



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

# International Journal of Innovation Studies

journal homepage: [www.keaipublishing.com/en/journals/international-journal-of-innovation-studies](http://www.keaipublishing.com/en/journals/international-journal-of-innovation-studies)



## Emerging countries could be different for MSMEs: Digitalization and the mediation effects of innovation confronted to environmental practices

José Antonio Clemente-Almendros<sup>a,\*</sup>, Alejandro Díaz Pelaez<sup>b</sup>,  
Gilber Chura Quispe<sup>c</sup>, Jehovanni Fabricio Velarde Molina<sup>c</sup>

<sup>a</sup> Universidad Internacional de La Rioja, Spain

<sup>b</sup> Fundación Universitaria Internacional de la Rioja, Colombia

<sup>c</sup> Escuela de Posgrado Newman, Peru

### ARTICLE INFO

#### Keywords:

SME  
Innovation  
Digitalization  
Sustainability

### ABSTRACT

Our study analyses the direct and indirect effects of digital strategic orientation on the performance of micro, small- and medium-sized enterprises (MSMEs) in emerging countries. Based on a statistically representative database of Peruvian MSMEs, we use a structural equation model to test the effects of digital strategies on MSMEs' performance as well as the mediation effect of innovation and environmental practices. Our results show the total positive effect of digital strategies, both directly and mediated by innovation. However, environmental practices do not exert either a direct or a mediating effect. It is necessary for the concurrence of innovation so that environmental practices exert the expected mediation effect. The total effect of digitalization on MSMEs' competitiveness is almost twice the size of the direct effect, resulting from both mediation effects. We shed light on the importance of analyzing emerging countries in the literature and test the influence of contextual factors.

### 1. Introduction

Micro, small, and medium-sized enterprises (MSMEs) account for at least 90 % of companies worldwide, and their contribution exceeds 40 % of GDP (OECD, 2019). They promote competence and entrepreneurial culture, regional development, economic growth, innovation, and sustainable development (Lin et al., 2022). However, in the Latin American context, they show lower productivity and greater difficulty in incorporating technological transformations into innovation processes for performance improvement (CEPAL, 2021).

In this context, Peru is characterized by its vulnerability to events marked by global uncertainty (Ojeda-Joya and Romero, 2023) and exhibits a chaotic and insecure environment with high levels of informality, which may be linked to poverty, low productivity, income, and educational deficits (Kamichi Miyashiro, 2023). This makes it difficult for MSMEs to survive and is further exacerbated by the lack of capital for implementing appropriate environmental practices (Global Reporting Initiative, 2021). In this critical context, competitiveness arises as a major issue (Gošnik et al., 2023). In recent years, more attention has been paid to the digital approach of

Peer review under the responsibility of China Science Publishing & Media Ltd.

\* Corresponding author.

E-mail address: [Joseantonio.clemente@unir.net](mailto:Joseantonio.clemente@unir.net) (J.A. Clemente-Almendros).

<https://doi.org/10.1016/j.ijis.2025.08.001>

Received 14 January 2025; Received in revised form 24 June 2025; Accepted 14 July 2025

Available online 5 August 2025

2096-2487/© 2025 China Science Publishing & Media Ltd. Publishing services by Elsevier B.V. on behalf of KeAi Communications Co. Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

companies, product innovation, management, processes and market (Fu et al., 2021), and environmental practices (Simmou et al., 2023).

The adoption of a digital strategic orientation provides a holistic market view for the presentation of innovative products (Ardito et al., 2021). Studies have addressed the positive contribution of technology to business advancement and the beneficial effects of digital implementation (Gao et al., 2023; Li et al., 2023; Šimberová et al., 2022; Virglerová et al., 2022). Innovation in adopting environmental practices could improve company performance (Chege and Wang, 2020). Digital strategies and solutions with technology represent higher-quality services or products and, consequently, greater competitiveness while taking care of the environment and society (Al-Sharafi et al., 2023). Although digital orientation is a facilitator of value creation (Björkdahl and Holmén, 2018), there is still debate in identifying the most relevant interventions for business success (Saruchera and Mpunzi, 2023), as well as the possible moderating relationships (Gök and Peker, 2017; Muafi Muafi, 2023; Abdel-Maksoud et al., 2020). Moreover, the direct impact of digitization (Rupeika-Apoga et al., 2022; Wang, 2022) or indirect effects mediated by innovation and environmental practices (Yang et al., 2022) on the competitiveness of MSMEs in emerging countries constitutes a space that has not yet been explored in the literature (Ardito et al., 2021).

Our study aims to provide empirical evidence of the direct effect of strategies on the competitiveness of MSMEs, as well as the indirect effect mediated by innovation and environmental practices. The mediating effect of innovation between digitization and competitiveness constitutes a gap that has not yet been addressed efficiently (Abdel-Maksoud et al., 2020; Gök and Peker, 2017; Ismail, 2022). Innovative practices should not be analyzed separately, but in combination with factors such as digitization (Chatterjee et al., 2021a) or environmental practices focused on business, society and environmental interests (Le, 2022). Various studies have examined the benefits that medium-term practices offer to business performance (Bu et al., 2020; Mitra, 2022), but there has been limited interest in their mediating effect (Al-Sharafi et al., 2023). Our study highlights a preoccupation for MSMEs located in an emerging market (Battaglia and Neirotti, 2022).

The support of this study is also based on different theories, such as stakeholders (Freeman, 1984), TOE (Technology Organization and Environment) (Tornatzky et al., 1990), DOI (Diffusion of Innovation) (Rogers, 1983) and TAM (Technology Acceptance Model) (Davis et al., 1989). The first explains the involvement of managers through the direction of environmental practices for performance. The second (TOE) supports the participation of digital transformation in the market and the relevance of technological instruments, organizational, procedural and structural measures (organization) and the socio-economic and political (environmental) scenario in which they develop. Moreover, the DOI describes the adoption of new technologies in line with innovation practices. The TAM expresses the importance of practicality for all collaborators.

Our research makes significant contributions to the literature in multiple ways. First, we present a new line of debate on the contribution of digital strategies to the competitiveness of MSMEs. Second, the aim is to know to what extent environmental innovations and practices contribute to competitive development. Third, as evidenced in the review of the literature, it is suggested to check the behavior of our variables in regions where MSMEs are highly relevant to the economy (Horváth and Szabó, 2019). Although the emerging country scenario presents demanding and challenging conditions for the process of digital transformation, few studies have addressed this type of market (Shahadat et al., 2023). Our study expands the landscape and allows further analysis of the assimilation process of digitization strategies in Peru.

To that end, Section 2 reviews the related literature and presents the hypotheses to be tested. Section 3 describes the databases used in our study, the variables included in our model, the methodology employed, and the results. Finally, Section 4 discusses the main findings, their implications, and the study's main limitations.

## 2. Literature and hypotheses

### 2.1. Digital strategies and competitiveness

Digital strategies constitute an indispensable change in the entrepreneurship of contemporary MSMEs. The employment of technology increasingly works as support for continued economic growth and competitive advantage (Roman and Rusu, 2022; Rupeika-Apoga et al., 2022). Therefore, awareness of the advantages and possibilities of digital practices is evident in the numerous resources available in digital spaces and the continuous development and proposal of new business models (Gao et al., 2023; Sándor and Gubán, 2021).

According to the DOI theory, digitization strategies offer competitive advantages, but human material (employees and managers) must be properly trained with continuous training (Fonseka et al., 2022; Garzella et al., 2021). In line with TOE, increased knowledge and awareness of digital strategies from management are associated with a greater probability of acquiring benefits (Del Giudice et al., 2019; Valdez-Juárez et al., 2022). Thus, it is possible to explain a greater competitive advantage with theoretical-practical support (Khin and Ho, 2019). Understanding structural changes in the current market driven by the implementation and acquisition of digital strategies represents a mechanism of improvement for organizations (Chatterjee et al., 2021a; Kindermann et al., 2021). The evaluation of implementation opportunities boosts decision-making to gain a competitive advantage (Casalet and Stezano, 2020).

According to existing empirical evidence, the following hypothesis is proposed:

**H1.** Digital strategies have a direct and significant effect on the competitiveness of MSMEs.

2.2. Mediating effect of environmental practices in the strategy of digitization and competitiveness of MSMEs

The need to integrate environmental practices involves innovating processes, organizations and products (Klewitz and Hansen, 2014). In addition, it provides the possibility of anticipating the preventive requirements of pollution and waste management (Ayuso and Navarrete-Báez, 2018). Organizations are beginning to adopt global strategies to accelerate environmental performance and competitive improvement, communication and brand acceptance (Pakurár et al., 2020). Environmental practices can bring competitiveness to small enterprises, for example, the selection of suppliers (Alraja et al., 2022), proper packaging management of plastic containers and derivatives (Ayuso and Navarrete-Báez, 2018), process design, energy management (Danso et al., 2019), water organization and conservation (Rehman et al., 2022), adequate waste management for cost reduction (Roxas et al., 2017) and the adoption of standards such as ISO 14001 (Bashir et al., 2022).

