).	0.910	0.910	84.574
	Digital start-ups try to take advantage of expected changes in the market ahead of their competitors.	0.926	0.926	106.505
Digitalization of business processes	Digital start-ups transfer technology to pursue new knowledge.	0.839	0.839	40.242
	Digital start-ups implement latest technologies in the internet of things to restore and use the knowledge of products and processes.	0.905	0.905	79.629
	Digital start-ups implement technology to restore and use knowledge in market and competitiveness.	0.892	0.893	69.289
Knowledge management	Digital start-ups implement the latest technologies to gain knowledge of new products and services in the industry.	0.884	0.884	59.367
	Knowledge management system facilitates formation of new knowledge.	-0.167	Removed	Removed
	Knowledge management system facilitates the required structures to form new knowledge.	0.883	0.883	63.779
	Knowledge management system designs processes to share knowledge across different performance areas.	0.842	0.846	28.296
	Knowledge management system facilitates knowledge sharing through structural borders.	0.913	0.911	75.251
	Digital start-ups develop processes to use knowledge to solve new problems.	0.900	0.900	70.485
	Digital start-ups adopt their knowledge resources to the problems and challenges.	0.857	0.858	53.415
	Digital start-up employees always perform their duties perfectly.	0.011	Removed	Removed
	Digital start-up employees contribute to planning activities.	0.846	0.846	45.273
Performance sustainability	Digital start-up employees contribute to organizational activities.	0.887	0.888	69.509
	Digital start-up employees contribute to performance, collaboration, and integration.	0.855	0.855	28.204
	Digital start-up employees comprehend their responsibilities.	0.830	0.830	50.295
	Digital start-up employees perform their duties effectively.	0.828	0.828	42.305

Table 3. The Reliability and Validity Indexes of the Instrument

Variables	Cronbach's alpha	Rho-A	Composite reliability	Average variance extracted (AVE)	R ²	Q ²
Entrepreneurial orientation	0.900	0.901	0.938	0.834	---	---
Digitalization	0.916	0.887	0.966	0.604	---	---
Knowledge management	0.940	0.960	0.971	0.782	0.651	0.624
Sustainable performance	0.938	0.941	0.952	0.705	0.723	0.680

Table 4. Divergent Validity

Variables	Entrepreneurial orientation	Digitalization	Knowledge management	Sustainable performance
Entrepreneurial orientation	0.913			
Digitalization	0.777	0.777		
Knowledge management	0.734	0.722	0.884	
Sustainable performance	0.654	0.543	0.879	0.899

The findings of SmartPLS4 software were tabularized in Tables 3 and 4. Accordingly, the measurement model has acceptable validity (convergent and divergent validity) and reliability (factor loading, composite reliability, and Cronbach's alpha coefficient). The variance inflation factor (VIF) index demonstrates the extent to which the behavior of a variable changes due to the influence of other variables. The VIF index reveals the degree to which collinearity has caused an increase in the variation in the predicted coefficients. The magnitude of the VIF value can be used to determine the severity of multiple collinearities. According to mathematics, the variance inflation factor for the variable of the regression model is defined as the ratio of the model's overall variance to the model's variance with an independent variable. A multiple regression model is applied to investigate the effect of several variables on the same outcome. Here, the effect of independent variables on dependent variables is identified. The independent variables constitute the inputs of the model. Since the correlation between variables can decrease the independent nature of the variables, it will cause problems in the multiple regression model. Researchers attempt to understand the impact of the combination of independent variables on the dependent variable, or the outcome of the regression model (Kock, 2015; Hosseini & Ferreira, 2023).

The variance inflation factor for the regression model variable is a ratio between the overall variance of the model and its variation with an independent variable. In order to examine the effects of a series of variables on an identical result, multiple regression models are used. In this case, it is found that independent variables have an effect on dependent variables (Tajpour et al., 2023). Kock (2015) claimed that the proposed model could be regarded as bias-free if all VIFs, on account of a comprehensive collinearity test, were similar to or below 3.3 (Kock, 2015). This was because all scales were explored by the self-report method to ensure the absence of any common method bias in the research. As a result, the VIF values for entrepreneurial orientation (VIF = 2.341), digitalization (VIF = 3.001), knowledge management (VIF = 2.607), and sustainable performance (VIF = 2.458) were all less than 3.3, demonstrating the model's independence from common method bias.