According to the TOE model, technology is related to the adoption of sustainable environmental practices and improves innovation capabilities (Singh et al., 2017). Technological factors such as work with staff or equipment deployment (Alraja et al., 2022; Setyaningrum and Muafi, 2023) simplify the process of incorporating environmental practices and inserting environmental attention (Rahman and Mordi, 2018) with conventional solutions to supply chains. In the current scenario, digital strategies must be ecosystem compatible and control potential environmental hazards (Jones et al., 2005). The following hypothesis is therefore proposed.

Based on the aforementioned evidence, we argue that environmental practices play a mediating role in the relationship between digital strategies and competitiveness through two pathways. The first is the effect of environmental practices on competitiveness. Second, there is the concurrence of innovation.

**H2.** Environmental practices significantly mediate the impact of digital strategies on the competitiveness of MSMEs.

2.3. Mediating effect of innovation in the strategy of digitization and the competitiveness of MSMEs

Innovation is a response that utilizes knowledge of efficient experiences (Thu and Xuan, 2023) for the utilization of technological and human resources in business performance as demanded by the market (Khattak et al., 2022). Innovation implies competitive improvement (Bouwman et al., 2019) in products or services, as well as in the management and presentation of new products (Khattak et al., 2022). The participation of innovation in a context where digitalization has had a great impact enables greater growth (Battaglia and Neirotti, 2022) in competitiveness (Agostini et al., 2020).

The changes and renovations represent continuous activities in response to the dynamization of the transition from the physical market to a digitized market (Valdez-Juárez et al., 2022). Adhering to innovative practices includes considering factors such as digitization aligned with competitive development in production and services (Rusu and Viscusi, 2017). Awareness-raising and interest in the training of staff and managers on the digital transformation of the company facilitate the process of achieving performance improvements. The positive relationship between digital strategies and innovative processes (Jun et al., 2022) improves the inter-communication between businesses and consumers and increases alternative solutions through knowledge, with a strict interest in improving and creating new business models (Li et al., 2023). The role that innovation plays takes into account the technology transfer process in MSMEs (Srisathan et al., 2023) since it can only grow with the implementation of adequate innovation processes (Yun et al., 2018). Given the abovementioned, this paper uses the data collected to test the following hypothesis:

**H3.** Innovation significantly mediates the impact of digital strategies on the competitiveness of MSMEs.

Based on the previous arguments, we present the research model in Fig. 1. The model examines the direct effect between digitalization and business competitiveness (Competitiveness, H1), as well as the indirect effect through environmental practices (Environmental, H2) and business innovation (Innovation, H3). In this sense, testing H2 requires specifying a path from digitalization to environmental practices (H2a), from the former to competitiveness (H2b) and finally to innovation (H2c). In the same vein, testing H3

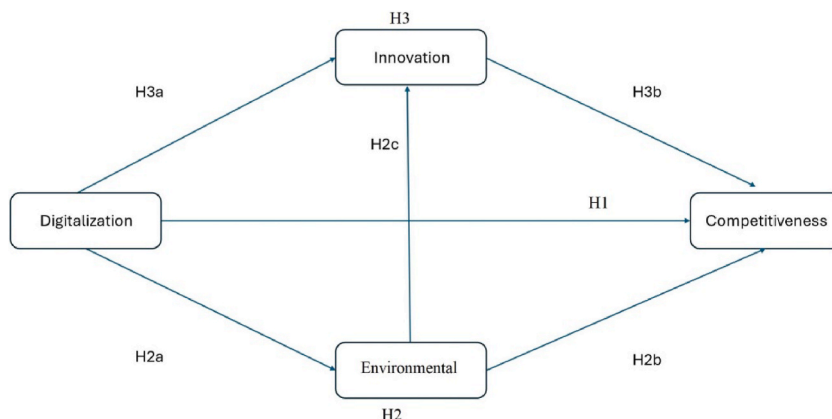


Fig. 1. Research model.

requires specifying a path from digitalization strategies (*Digitalization*) to innovation (H3a) and from the former to competitiveness (H3b).

### 3. Data and Methodology

#### 3.1. Source

This study results from the “MSMEs 2022 report—Digitization and sustainable development of MSMEs in Latin America”, developed by the Ibero-American Observatory of MSMEs and the “MSMEs’ digitalization and sustainable development in Perú” report. The data used in our sample were collected through telephone and online surveys from general managers of MSMEs in Peru. Both approaches of collecting data have proven to be cost-effective, with the highest response rate in similar and previous research conducted by the Observatory. For the data collection, a simple random sample was used, which generated a representative sample of the population. The closed questionnaire was administered during February and March of 2022 to the general managers of Peruvian MSMEs since they are the most important decision makers (García-Pérez-de-Lema et al., 2021). This questionnaire showed the following Informed Consent Statement: “The information provided from this questionnaire will be treated with confidentiality and for the relevant uses of the study as established in the Organic Law 3/2018 of 5 December on the Protection of Personal Data and Guarantee of Digital Rights”. With respect to ethical issues, this research adhered in November 2023 to the European Code of Conduct for integrity in research, elaborated by the European Federation of Academies of Sciences and Humanities, in the development of research and publications derived from the use of the database provided by the Ibero-American Observatory of MSMEs. As in similar studies, we highlighted that there were no correct or incorrect answers, and anonymity and data confidentiality were guaranteed (Castillo-Vergara and García-Pérez-de-Lema, 2021; Yang et al., 2015). Finally, we collected 346 valid questionnaires, which represents a global sampling error of our study is 5.3 % for a confidence level of 95 %. Table 1 shows the characterization of our sample.

To check for potential bias in our survey, we conducted different tests. First, we use Harman’s one-factor approach (Podsakoff et al., 2003) and apply a principal component analysis of all the variables included in our models. As there was no dominant factor, the main factor explained 21.631 % of the variance, confirming the absence of common method bias. Second, by comparing early and late respondents in our sample, we check for potential non-response bias (Scott et al., 1977). Our results show that there are no significant differences in the dependent or independent variables, age, size, or industry.

#### 3.2. Variables

##### 3.2.1. Business competitiveness (Competitiveness)

The dependent variable is a construct built from specific five-point (where 1 stands for worse and 5 stands for better) Likert-type scale questions in the survey related to *Competitiveness* indicators in comparison with the direct competitors of the MSME surveyed. These indicators are related to the quality of the products, the efficiency of the productive processes, customer satisfaction, the adaptation speed to changes in the market, sales growth speed, profitability, the employees’ satisfaction, and the employees’ absenteeism rate.

This variable captures managers’ perceptions related to the competitive position of their MSMEs. In line with the literature (Duréndez et al., 2016; García-Pérez-de-Lema et al., 2016), the position of MSMEs against competitors, measured by means of different indicators, can describe a company’s relative success (AECA, 1988). Our indicators have been used in similar studies (Chenhall and Langfield-Smith, 2007; Dehning et al., 2007; Gunday et al., 2011; López-Mielgo et al., 2009).

##### 3.2.2. Business innovation (Innovation)

*Innovation* is a construct created from the survey, using five-point Likert-type scale questions related to different innovations carried out by the companies in our sample. The items asked about in the survey and included in this construct are improvements or changes in products or services, new products or services, improvements in production processes, acquisition of capital equipment, and

**Table 1**  
Sampling distribution by sector and size.

Sector	Number of companies	%
Primary sector	27	7.83
Extractive sector	61	17.78
Building	30	8.73
Commerce	31	9.04
Services	152	43.97
Other	44	12.65
Size	Number of companies	%
Micro (6–9 employees)	179	51.88
Small (10–49 employees)	108	31.31
Medium (50–249 employees)	58	16.81
Total sample	345	100.00

improvements or changes in the organization or internal processes. These innovations are in line with the related literature about innovation in MSMEs (Al-Hanakta et al., 2021; Avermaete et al., 2003; García-Pérez-de-Lema et al., 2021; Rosenbusch et al., 2011; Van Auken et al., 2008).

3.2.3. Environmental practices (Environmental)

This variable captures the use and importance of different *Environmental* practices or criteria in the specific MSME aspects: supplier selection, management of plastic containers and derivatives, process design, energy management, water management, waste

**Table 2**  
Variable definition.

Variable	Items	References
Business Competitiveness (Competitiveness)	<p><u>Compared to your direct competitors, indicate where your company stands with the following COMPETITIVENESS indicators, please rate from 1 to 5 (1 is worse, 5 is better):</u></p> <ol style="list-style-type: none"> <li>1. Quality of your products</li> <li>2. Efficiency of production processes</li> <li>3. Customer satisfaction</li> <li>4. Speed of adaptation to changes in the market</li> <li>5. Rapid sales growth</li> <li>6. Profitability</li> <li>7. Employee satisfaction</li> <li>8. Degree of work absenteeism</li> </ol>	Chenhall and Langfield-Smith (2007); Dehning et al. (2007); Duréndez et al. (2016); García-Pérez-de-Lema et al. (2016); Gunday et al. (2011); López-Mielgo et al. (2009)
Business Innovation (Innovation)	<p><u>Indicate if your company has carried out, in 2021, the following innovations and, if so, indicate the degree of importance of each of them, please rate from 1 to 5 (1 is low important, 5 is very important):</u></p> <ol style="list-style-type: none"> <li>1. Changes or improvements in existing products/services</li> <li>2. Market launch of new products/services</li> <li>3. Changes or improvements in production processes</li> <li>4. Acquisition of new capital goods</li> <li>5. New changes or improvements in organization and/or management</li> <li>6. New changes or improvements in purchases and/or supplies</li> <li>7. New changes or improvements in commercial and/or sales</li> </ol>	Al-Hanakta et al. (2021); Avermaete et al. (2003); García-Pérez-de-Lema et al. (2021); Rosenbusch et al. (2011); Van Auken et al. (2008)
Environmental Practices (Environmental)	<p><u>Indicate whether your company has used, in 2021, any of the following environmental criteria and, if so, indicate their degree of importance for your company, please rate from 1 to 5 (1 is low important, 5 is very important):</u></p> <ol style="list-style-type: none"> <li>1. Environmental criteria in the selection of suppliers</li> <li>2. Environmental criteria in the management of plastic packaging and derivatives</li> <li>3. Environmental criteria in the design of processes</li> <li>4. Environmental criteria for energy management</li> <li>5. Environmental criteria for water management</li> <li>6. Environmental criteria for waste management</li> <li>7. Environmental certifications (e.g., ISO14001/EMAS)</li> </ol>	Cantele and Zardini (2020); Jansson et al. (2017); Ndubisi et al. (2021); United Nations Global Compact (2016)
Digitalization Strategies (Digitalization)	<p><u>Indicate the degree of agreement or disagreement on a scale of 1 to 5 on the following aspects related to the DIGITALIZATION STRATEGY, please rate from 1 to 5 (1 is total disagreement, and 5 is strongly agree):</u></p> <ol style="list-style-type: none"> <li>1. We are well aware of the possibilities and advantages of digitization</li> <li>2. We allocate significant resources to digitize the business</li> <li>3. The business model is evaluated and updated in terms of digitization</li> <li>4. Our employees are prepared for the digital development of the company</li> <li>5. Our managers are well-trained in digitalization</li> <li>6. The degree of process automation is high in my company</li> <li>7. We use digitization in the organizational management of the company</li> <li>8. Our company regularly organizes training for digital transformation</li> </ol>	Burchardt and Maisch (2019); Chatterjee et al. (2021b); Heavin and Power (2018); Kindermann et al. (2021); Matt et al. (2015)
Size	Number of employees	Van Auken et al. (2008); Duréndez et al. (2016);
Age	Firm age	García-Pérez-de-Lema et al. (2016); González-Cruz et al. (2021)
Sectorial Dummies		Duréndez et al. (2016); García-Pérez-de-Lema et al. (2016); González-Cruz et al. (2021); Van Auken et al. (2008)

management, and environmental certifications. These environmental practices are in line with the Sustainable Development Goals (SDGs) (United Nations Global Compact, 2016), and the 2030 Agenda for Sustainable Development (UNGC, 2016), as well as the literature concerning MSMEs and sustainable management and sustainability (Cantele and Zardini, 2020; Jansson et al., 2017; Ndubisi et al., 2021). Our variable captures the environmental responsible activity and the organizational transformation aimed at achieving the 2030 SDG. MSMEs play a critical role in this pursuit of the SDGs since they are the prevailing form of business and cannot be achieved without considering the relevant contributions and specific issues of MSMEs, as they do not behave in the same way as large corporations do (Cantele and Zardini, 2020).

3.2.4. Digitalization strategies (Digitalization)

This variable measures the level of the digitalization strategy in our sample. More specifically, it captures the following items: awareness of the possibilities and advantages of digitalization, level of resource allocation to digitize the business, evaluation, and update of the business model in terms of digitalization, employees and managers are trained for business digital development, degree of process automation, use of digitalization in business organizational management, and regular training in the company for digital transformation. Our construct is in harmony with prior research. The continuous assessment of the resources allocated, as well as the specific training, is critical in the digitalization process (Heavin and Power, 2018; Kindermann et al., 2021; Matt et al., 2015). Moreover, digital transformation, such as automation, requires new skills and organizational changes (Heavin and Power, 2018; Matt et al., 2015). In this vein, not only technology but also organizations’ strategic directions, involving the whole organization in the use of digital resources, and structural changes drive proper digital transformation (Kindermann et al., 2021). However, it is necessary for managers to understand and be aware of how digitalization can strengthen the company (Burchardt and Maisch, 2019; Chatterjee et al., 2021b).

Finally, we use control variables in line with the related literature about Competitiveness in MSMEs: firm size (Size), measured by the number of employees; firm age (Age) and sectoral dummies (Duréndez et al., 2016; García-Pérez-de-Lema et al., 2016; González-Cruz et al., 2021; Van Auken et al., 2008). Table 2 summarizes the variables used in our model.

3.3. Methodology

3.3.1. Data analysis

The proposed hypotheses were tested simultaneously by applying the minimum partial square methods in SmartPLS (v.4.0.9.8) (Ringle et al., 2022). The technique has two advantages: it does not require assumptions for the distribution of indicators, and there is no independence of observations.

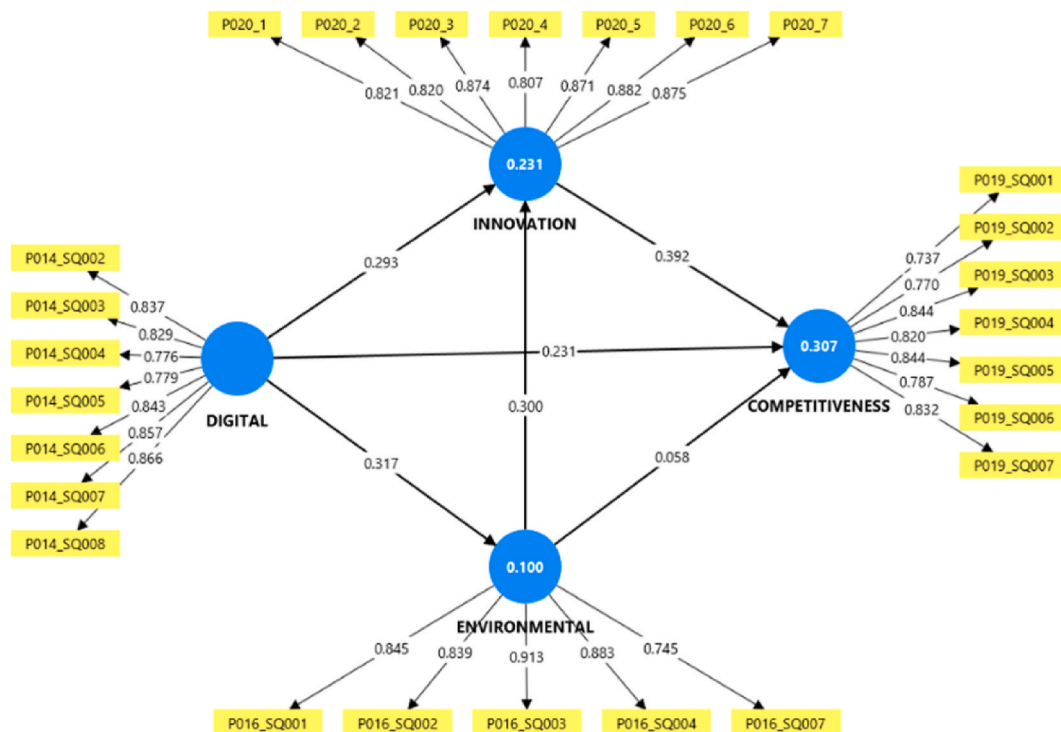


Fig. 2. Structural model and results.