Findings

Descriptive Statistics

According to the study's findings, the demographic profile of the respondents was as follows: 77% of them were men and 23% of them were women; 15% had bachelor's degrees or less, 47% had master's degrees, and 38% had doctorates or higher; 31% of them had fewer than ten years of work experience, 69% had between ten and twenty years, and 28% had more than twenty years of experience.

Inferential Statistics

Three levels of analysis have been conducted on the model's fit: measurement, structural, and general. The degree of measurement has been examined using the concepts of validity and reliability. T-statistic, coefficient of determination (R²), and Q² values have been used to examine the structural level, and GOF values have been used to examine the general level. Based on the t-test results, the values for the impact

of entrepreneurial orientation on the sustainable performance of digital start-ups were equal to 10.731. As a result, when knowledge management was used as a mediator variable, entrepreneurial intuition had a significant impact of 9.957 on the sustainability of digital start-ups. When knowledge management was taken into account as a mediator variable, the path of digitalization of business processes had a significant impact of 11.968 on the sustainable performance of digital start-ups; this effect was even more pronounced when 6.391 was taken into account. The sustainable performance of digital start-ups was significantly impacted by knowledge management as well (with an impact of 3.202). Besides, the obtained t-value should be beyond 1.96 at the 95% confidence level to confirm the significance of the structural model fit. Based on Figure 1, all five hypotheses are approved.

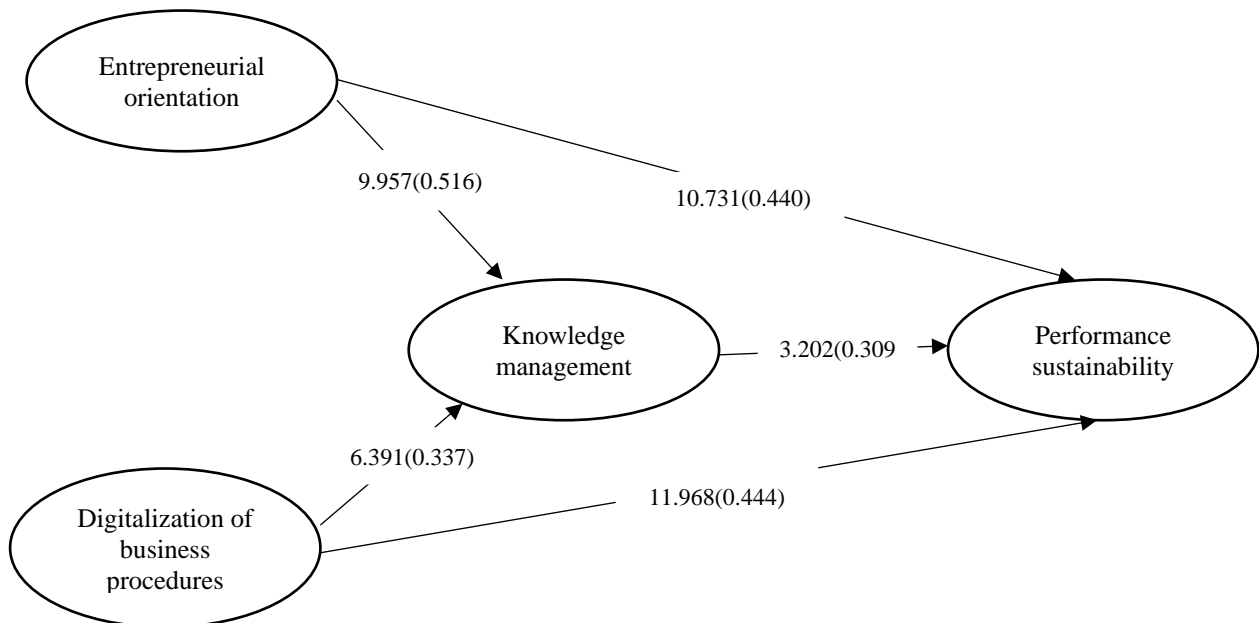


Fig. 1. T-value and the Model's Fit Indexes

R^2 is the second way employed to ensure the adequacy of the structural model, and we already figured it out. R^2 shows how external factors affect an internal entity, and numbers like 0.19, 0.33, and 0.67 tell us if the connection is weak, average, or strong. If one or two external factors affect the internal ones, an R^2 higher than 0.33 means the connection is really strong. The measured values for knowledge management and performance sustainability are 0.651 and 0.723, respectively; hence, the model fit has a strong contribution (Table 3).