3.3.2. Internal model

The model meets all the established requirements. The SRMR value of the saturated model was 0.055, which is less than the cutoff value of 0.08 suggested by Hu and Bentler (1999). This provides empirical evidence for the constructs that were operationalized. The loading ( $\lambda$ ) of each element of the model construct (Fig. 2) should be greater than 0.707, which verifies the reliability indicator and the Business Competitiveness construct indicator. The Competitiveness item P19 - Q008 is below the parameter (0.556), so it was removed, and the other indicators are above 0.707 (Martelo-Landroguez et al., 2019). The model meets the requirement of construct reliability, since the Dijkstra-Henseler indicator ( $\rho$ ), as well as the Cronbach’s alpha coefficient and the composite reliability exceed 0.7 (Table 3). The AVE values (Table 3) exceed the threshold of 0.5, indicating that convergent validity is achieved. Finally, all variables achieve discriminant validity, as the Fornell-Larcker (Fornell and Larcker, 1981) criterion is satisfactorily met, and the bootstrap-based confidence interval for the HTMT (heterotrait-monotrait correlation ratio) value (Table 3) exceeds the threshold value of 1 (Henseler et al., 2015).

3.3.3. External model

Hayes and Scharkow (2013) demonstrated that the confidence interval calculated by bootstrapping is the correct approach for detecting route coefficients. The trajectory coefficients were found to be compatible in all the cases. Fig. 2 shows the structural model and results, which explain 31.5 % of the variation in company performance (Business Competitiveness).

Bootstrapping (PLS) results were agreed upon for the combination of the path from Digitalization Strategies to Business Innovation and the path (Business Innovation to Business Competitiveness) to prove the importance of the indirect effect. The direct effect (Digitalization Strategies to Business Competitiveness) was insignificant, but the indirect effect was significant, indicating mediation (Nitzl et al., 2016).

The mediating role of the Environmental Practices variable was also analyzed, and the importance of mediation and its indirect effect were determined. The results are also presented in Table 4. The bootstrapping - PLS for the combination of the path from Digitalization Strategies to Environmental Practices and the path of Environmental to Business Competitiveness proves that the indirect path is not statistically significant-active since the range includes zero (Hair et al., 2017) (see Table 5).

As explained, the PLS technique consists of three steps. In the first step, the model adjustment is studied. The model’s overall adjustment test was not rejected ( $dG = 0.723$ ,  $dG < 95\%$ ) and ( $dULS = 1.318$ ,  $dULS < 95\%$ ), while the standardized square average residual (SRMR) value for the estimated model was  $SRR = 0.055$ . Hu and Bentler (1998) suggested a value below 0.09. The results of the internal model analysis are presented below.

The  $Q^2$  of Geisser (1974) and Stone (1974) is the technique for evaluating the predictive relevance of the structural model, which must be greater than zero (Chin, 1998). Furthermore,  $Q^2$  values close to 0.02, 0.15 and 0.35 indicate degrees of weak, moderate, and strong predictive relevance, respectively. In this case, the  $Q^2$  values for the endogenous buildings (Business Innovation, Business Competitiveness and Environmental) indicate a moderate threshold.

4. Discussion and Conclusions

Our research offers a model that explains the direct effect of digital strategies on the competitiveness of Peruvian MSMEs (H1), as well as the indirect effect of variables such as innovation (H3) and environmental practices (H2). This study addresses the knowledge gap regarding the need to have studies that verify the direct or indirect influence of variables (Abdel-Maksoud et al., 2020; Bu et al., 2020; Ismail, 2022; Mitra, 2022). The results confirm our first two hypotheses, with a significant and positive effect, whereas with regard to the third hypothesis, sufficient statistical significance has not been found to confirm the mediation of environmental practices, given the lack of significance of the former with business competitiveness, but it becomes significant with the concurrence on innovation. Research is based on theories such as TOE, DOI, TAM and stakeholders.

The first hypothesis shows that digital strategies have a significant effect on MSMEs, with a direct effect of 0.231. Our results align with the existing literature, indicating that the implementation of digital strategies slightly enhances competitiveness compared to peers (Radicic and Petković, 2023; Roman and Rusu, 2022; van Nguyen et al., 2022; Wang, 2022). Aligned with DOI (need of organizational diffusion), TOE (need of internal factors) and TAM (need of awareness), training programs (Del Giudice et al., 2019), training of employees and senior managers (Fonseka et al., 2022; Garzella et al., 2021) and organization digital adaptation (Rupeika-Apoga et al., 2022; Valdez-Juárez et al., 2022) improve business competitiveness positively. Therefore, implementing digital strategies is a set of actions and does not culminate in the acquisition of technological assets.

In the case of the second hypothesis, the mediation effect of environmental practices in the relationship between digitalization and competitiveness is not significant (coefficient 0.018). Although the literature indicates that the implementation of environmental

**Table 3**  
Reliability, convergent validity, and discriminant values of the outer model.

Construct	Cronbach’s alpha	rho_A	Composite Reliability	AVE	HTMT		
					Competitiveness	Digitalization	Environmental
Business Competitiveness	0.910	0.919	0.928	0.649			
Digitalization Strategies	0.923	0.928	0.938	0.684	0.431		
Environmental Practices	0.938	0.910	0.927	0.717	0.313	0.344	
Business Innovation	0.936	0.938	0.948	0.723	0.535	0.414	0.418

**Table 4**

VAF variance accountant for Digitalization Strategies, Business Innovation, Business Competitiveness, Environmental Practices  $p < 0.05$  (based on  $t_{(4999)}$ , double queue test).

	Direct effects						
	Coef.	Effect	2.5 %	97.5 %	Valor $t$	$p$ -value	Nivel de Signif.
H1 (Digitalization Strategies → Business Competitiveness)	0.231		0.120	0.335	4.205	0.000	***
H2a (Digitalization Strategies → Environmental Practices)	0.317		0.208	0.426	5.641	0.000	***
H3a (Digitalization Strategies → Business Innovation)	0.293		0.171	0.413	4.728	0.000	***
H2b (Environmental Practices → Business Competitiveness)	0.058		-0.052	0.168	1.040	0.298	
H2c (Environmental Practices → Business Innovation)	0.300		0.169	0.431	4.464	0.000	***
H3b (Business Innovation → Business Competitiveness)	0.392		0.276	0.506	6.646	0.000	***
	Mediation effects (paths)						
H2a → H2c → H3b (Digitalization Strategies → Environmental Practices → Business Innovation → Business Competitiveness)		0.037	0.018	0.065	3.037	0.002	***
H3a → H3b (Digitalization Strategies → Business Innovation → Business Competitiveness)		0.115	0.057	0.186	3.467	0.001	***
H2a → H2b (Digitalization Strategies → Environmental Practices → Business Competitiveness)		0.018	-0.016	0.06	0,972	0.331	
Total effect Digitalization → Competitiveness		0.401	0.311	0.490	8.624	0.000	***

(\*):  $p < 0.1$ ; (\*\*):  $p < 0.05$ ; (\*\*\*)  $p < 0.01$ .

**Table 5**

$Q^2$  Predictive Relevance Path for Business Innovation, Business Competitiveness, and Environmental Practices  $p < 0.05$  (based on  $t_{(4999)}$ , double queue test).

Construct	$Q^2$ predict	RMSE	MAE	$R^2$
Business Competitiveness	0.153	0.931	0.673	0.301
Environmental Practices	0.092	0.958	0.720	0.098
Business Innovation	0.141	0.936	0.668	0.226

practices positively influences the impact of technology on business performance (León-Gómez et al., 2022), our empirical evidence complements the existing findings by revealing a lack of a statistically significant relationship between environmental practices and business performance ( $\beta = 0.058, p = 0.298$ ) (Ben Amara and Chen, 2021; Courrent et al., 2018). For MSMEs, the cost of capital invested in the implementation of environmental strategies is higher (Gjergji et al., 2021) and may result in lower returns (Dal Maso et al., 2020). The non-impact of mediation of environmental practices can be explained by the small investment devoted to its implementation, or the ignorance of the structure of the sector and market (TOE), and the lack of awareness of the use of technology (TAM). Using technology and examining the context for its application are essential elements for internal and external innovation (TOE, TAM and DOI). The business orientation of a firm is significantly influenced by the commitment of its socially responsible investors, owners and managers (Arco-Castro et al., 2023), since the visualization of sustainability as a profitable strategy can benefit the planet and performance (Nogueira et al., 2023). However, the mediation effect of environmental practices by the concurrence of innovation is significant (coefficient 0.037). This finding is consistent with the literature (Klewitz and Hansen, 2014; Wang et al., 2021). The effect of environmental practices on business performance is subject to further research (Lee and Suh, 2022). Indeed, our results show that only with the concurrence of innovation can environmental practices exert a positive effect on business competitiveness. Innovation has become a key factor influencing MSME environmental practices (Clemente-Almendros et al., 2025). Therefore, these small organizations need to connect their environmental practices to their products, services, processes, and organizational innovations.