Predictive Relevance (Q^2)

The Q^2 criterion looks at how well different factors in a study can predict certain outcomes. It combines the values of the factors and their coefficient of determination to see how accurately they can predict the results. This criterion, introduced by Stone in 1977, helps determine how well the model's independent variables can predict the end results. Basically, if the relationships between the factors in a study are well-defined, they should be able to accurately influence each other's outcomes and confirm the study's hypotheses.

Each dependent construct is subjected to the Q^2 criterion calculation. It is the result of adding the values of the research constructs' associated coefficients of determination together. Stone (1977) first proposed this criterion, which assesses the model's ability to predict independent variables. He contend that models with a good structural fit ought to be able to forecast the properties of the model's endogenous constructs (Hosseini et al., 2023). As a result, the hypotheses are appropriately validated if the links between the constructs in a model are sufficiently defined to allow the constructs to have an impact on one another's features. The values of 0.2, 0.15, and 0.35 were found to be appropriate for all endogenous constructs with varying levels of predictive power, as explained by Kline (2023). In our study, the results showed Q^2 values of 0.624 and 0.680 for knowledge management and sustainable performance. These values are considered acceptable for the dependent variables we are studying. To

clarify, the ideal values for constructs with low, medium, and strong predictive power are 0.2, 0.15, and 0.35, as mentioned by Kline (2023). Our analysis revealed Q^2 values of 0.624 and 0.680 for knowledge management and sustainable performance, respectively. This confirms that the predictive relevance values align well with the variables we are focusing on in this study.

Overall Model Fit

The overall model fit relies on the fit of the measurement and structural dimensions. Therefore, the overall fit of the model is assessed using the goodness of fit (GOF) index. The obtained GOF values of 0.10, 0.25, and 0.36 indicate weak, average, and strong fit indexes. Thus, the GOF index of 0.810 for the present research refers to the robust fit of the model.

$$GOF = \sqrt{\text{Communalities} \times R^2}$$

The average of the extent to which each variable contributes to the overall model is called "communality," and it was calculated to be 0.957. R^2 is the average accuracy of the model's predictions and it is 0.687. To assess the adequacy of the model fit, we examined the SRMR and NFI values. NFI is 0.901 and SRMR is 0.017, both of which fall within the acceptable ranges according to Kline (2023). He suggests that NFI should be between 0 and 1, and SRMR should be less than 0.1.

Examining the Significance Coefficient of the Mediator Hypothesis

The Sobel test was used to examine the mediator role of knowledge management in digital start-ups. In this formula, (a) refers to the coefficient of the independent and mediator variables, (b) represents the coefficient of the dependent and mediator variable, (s_a) signifies the standard error of the path between the independent and mediator variable, and (s_b) refers to the standard error of the path between the dependent and mediator variable. Based on the information presented in Table 5, knowledge management plays an important role in both entrepreneurial orientation and the digitalization of business processes. This was confirmed by the results, which showed values greater than 1.96.

Table 5. The Sobel Test Results

Hypotheses		A	B	SEA	SEB	Sobel test	Two-tailed probability	Result
1	entrepreneurial orientation → knowledge management → performance sustainability	0.516	0.309	0.079	0.061	4.002	0.000	Mediates
2	digitalization of business processes → knowledge management → performance sustainability	0.337	0.309	0.062	0.061	3.706	0.000	Mediates

Testing research hypotheses

T-value was employed to evaluate the potential relationship between variables. Five sub-hypotheses were used to assess the main hypothesis. Table 6 suggests that the obtained t-values for all the five sub-hypotheses are confirmed. Moreover, the standardized factor loading coefficients of each hypothesis path were investigated to determine the impact of predictive variables on dependent variables. These coefficients also determine the effect size of independent variables on the changes in dependent variables.

Table 6. T-value and Effect Size Coefficients

Hypotheses	Path coefficient	t-value	P-value	Result
H1: Entrepreneurial orientation has substantial influences on sustainable performance of digital start-ups.	0.440	10.731	0.000	Approved
H2: Entrepreneurial orientation has substantial influences on sustainable performance of digital start-ups through the intervention of knowledge management.	0.516	9.957	0.007	Approved
H3: Digitalization of business processes has substantial influences on sustainable performance of digital start-ups.	0.444	11.968	0.000	Approved
H4: Digitalization of business processes has substantial influences on sustainable performance of digital start-ups through the intervention of knowledge management.	0.337	6.391	0.000	Approved
H5: Knowledge management has substantial influences on sustainable performance of digital start-ups.	0.309	3.202	0.015	Approved

In figuring out the strength of a relationship in a structural model, researchers used a method called PLS-SEM to calculate a path coefficient. If the value is close to 0, it means the relationship is weak. A value closer to +1 indicates a strong positive correlation, while a value closer to -1 indicates a strong negative correlation (Li et al., 2019). The effect of possessing an entrepreneurial mindset on how well digital start-ups do over time is pretty substantial, with a significant coefficient of 0.440. When knowledge management comes into play, that effect increases significantly to 0.516. Going digital in how a business runs operations is also influential, with an impact of 0.444. Trust also plays a role in how sustainable a start-up's performance is, with a score of 0.337. Knowledge management has a significant impact on the long-term success of a digital start-up, with a coefficient of 0.309.

Discussion

Companies' strategic orientation can guarantee their performance efficiency. It develops fundamental principles in the company's functional activities, which improves the performance by creating appropriate behaviors. In other words, this orientation leads to enhanced productivity and reputation. The first research hypothesis highlights the substantial influence of entrepreneurial orientation on sustainable performance in digital start-ups. It can be concluded that entrepreneurial orientation in such companies refers to the process by which entrepreneurs implement novel ideas to establish and promote their businesses. These ideas are technology-oriented and lead to customer valuation, higher competitiveness, and enhanced corporate performance. According to Ritter and Pedersen's research findings (2020), entrepreneurial orientation in knowledge-based enterprises is a process where entrepreneurs use fresh, original ideas to start and grow their businesses. These concepts are frequently informed by technology and information, and they increase consumer value, boost competitiveness, and improve business performance. Entrepreneurial orientation and sustainability are significant variables for the performance of digital start-ups, according to Afum et al. (2023). As a result, encouraging businesses to be creative, take chances, and seek out new growth prospects can result in sustainable performance. Moreover, Tajeddini (2010) asserts that, for optimal performance, customer orientation, entrepreneurial orientation and innovativeness should be fostered by managers and owners in the firms.

According to the findings of Tajpour et al. (2023), sustainable performance can aid digital start-ups in maintaining their competitive advantage by setting them apart from rivals and fostering customer loyalty and trust among those who value businesses that take responsibility for the environment and the community. Together, entrepreneurial orientation and sustainable performance can improve the workplace and boost dedication to providing high-quality services, which can promote customer loyalty and financial performance. The connection between an entrepreneurial mindset and sustainable performance is intricate and multifaceted overall. Prioritizing both variables enables digital start-ups to develop a distinctive sustainability vision that distinguishes them from competitors and supports performance sustainability in the face of market adversities. Therefore, the results of the first hypothesis are aligned and consistent with Tajpour et al. (2023), Afum et al. (2023) and Ritter and Pedersen (2020).