For the results of the third hypothesis, the indirect and significant effect of digital strategies on competitiveness through innovation confirms H3 (coefficient 0.148). Innovation is a factor that can foster competitiveness (Bouwman et al., 2019). The model explains that creating and updating active technology products, services, processes, sales and acquisition (Al-Hanakta et al., 2021; Radicic and Petković, 2023) promotes innovative activity and fosters a competitive advantage in emerging scenarios (Carvalho et al., 2016). In addition, they mediate the implementation of digital platforms and business performance in such a way as to mediate the acquisition of technological mechanisms and migration to models for commercialization and increase sales and services (Khin and Ho, 2019). The new ideas associated with the technological domain spread through various forms of operation for the benefit of the organization (DOI), making use of the information systems, products and technological services (TOE) and increasing the utility and perception of ease for the institutions (TAM). Our results also show that the initial positive effect can be substantially increased by the mediation of innovation. We demonstrate how digitalization can engage with the organization through a transformational process (training, awareness, updating, evaluation, process automation, digitalization of organizational management). We also address the need for evidence regarding contingency factors that could affect the ultimate impact of digitalization (Ciampi et al., 2021). The potential provided by digital technologies increases when innovation aimed at enhancing a company’s value proposition to the market interacts with digital strategy (the coefficient increases from 0.243 to 0.413).

Finally, it is quite relevant to highlight that the total effect of digital strategies on the competitiveness in MSMEs in emerging countries shows a total effect of 0.401, which is almost twice the size of the direct effect (0.231). The mediation effect of innovation (0.115) and environmental practices (0.037 + 0.018) helps increase the initial direct effect. This novel finding has very relevant implications.

Our study is one of the first approaches to the impact of digitization and its mediators (innovation and environmental practices) in emerging countries for MSMEs. The role of socio-economic backgrounds is limitedly discussed in the literature (TOE). Moreover, there is a lack of research on sustainable policies and their influence on MSMEs' performance in comparison to peers (Singh and Kumar, 2023). Even though business digitalization is very important for economic growth and the fact that emerging countries struggle with specific challenges in comparison to developed countries, just a few studies have shed light on the implementation of technology in emerging countries (Shahadat et al., 2023). Our study highlights the need for more research on different situations of MSMEs located in distinct geographical areas to understand the role played by contextual factors.

We show that in emerging countries such as the Peruvian market, which is characterized by informality (Kamichi Miyashiro, 2023), the higher the innovative activity, the better the performance considerably (García-Pérez-de-Lema et al., 2016). While uncertainty and costs may slow the implementation of digital strategies (Ojeda-Joya and Romero, 2023), managers must promote MSMEs' digital transformation processes through organizational change (TOE) to acquire new skills for the formulation of strategies and the use of digital resources (Chatterjee et al., 2021b). It is pertinent to continuously make improvements and changes to their products, processes and services, aimed at greater efficiency at lower cost (García-Pérez-de-Lema et al., 2021). Our results highlight the importance of implementing not only digitalization strategies in the future but also business models that enhance performance, utilizing not only technological competence but also the ability to implement new processes for the production and management of a company to accelerate productivity, increase customer satisfaction, and improve profitability.

On the other hand, environmental practices do not seem to mediate the improvements between digitization and enterprise competitiveness rates, owing to low investment in the emerging country context. In some specific contexts, such as emerging areas, the expected positive effect of environmental practices may not be achieved. Consequently, national and regional institutions could intervene with alternatives for the benefit of the environment with strategies based on the imitation of successful experiences in other companies (Adomako et al., 2021), public policies and initiatives for better environmental management for competitiveness (Zameer et al., 2022) to align MSMEs with the 2030 SDGs (CEPAL, 2021), environmental standards such as ISO 14001 (Bashir et al., 2022), and support and training programs (Global Reporting Initiative, 2021). Our study shows that understanding the effect of the MSMEs' context (Arco-Castro et al., 2023; P. A. Nguyen et al., 2020; Nogueira et al., 2023) helps explain the different and contradictory evidence in the related literature (Amini and Dal Bianco, 2017). Policymakers and business owners still need to explore appropriate strategies to encourage the adoption of these practices; thus, researchers, mainly from emerging countries, have a reason to contend by promoting studies in neighboring countries. However, through innovation, environmental practices can mediate the effect of digitalization on competitiveness. Therefore, environmental policies may be conceived not only as compliance practices but also as a mechanism to innovate along the value chain of the organization, resulting in competitiveness improvement. In this vein, policymakers need to develop environmental policies that promote environmentally oriented innovation activities.

The limitations of our study represent an opportunity for future research. We present static and transverse photography, as well as a quantitative view of reality; therefore, it is suggested to promote longitudinal and qualitative studies to delve more deeply into the subject.

#### Data availability statement

Data subject to third-party restrictions.

#### Ethical statement

Personal data is under the Data Protection Act.

#### Declaration of competing interest

The authors certify that they do not have any kind of conflict of interest.

#### References

- Abdel-Maksoud, A., Jabbour, M., Abdel Kader, M., 2020. Stakeholder pressure, eco-control systems, and firms' performance: empirical evidence from UK manufacturers. *Account. Forum* 45 (1), 30–57. <https://doi.org/10.1080/01559982.2020.1827697>.
- Adomako, S., Ning, E., Adu-Ameyaw, E., 2021. Proactive environmental strategy and firm performance at the bottom of the pyramid. *Bus. Strat. Environ.* 30 (1), 422–431. <https://doi.org/10.1002/bse.2629>.
- AECA, 1988. *La Competitividad De La Empresa: Concepto, Características Y Factores Determinantes. Principios De Organización De Empresas, Documento No4. Asociación Española de Contabilidad y Administración de Empresas.*
- Agostini, L., Galati, F., Gastaldi, L., 2020. The digitalization of the innovation process: challenges and opportunities from a management perspective. *Eur. J. Innovat. Manag.* 23 (1), 1–12. <https://doi.org/10.1108/EJIM-11-2019-0330>.
- Al-Hanakta, R., Illés, B.C., Dunay, A., Abdissa, G.S., Abdi Khalife, M., 2021. The effect of innovation on small and medium enterprises: a bibliometric analysis. *Visegrad J. Bioecon. Sustain. Dev.* 10 (1), 35–50. <https://doi.org/10.2478/vjbsd-2021-0008>.