The second research hypothesis demonstrates the substantial influence of entrepreneurial orientation on sustainable performance in digital start-ups through the intervention of knowledge management. Hence, companies can improve their performance sustainability by promoting two fundamental factors of robust knowledge management and entrepreneurial activities. It can be said that entrepreneurial orientation along with value creation for customers, innovation, and constant improvement of processes and products can enhance companies' entrepreneurial performances. Given that it includes entrepreneurial strategies and practices in service and product delivery, Sharma et al. (2020) stressed the importance of entrepreneurial orientation for digital start-ups. According to the findings of Bratianu et al. (2023), entrepreneurial orientation is a strategic propensity of businesses that is demonstrated by their participation in entrepreneurial activities including opportunity hunting, risk-taking, and proactivity. The research's findings indicate a company's capacity to take advantage of information-based resources and knowledge exploration to identify new possibilities and reduce the knowledge gap (Teng, 2007). According to Lumpkin and Dess's (2001) research findings, a company's propensity to pursue new market opportunities and reinvent existing business lines is referred to as having an entrepreneurial attitude. Businesses with an entrepreneurial mindset frequently promote environments that reward

creativity, take calculated risks, and actively seek out opportunities. Further mediating the link between knowledge-based resources and sustainable performance is this entrepreneurial attitude. Therefore, the results of the present study highlight that the growth and performance sustainability in digital start-ups can be facilitated as a result of entrepreneurial orientation and knowledge sharing. This strategy can lead to a significant improvement in knowledge management in organizations. Consequently, companies can explain the relationship between entrepreneurial orientation and knowledge management to facilitate the implementation of knowledge and experience in the development of the knowledge management process. This hypothesis is also consistent with the results of Han et al.'s (2024) research, which showed that entrepreneurial orientation includes dimensions, such as risk-taking, innovation, and being active, and has a positive effect on the company's sustainable performance. However, the extent of this impact depends on certain factors, including the ability to effectively manage knowledge. It is also aligned and compatible with Momanyi (2023) research, demonstrating that digital startups that actively seek new entrepreneurial opportunities, take risks, and actively participate in innovative initiatives are more likely to succeed. Digital startups and managers should stimulate knowledge acquisition from incubators to reduce limitations in technological or market knowledge. They should also develop routines and procedures to exploit the knowledge gained from digital start-ups for entrepreneurial purposes. According to the compatibility of this hypothesis with Ameer and Khan (2020) results, it can be argued that digital startups that combine a strong entrepreneurial orientation with effective knowledge management practices are more likely to achieve sustainable performance. According to the compatibility of the findings with Deslatte and Swann (2020) results, it can be said that entrepreneurial orientation is a key factor in determining the sustainable performance of digital startups. However, this relationship is strengthened when digital startups effectively manage their knowledge resources, especially in terms of knowledge acquisition, transformation, and exploitation. Therefore, the results of the second hypothesis are aligned and consistent with Bratianu et al. (2023), Sharma et al. (2020), Teng (2007), and Lumpkin and Dess (2001).

The third research hypothesis establishes the substantial influence of the digitalization of business processes on sustainable performance in digital start-ups. Similarly, Afshan et al. (2021), declared that the digitalization of business processes can facilitate the establishment of higher flexibility in dealing with market changes, the promotion of customers' experiences, higher access to required information, and enhancement of productivity in digital start-ups. Therefore, digital start-ups can improve their sustainable performance and succeed. In a different ground-breaking study, Hosseini and Ferreira (2023) came to the conclusion that new technologies and digital platforms can be used to improve knowledge management procedures and support the excellence and productivity of digital start-ups. Accordingly, the current study is consistent with that of Afshan et al. (2021), who found that digitalizing business processes enables knowledge-based businesses to increase productivity, adapt more readily to market changes, enhance customer satisfaction, and increase information availability, making it more timely, coordinated, and compatible. All of these improvements make it easier for knowledge-based businesses to perform more consistently, and help them move ahead on the path to success and growth. Moreover, companies' overall performance can improve by increasing the competitive advantage and collaboration among employees. Thus, the digitalization of business processes should be implemented as a crucial instrument to promote knowledge management in digital start-ups. It is consistent with Di Vaio et al. (2023) that digitalization supports by enabling companies to transform their business models towards sustainability. This transformation involves the integration of sustainability considerations into business operations and the creation of new business models that address environmental and social concerns. Digital tools can assist in this process by improving operational efficiency, reducing waste, and enhancing transparency throughout the supply chain. It is also consistent with Nwankpa et al. (2022). They stated that effective knowledge management is crucial for digital start-ups to leverage the benefits of digitalization for sustainable performance. Digitalization enhances knowledge management by providing platforms for knowledge sharing, collaboration, and innovation. Therefore, the results of the third hypothesis are aligned and consistent with Hosseini and Ferreira (2023), and Afshan et al. (2021).