- Al-Sharafi, M.A., Iranmanesh, M., Al-Emran, M., Alzahrani, A.I., Herzallah, F., Jamil, N., 2023. Determinants of cloud computing integration and its impact on sustainable performance in SMEs: an empirical investigation using the SEM-ANN approach. *Heliyon* 9 (5), e16299. <https://doi.org/10.1016/j.heliyon.2023.e16299>.
- Alraja, M.N., Imran, R., Khashab, B.M., Shah, M., 2022. Technological innovation, sustainable green practices and SMEs sustainable performance in times of crisis (COVID-19 pandemic). *Inf. Syst. Front.* 24 (4), 1081–1105. <https://doi.org/10.1007/s10796-022-10250-z>.
- Amini, C., Dal Bianco, S., 2017. Corporate social responsibility and Latin American firm performance. *Corp. Gov. Int. J. Bus. Soc.* 17 (3), 403–445.
- Arco-Castro, M.L., López-Pérez, M.V., Macías-Guillén, A., Rodríguez-Ariza, L., 2023. The role of socially responsible investors in environmental performance. An analysis of proactive and reactive practices. *J. Clean. Prod.* 419 (December 2022). <https://doi.org/10.1016/j.jclepro.2023.138279>.
- Ardito, L., Raby, S., Albino, V., Bertoldi, B., 2021. The duality of digital and environmental orientations in the context of SMEs: implications for innovation performance. *J. Bus. Res.* 123 (February 2020), 44–56. <https://doi.org/10.1016/j.jbusres.2020.09.022>.
- Avermaete, T., Viaene, J., Morgan, E.J., Crawford, N., 2003. Determinants of innovation in small food firms. *Eur. J. Innovat. Manag.* 6 (1), 8–17. <https://doi.org/10.1108/14601060310459163>.
- Ayuso, S., Navarrete-Báez, F.E., 2018. How does entrepreneurial and international orientation influence SMEs' commitment to sustainable development? Empirical evidence from Spain and Mexico. *Corp. Soc. Responsib. Environ. Manag.* 25 (1), 80–94. <https://doi.org/10.1002/csr.1441>.
- Bashir, H., Ojiako, U., Haridy, S., Shamsuzzaman, M., Musa, R., 2022. Implementation of environmentally sustainable practices and their association with ISO 14001 certification in the construction industry of the United Arab Emirates. *Sustain. Sci. Pract. Pol.* 18 (1), 55–69. <https://doi.org/10.1080/15487733.2021.2022880>.
- Battaglia, D., Neirotti, P., 2022. Dealing with the tensions between innovation and internationalization in SMEs: a dynamic capability view. *J. Small Bus. Manag.* 60 (2), 379–419. <https://doi.org/10.1080/00472778.2020.1711635>.
- Ben Amara, D., Chen, H., 2021. The impact of participative decision-making on eco-innovation capability: the mediating role of motivational eco-innovation factors. *Environ. Dev. Sustain.* 23 (5), 6966–6986. <https://doi.org/10.1007/s10668-020-00900-0>.
- Björkdahl, J., Holmén, M., 2018. Exploiting the control revolution by means of digitalization: value creation, value capture, and downstream movements. *Ind. Corp. Change* 28 (3), 423–436. <https://doi.org/10.1093/icc/dty022>.
- Bouwman, H., Nikou, S., de Reuver, M., 2019. Digitalization, business models, and SMEs: how do business model innovation practices improve performance of digitalizing SMEs? *Technol. Innov. Policy* 43 (9), 101828. <https://doi.org/10.1016/j.telpol.2019.101828>.
- Bu, X., Dang, W.V.T., Wang, J., Liu, Q., 2020. Environmental-orientation-green-supply-chain-management-and-firm-performance-empirical-evidence-from-Chinese-small-and-medium-sized-enterprises. *International Journal of Environmental Research and Public Health*. <https://doi.org/10.3390/ijerph171117>.
- Burchard, C., Maisch, B., 2019. Digitalization needs a cultural change – examples of applying Agility and open innovation to drive the digital transformation. *Proced. CIRP* 84, 112–117. <https://doi.org/10.1016/j.procir.2019.05.009>.
- Cantele, S., Zardini, A., 2020. What drives small and medium enterprises towards sustainability? Role of interactions between pressures, barriers, and benefits. *Corp. Soc. Responsib. Environ. Manag.* 27 (1), 126–136. <https://doi.org/10.1002/csr.1778>.
- Carvalho, A. O. de, Ribeiro, I., Ciriari, C.B.S., Cintra, R.F., 2016. Organizational resilience: a comparative study between innovative and non-innovative companies based on the financial performance analysis. *International Journal of Innovation* 4 (1), 58–69. <https://doi.org/10.5585/iji.v4i1.73>.
- Casalet, M., Stezano, F., 2020. Risks and opportunities for the progress of digitalization in Mexico. *Econ. Innovat. N. Technol.* 29 (7), 689–704. <https://doi.org/10.1080/10438599.2020.1719643>.
- Castillo-Vergara, M., García-Pérez-de-Lema, D., 2021. Product innovation and performance in SMEs: the role of the creative process and risk taking. *Innovation* 23 (4), 470–488. <https://doi.org/10.1080/14479338.2020.1811097>.
- Chatterjee, S., Chaudhuri, R., Vrontis, D., Thrassou, A., Ghosh, S.K., 2021a. Adoption of artificial intelligence-integrated CRM systems in agile organizations in India. *Technol. Forecast. Soc. Change* 168, 120783. <https://doi.org/10.1016/j.techfore.2021.120783>.
- Chatterjee, S., Rana, N.P., Dwivedi, Y.K., Baabdullah, A.M., 2021b. Understanding AI adoption in manufacturing and production firms using an integrated TAM-TOE model. *Technol. Forecast. Soc. Change* 170 (May), 120880. <https://doi.org/10.1016/j.techfore.2021.120880>.
- Chege, S.M., Wang, D., 2020. The influence of technology innovation on SME performance through environmental sustainability practices in Kenya. *Technol. Soc.* 60 (June 2019), 101210. <https://doi.org/10.1016/j.techsoc.2019.101210>.
- Chenhall, R.H., Langfield-Smith, K., 2007. Multiple perspectives of performance measures. *Eur. Manag. J.* 25 (4), 266–282. <https://doi.org/10.1016/j.emj.2007.06.001>.
- Ciampi, F., Demi, S., Magrini, A., Marzi, G., Papa, A., 2021. Exploring the impact of big data analytics capabilities on business model innovation: the mediating role of entrepreneurial orientation. *J. Bus. Res.* 123, 1–13. <https://doi.org/10.1016/j.jbusres.2020.09.023>.
- Chin, W.W., 1998. The partial least squares approach to structural equation modeling. *Modern Methods for Business Research* 295 (2), 295–336.
- Clemente-Almendros, J.A., González-Cruz, T., Camisón-Haba, S., 2025. Does innovation practices enhance the impact of environmental criteria adoption over entrepreneurial SMEs' performance? *Int. Enterpren. Manag. J.* 21, 18. <https://doi.org/10.1007/s11365-024-01030-z>.
- Comisión Económica para América Latina y el Caribe, 2021. Construir Un Futuro Mejor. Acciones Para Fortalecer La Agenda 2030 Para El Desarrollo Sostenible. In Cepal. CEPAL. [www.cepal.org/apps](http://www.cepal.org/apps).
- Courent, J.M., Chassé, S., Omri, W., 2018. Do entrepreneurial SMEs perform better because they are more responsible? *J. Bus. Ethics* 153 (2), 317–336. <https://doi.org/10.1007/s10551-016-3367-4>.
- Dal Maso, L., Basco, R., Bassetti, T., Lattanzi, N., 2020. Family ownership and environmental performance: the mediation effect of human resource practices. *Bus. Strat. Environ.* 29 (3), 1548–1562. <https://doi.org/10.1002/bse.2452>.
- Danso, A., Adomako, S., Amankwah-Amoah, J., Owusu-Agyei, S., Konadu, R., 2019. Environmental sustainability orientation, competitive strategy and financial performance. *Bus. Strat. Environ.* 28 (5), 885–895. <https://doi.org/10.1002/bse.2291>.
- Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1989. User acceptance of computer technology: a comparison of two theoretical models. *Manag. Sci.* 35 (8), 982–1003. <https://doi.org/10.1287/mnsc.35.8.982>.
- Dehning, B., Richardson, V.J., Zmud, R.W., 2007. The financial performance effects of IT-based supply chain management systems in manufacturing firms. *J. Oper. Manag.* 25 (4), 806–824. <https://doi.org/10.1016/j.jom.2006.09.001>.
- Del Giudice, M., Scuotto, V., Garcia-Perez, A., Messeni Petruzzelli, A., 2019. Shifting wealth II in Chinese economy. The effect of the horizontal technology spillover for SMEs for international growth. *Technol. Forecast. Soc. Change* 145 (September 2017), 307–316. <https://doi.org/10.1016/j.techfore.2018.03.013>.
- Duréndez, A., Ruíz-Palomo, D., García-Pérez-de-Lema, D., Diéguez-Soto, J., 2016. Management control systems and performance in small and medium family firms. *European Journal of Family Business* 6 (1), 10–20. <https://doi.org/10.1016/j.ejfb.2016.05.001>.
- Fonseka, K., Jaharadak, A.A., Raman, M., 2022. Impact of E-commerce adoption on business performance of SMEs in Sri Lanka; moderating role of artificial intelligence. *Int. J. Soc. Econ.* 49 (10), 1518–1531. <https://doi.org/10.1108/IJSE-12-2021-0752>.
- Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. *J. Mark. Res.* 18 (1), 39–50. <https://doi.org/10.20546/jcrar.2016.409.006>.
- Freeman, E.R., 1984. *Strategic Management: a Stakeholder Approach*. Pitman/Ballinger.
- Fu, Q., Sial, M.S., Arshad, M.Z., Comite, U., Thu, P.A., Popp, J., 2021. The inter-relationship between innovation capability and SME performance: the moderating role of the external environment. *Sustainability* 13 (16). <https://doi.org/10.3390/su13169132>.
- Gao, J., Siddik, A.B., Khawar Abbas, S., Hamayun, M., Masukujaman, M., Alam, S.S., 2023. Impact of E-Commerce and digital marketing adoption on the financial and sustainability performance of MSMEs during the COVID-19 pandemic: an empirical study. *Sustainability* 15 (2), 1594. <https://doi.org/10.3390/su15021594>.
- García-Pérez-de-Lema, D., Gálvez-Albarraçin, E.J., Maldonado-Guzmán, G., 2016. Effect of innovation on growth and performance of SMES in the Pacific alliance. An empirical study. *Estud. Gerenciales* 32 (141), 326–335. <https://doi.org/10.1016/j.estger.2016.07.003>.
- García-Pérez-de-Lema, D., Ruíz-Palomo, D., Diéguez-Soto, J., 2021. Analysing the roles of ceo's financial literacy and financial constraints on Spanish SMEs technological innovation. *Technol. Soc.* 64, 101519. <https://doi.org/10.1016/j.techsoc.2020.101519>.