The fourth research hypothesis highlights the substantial influence of the digitalization of business processes on sustainable performance in digital start-ups through the intervention of knowledge management. It can be argued that digital processes and novel technologies can help develop a

competitive advantage in companies. Subsequently, optimal knowledge management can lead to the enhancement of entrepreneurship and innovation. As a result, digital start-ups will heighten their performance sustainability and reduce production and communication costs. Digitalization can improve the efficiency of product creation, according to Björkdahl (2020). Physical objects and models are less necessary as a result of the digitalization of product development. Additionally, mathematical computation tools and devices for modeling and imaging are becoming increasingly sophisticated and collaborative. According to Shahatha Al-Mashhadani et al. (2021), the rapid growth of markets is providing opportunities for young people and new industrialists with high-tech, corporate, and relational support to create firms based on cutting-edge digital technologies. Furthermore, Tajeddini et al. (2024) show that innovation is the key to competitiveness in modern markets. Their results indicated that the digital orientation strengthens the innovation that can affect the sustainability of performance. This hypothesis, along with the results of Nasiri (2021) research, showed that digitalization enables the implementation of sustainable business models by providing tools that facilitate the integration of sustainability considerations and enhance competitive advantage, aligned and adaptive. The findings are also consistent with Agrawal et al. (2022) results that digitalization fosters innovation and adaptation by providing access to new technologies and enabling the development of new business models that address sustainability concerns. Therefore, the results of the fourth hypothesis are aligned and consistent with Tajeddini et al. (2024), Shahatha Al-Mashhadani et al. (2021), and Björkdahl (2020).

The fifth research hypothesis demonstrates the substantial influence of knowledge management on sustainable performance in digital start-ups. The research findings suggest that digital start-ups are more likely to succeed and develop sustainable performance if they implement efficient knowledge management strategies. Since digital start-ups are engaged in a technology-driven and innovative environment, and they have been primarily established based on novel ideas and knowledge, product and service knowledge is regarded as crucial and knowledge management for growth and success. Given that knowledge is regarded as the primary asset for digital start-ups, knowledge management can facilitate and expand productivity and performance sustainability. For instance, knowledge management in digital start-ups makes it easier to properly apply information as a source of new goods and more effective production methods, according to Tajpour et al. (2023). Additionally, it may result in improved productivity and lower manufacturing costs, increasing the sustainability of performance. Besides, knowledge management in digital start-ups helps them continuously update their expertise while taking both internal and external developments into account. As a result, it will lead to long-term sustainability and growth. Because of the nature of the activities performed by digital start-ups, their expertise and technology are dynamic and developing. Employees thus tend to withhold their knowledge to minimize the availability of crucial information needed by others to complete jobs independently, according to research findings by Bratianu et al. (2023). As a result, the organization may be unable to fully utilize its collective knowledge and skills since crucial insights and lessons from prior experiences may not reach the individuals who need them. In order to promote sustainable practices, it hinders the company's capacity to make informed decisions, create novel products and services, and efficiently react to shifting market conditions. It is consistent with Fantazy and Tipu (2024) results that knowledge management involves the acquisition, transformation, and exploitation of knowledge to support entrepreneurial activities and organizational performance. Effective knowledge management can lead to improved sustainable performance by facilitating innovation, reducing waste, and enhancing transparency throughout the supply chain. The findings are also consistent with Kordab et al. (2020) who argued that by effectively managing knowledge, organizations can drive innovation, reduce waste, enhance transparency, and gain a competitive advantage. This is essential for achieving long-term success and contributing to a more sustainable future. Therefore, the results of the fifth hypothesis are aligned and consistent with Bratianu et al. (2023), and Tajpour et al. (2023).

Therefore, sustained performance necessitates ongoing innovation, as well as efficient information and best practice transfer. People tend to save resources (especially knowledge-specialized) as a result of factors including risk-taking (climate), the imbalance between job demands (e.g., time pressure and workload), and the resources one has to deal with these demands. Studies demonstrate that this is particularly true in competitive situations, which conceal more information. Therefore, knowledge

management helps them deal with the pace of changes, respond to market and customer changes, keep their knowledge up-to-date, and maintain their performance sustainability. Digital start-ups can also implement knowledge management processes, techniques, and instruments to collect, save, and share their knowledge efficiently, and then use it as a resource for developing new products and improving production processes.

Managerial Implications

This study provides a fresh perspective on sustainable performance from a managerial viewpoint, emphasizing the role of true autonomy in fostering entrepreneurial orientation and digitalization within organizations. By empowering managers to cultivate a culture of innovation and entrepreneurship, companies can unlock the creative potential of their workforce and drive long-term success in today's fast-paced business landscape. Understanding and addressing the factors that influence the flow of knowledge and experience within an organization is crucial for promoting an entrepreneurial culture and enhancing performance sustainability. By proactively addressing knowledge sharing barriers and fostering a culture of open communication, managers can create an environment that nurtures innovation, improves competitiveness, and enhances adaptability to change. While some organizations have implemented procedures to combat knowledge hiding, promoting a knowledge management culture that actively discourages such practices can be instrumental in mitigating their negative impact. Future research should focus on developing strategies that not only encourage information sharing, but also prevent knowledge hoarding within organizational structures, ultimately fostering a culture of transparency, collaboration, and continuous learning. By emphasizing the importance of knowledge management and open communication, businesses can position themselves for sustained success and competitiveness in the evolving business landscape.

Conclusion

The findings of the present research indicate that entrepreneurial orientation and digitalization of business processes can help develop and promote innovation in digital start-ups. Such innovations can lead to providing new products and services, improving processes, and enhancing company performance. Moreover, digital start-ups can develop their competitive advantage because entrepreneurial orientation and digitalization of business processes will result in timely and efficient responses to market and customer changes, as well as the improvement of sustainable performance. Digital start-ups can employ digital technology and innovation to pursue constant profit and development. Such measurable development and enhancement can guarantee performance sustainability in these companies. Furthermore, entrepreneurial orientation and digitalization of business processes can facilitate expansion into new markets and global competition to achieve new opportunities. Consequently, these companies will experience enhancement of products and services, greater competitiveness, sustainable development, new market opportunities, improvement of processes and productivity, more efficient collaboration, and create value for their stakeholders. As a result, these changes will lead to sustainability in digital start-ups, and they will be able to face market challenges and compete with other companies.

Therefore, it is recommended that careful consideration is given to the users of digital agents, ensuring that they are designed in alignment with the specific needs of the organization or individual. This is because every project with entrepreneurship and digitalization is specific to certain departments and people. Managers and policymakers are advised to enhance the entrepreneurial culture within the firm in order to support the entrepreneurial orientation in digital start-ups. It is feasible to plan for holding training sessions, inspiring staff with excitement and motivation, and fostering originality and creativity as examples for this goal. The use of technology in knowledge management can help digital start-ups perform better and be more sustainable. Process improvement and cost reduction can be achieved, for instance, through the development of knowledge management systems, knowledge databases, project management software, and electronic communication. The performance of digital start-ups can be enhanced by developing data analysis systems, utilizing cloud technologies, developing electronic platforms for sales and marketing, developing intelligent inventory management systems, and developing the best possible production and distribution procedures. New technologies, like the Internet of Things, artificial intelligence, block chains, and 5G, can also help

digital start-ups operate more efficiently and at a lower cost, enhance the productivity, quality, and efficiency of the production and delivery operations. The manufacturing and presentation processes should also make use of modern technology, and efforts should be made to increase the processes' stability and lower their costs.

Limitations and Suggestions for Future Research

Although unique, this study had certain drawbacks. The investigation was first conducted on digital start-ups in Tehran, Iran, which has an impact on the generalizability of the findings due to cultural variances. Second, a collection of digital start-ups was the subject of this investigation. It would be better to test this concept in other businesses and contrast the outcomes with those of this study. Future research should target a broader statistical population and expand the current model to include additional elements like opportunity recognition and prior knowledge.

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