- Garzella, S., Fiorentino, R., Caputo, A., Lardo, A., 2021. Business model innovation in SMEs: the role of boundaries in the digital era. *Technol. Anal. Strateg. Manag.* 33 (1), 31–43. <https://doi.org/10.1080/09537325.2020.1787374>.
- Geisser, S., 1974. A predictive approach to the random effect model. *Biometrika* 61, 101–107. <https://doi.org/10.1093/biomet/61.1.101>.
- Gjergji, R., Vena, L., Sciascia, S., Cortesi, A., 2021. The effects of environmental, social and governance disclosure on the cost of capital in small and medium enterprises: the role of family business status. *Bus. Strat. Environ.* 30 (1), 683–693. <https://doi.org/10.1002/bse.2647>.
- Global Reporting Initiative, 2021. Buenas Prácticas de Sostenibilidad en la MIPYME peruana. Fondo Cooperación Suiza - SECO. <https://www.globalreporting.org/media/neqdy5z1/msmesperu-publications-es.pdf>.
- Gök, O., Peker, S., 2017. Understanding the links among innovation performance, market performance and financial performance. *Review of Managerial Science* 11 (3), 605–631. <https://doi.org/10.1007/s11846-016-0198-8>.
- González-Cruz, T., Clemente-Almendros, J.A., Puig-Denia, A., 2021. Family governance systems: the complementary role of constitutions and councils. *Economic Research-Ekonomska Istraživanja* 34 (1), 3139–3165. <https://doi.org/10.1080/1331677X.2020.1867603>.
- Gošnik, D., Kavčič, K., Meško, M., Milost, F., 2023. Relationship between changes in the business environment, innovation strategy selection and firm's performance: empirical evidence from Slovenia. *Adm. Sci.* 13 (4). <https://doi.org/10.3390/admsci13040099>.
- Gunday, G., Ulusoy, G., Kilic, K., Alpkan, L., 2011. Effects of innovation types on firm performance. *Int. J. Prod. Econ.* 133 (2), 662–676. <https://doi.org/10.1016/j.ijpe.2011.05.014>.
- Hair, J.F., Hult, G.T.M., Ringle, C., Sarstedt, M., 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage Publications.
- Hayes, A.F., Scharkow, M., 2013. The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: does method really matter? *Psychol. Sci.* 24 (10), 1918–1927. <https://doi.org/10.1177/0956797613480187>.
- Heavin, C., Power, D.J., 2018. Challenges for digital transformation – towards a conceptual decision support guide for managers. *J. Decis. Syst.* 27 (1), 38–45. <https://doi.org/10.1080/12460125.2018.1468697>.
- Henseler, J., Ringle, C.M., Sarstedt, M., 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Market. Sci.* 43 (1), 115–135. <https://doi.org/10.1007/s11747-014-0403-8>.
- Horváth, D., Szabó, R.Z., 2019. Driving forces and barriers of industry 4.0: do multinational and small and medium-sized companies have equal opportunities? *Technol. Forecast. Soc. Change* 146, 119–132. <https://doi.org/10.1016/j.techfore.2019.05.021>.
- Hu, L., Bentler, P.M., 1998. Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. *Psychol. Methods* 3, 424–453.
- Hu, L.T., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct. Equ. Model.* 6 (1), 1–55. <https://doi.org/10.1080/10705519909540118>.
- Ismail, I.J., 2022. Entrepreneurs' competencies and sustainability of small and medium enterprises in Tanzania. A mediating effect of entrepreneurial innovations. *Cogent Business & Management* 9 (1), 2111036. <https://doi.org/10.1080/23311975.2022.2111036>.
- Jansson, J., Nilsson, J., Modig, F., Hed Vall, G., 2017. Commitment to sustainability in small and medium-sized enterprises: the influence of strategic orientations and management values. *Bus. Strat. Environ.* 26 (1), 69–83. <https://doi.org/10.1002/bse.1901>.
- Jones, R.A., Jimmieson, N.L., Griffiths, A., 2005. The impact of organizational culture and reshaping. *J. Manag. Stud.* 42 (2), 361–386.
- Jun, W., Nasir, M.H., Yousaf, Z., Khattak, A., Yasir, M., Javed, A., Shirazi, S.H., 2022. Innovation performance in digital economy: does digital platform capability, improvisation capability and organizational readiness really matter? *Eur. J. Innovat. Manag.* 25 (5), 1309–1327. <https://doi.org/10.1108/EJIM-10-2020-0422>.
- Kamichi Miyashiro, M.J., 2023. La realidad de la informalidad en el Perú previo a su bicentenario. *Desde El Sur* 15 (1), e0013. <https://doi.org/10.21142/des-1501-2023-0013>.
- Khattak, A., Tabash, M.I., Yousaf, Z., Radulescu, M., Nassani, A.A., Haffar, M., 2022. Towards innovation performance of SMEs: investigating the role of digital platforms, innovation culture and frugal innovation in emerging economies. *Journal of Entrepreneurship in Emerging Economies* 14 (5), 796–811. <https://doi.org/10.1108/JEEE-08-2021-0318>.
- Khin, S., Ho, T.C.F., 2019. Digital technology, digital capability and organizational performance: a mediating role of digital innovation. *Int. J. Innovat. Sci.* 11 (2), 177–195. <https://doi.org/10.1108/IJIS-08-2018-0083>.
- Kindermann, B., Beutel, S., García de Lomana, G., Stresse, S., Bendig, D., Brettel, M., 2021. Digital orientation: conceptualization and operationalization of a new strategic orientation. *Eur. Manag. J.* 39 (5), 645–657. <https://doi.org/10.1016/j.emj.2020.10.009>.
- Klewitz, J., Hansen, E.G., 2014. Sustainability-oriented innovation of SMEs: a systematic review. *J. Clean. Prod.* 65, 57–75. <https://doi.org/10.1016/j.jclepro.2013.07.017>.
- Le, T.T., 2022. Corporate social responsibility and SMEs' performance: mediating role of corporate image, corporate reputation and customer loyalty. *Int. J. Emerg. Mark.* (January). <https://doi.org/10.1108/IJOEM-07-2021-1164>.
- Lee, M.T., Suh, I., 2022. Understanding the effects of environment, social, and governance conduct on financial performance: arguments for a process and integrated modelling approach. *Sustainable Technology and Entrepreneurship* 1 (1), 100004. <https://doi.org/10.1016/j.stae.2022.100004>.
- León-Gómez, A., Santos-Jaén, J.M., Ruiz-Palomo, D., Palacios-Manzano, M., 2022. Disentangling the impact of ICT adoption on SMEs performance: the mediating roles of corporate social responsibility and innovation. In *Oeconomia Copernicana* 13 (Issue 3). <https://doi.org/10.24136/oc.2022.024>.
- Li, S., Gao, L., Han, C., Gupta, B., Alhalabi, W., Almakdi, S., 2023. Exploring the effect of digital transformation on firms' innovation performance. *Journal of Innovation & Knowledge* 8 (1), 100317. <https://doi.org/10.1016/j.jik.2023.100317>.
- Lin, J.Y., Yang, Z., Li, Y., Zhang, Y., 2022. Development strategy and the MSMEs finance gap. *Journal of Government and Economics* 5 (February), 100034. <https://doi.org/10.1016/j.jge.2022.100034>.
- López-Mielgo, N., Montes-Peón, J.M., Vázquez-Ordás, C.J., 2009. Are quality and innovation management conflicting activities? *Technovation* 29 (8), 537–545. <https://doi.org/10.1016/j.technovation.2009.02.005>.
- Martelo-Landroguez, S., Cegarra Navarro, J.G., Cepeda-Carrion, G., 2019. Uncontrolled counter-knowledge: its effects on knowledge management corridors. *Knowl. Manag. Res. Pract.* 17 (2), 203–212. <https://doi.org/10.1080/14778238.2019.1599497>.
- Matt, C., Hess, T., Benlian, A., 2015. Digital transformation strategies. *Business and Information Systems Engineering* 57 (5), 339–343. <https://doi.org/10.1007/s12599-015-0401-5>.
- Mitra, S., 2022. An exploratory study of sustainability and firm performance for Indian manufacturing small and medium enterprises. *J. Clean. Prod.* 371 (July 2021), 133705. <https://doi.org/10.1016/j.jclepro.2022.133705>.
- Muafi Muafi, M.S., 2023. Green logistic and absorptive capacity on business sustainability: the mediating role of circular economy implementation. *J. Ind. Eng. Manag.* 16 (2), 275–293. <https://doi.org/10.3926/jiem.5283>.
- Ndubisi, N.O., Zhai, X.A., Lai, K.H., 2021. Small and medium manufacturing enterprises and Asia's sustainable economic development. *Int. J. Prod. Econ.* 233, 107971.
- Nguyen, P.A., Kecskés, A., Mansi, S., 2020. Does corporate social responsibility create shareholder value? The importance of long-term investors. *J. Bank. Finance* 112. <https://doi.org/10.1016/j.jbankfin.2017.09.013>.
- Nitzl, C., Roldan, J.L., Cepeda, G., 2016. Mediation analysis in partial least squares path modeling. *Ind. Manag. Data Syst.* 116 (9), 1849–1864. <https://doi.org/10.1108/imds-07-2015-0302>.
- Nogueira, E., Gomes, S., Lopes, J.M., 2023. A meta-regression analysis of environmental sustainability practices and firm performance. *J. Clean. Prod.* 426 (July). <https://doi.org/10.1016/j.jclepro.2023.139048>.
- Ojeda-Joya, J., Romero, J.V., 2023. Global uncertainty shocks and exchange-rate expectations in Latin America. *Econ. Modell.* 120. <https://doi.org/10.1016/j.econmod.2022.106185> (December 2022).
- Organización para la Cooperación y el Desarrollo Económicos, 2019. *Perspectivas económicas de América Latina 2019: desarrollo en transición*. Centro de Desarrollo OCDE. [https://www.oecd.org/dev/americas/Overview\\_SP-Leo-2019.pdf](https://www.oecd.org/dev/americas/Overview_SP-Leo-2019.pdf).
- Pakurár, M., Khan, M.A., Benedek, A., Oláh, J., 2020. The impact of green practices, cooperation and innovation on the performance of supply chains using statistical method of meta-analysis. *Journal of International Studies* 13 (3), 111–128. <https://doi.org/10.14254/2071-8330.2020/13-3/8>.

- Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., 2003. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J. Appl. Psychol.* 88 (5), 879–903. <https://doi.org/10.1037/0021-9010.88.5.879>.
- Radicić, D., Petković, S., 2023. Impact of digitalization on technological innovations in small and medium-sized enterprises (SMEs). *Technol. Forecast. Soc. Change* 191 (January). <https://doi.org/10.1016/j.techfore.2023.122474>.
- Rahman, M., Mordi, C., 2018. Factors influencing E-HRM implementation in government organisations. *J. Enterprise Inf. Manag.* 31 (2), 247–275.
- Rehman, S.U., Bresciani, S., Yahiaoui, D., Giacosa, E., 2022. Environmental sustainability orientation and corporate social responsibility influence on environmental performance of small and medium enterprises: the mediating effect of green capability. *Corp. Soc. Responsib. Environ. Manag.* 29 (6), 1954–1967. <https://doi.org/10.1002/csr.2293>.
- Ringle, C.M., Wende, S., Becker, J.M., 2022. Smartpls 4. Boenningstedt: SmartPLS GmbH. <http://www.smartpls.com>.
- Rogers, E.M., 1983. *Diffusion of Innovations*. Free Press.
- Roman, A., Rusu, V.D., 2022. Digital technologies and the performance of small and medium enterprises. *Studies in Business and Economics* 17 (3), 190–203. <https://doi.org/10.2478/sbe-2022-0055>.
- Rosenbusch, N., Brinckmann, J., Bausch, A., 2011. Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *J. Bus. Ventur.* 26 (4), 441–457. <https://doi.org/10.1016/j.jbusvent.2009.12.002>.
- Roxas, B., Ashill, N., Chadee, D., 2017. Effects of entrepreneurial and environmental sustainability orientations on firm performance: a study of small businesses in the Philippines. *J. Small Bus. Manag.* 55, 163–178. <https://doi.org/10.1111/jsbm.12259>.
- Rupeika-Apoga, R., Petrovska, K., Bule, L., 2022. The effect of digital orientation and digital capability on digital transformation of SMEs during the COVID-19 pandemic. *Journal of Theoretical and Applied Electronic Commerce Research* 17 (2), 669–685. <https://doi.org/10.3390/jtaer17020035>.
- Rusu, L., Viscusi, G., 2017. Information technology governance in public organizations. In: Rusu, L., Viscusi, G. (Eds.), *Integrated Series in Information Systems*, first ed. Springer, Cham.
- Sándor, Á., Gubán, Á., 2021. A measuring tool for the digital maturity of small and medium-sized enterprises. *Manag. Prod. Eng. Rev.* 12 (4), 133–143. <https://doi.org/10.24425/MPER.2021.140001>.
- Saruchera, F., Mpunzi, S., 2023. Digital capital and food agricultural SMEs: examining the effects on SME performance, inequalities and government role. *Cogent Business & Management* 10 (1), 2191304. <https://doi.org/10.1080/23311975.2023.2191304>.
- Scott, J., Scott Armstrong, J., Overton, T.S., 1977. Estimating nonresponse bias in mail surveys. *J. Mark. Res.* 14 (3), 396–402. <https://doi.org/10.2307/3150783>.
- Setyaningrum, R., Muafi, M., 2023. Green human resource management, green supply chain management, green lifestyle: their effect on business sustainability mediated by digital skills. *J. Ind. Eng. Manag.* 16 (1), 1–26. <https://doi.org/10.3926/jiem.4152>.
- Shahadat, M.M.H., Nekmahmud, M., Ebrahimi, P., Fekete-Farkas, M., 2023. Digital technology adoption in SMEs: what technological, environmental and organizational factors influence SMEs' ICT adoption in emerging countries? *Global Business Review*, January. <https://doi.org/10.1177/09721509221137199>.
- Singh, N., Kumar, S., 2023. Evolution and assessment of corporate social performance through the lens of top category journals: a theoretical structural analysis. *Journal of Advances in Management Research*. <https://doi.org/10.1108/JAMR-02-2023-0051> ahead-of-print No. ahead-of-print.
- Šimberová, I., Korauš, A., Schüller, D., Smolíkova, L., Straková, J., Váchal, J., 2022. Threats and opportunities in digital transformation in SMEs from the perspective of sustainability: a case study in the Czech Republic. *Sustainability* 14, 3628. <https://doi.org/10.3390/su14063628>.
- Simmou, W., Govindan, K., Sameer, I., Hussainey, K., Simmou, S., 2023. Doing good to be green and live clean! - linking corporate social responsibility strategy, green innovation, and environmental performance: evidence from Maldivian and Moroccan small and medium-sized enterprises. *J. Clean. Prod.* 384 (May 2022), 135265. <https://doi.org/10.1016/j.jclepro.2022.135265>.
- Singh, D., Khamba, J.S., Nanda, T., 2017. Influence of technological innovation on performance of small manufacturing companies. *Int. J. Prod. Perform. Manag.* 66 (7), 838–856. <https://doi.org/10.1108/IJPPM-02-2016-0035>.
- Srisathan, W.A., Ketkaew, C., Naruetharadhol, P., 2023. Assessing the effectiveness of open innovation implementation strategies in the promotion of ambidextrous innovation in Thai small and medium-sized enterprises. *Journal of Innovation & Knowledge* 8 (4), 100418. <https://doi.org/10.1016/j.jik.2023.100418>.
- Stone, M., 1974. Cross-validatory choice and assessment of statistical predictions. *J. Roy. Stat. Soc. B* 36 (2), 111–133.
- Thu, N.T.P., Xuan, V.N., 2023. Factors affecting the performance of small and medium enterprises regarding the sustainable development goals—the case of foreign direct investment firms in Vietnam. *Economies* 11 (3), 72. <https://doi.org/10.3390/economies11030072>.
- Tornatzky, L., Tchell, F., Alok, K.C., 1990. *The Process of Technological Innovation*. The Free Press.
- United Nation Global Compact, 2016. *SDG Compass. La guía para la acción empresarial en los ODS*. *SDG Compass*.
- Valdez-Juárez, L.E., Castillo-Vergara, M., Ramos-Escobar, E.A., 2022. Innovative business strategies in the face of COVID-19: an approach to open innovation of SMEs in the Sonora region of Mexico. *J. Open Innov. Technol. Mark. Complex.* 8 (1), 47. <https://doi.org/10.3390/joitmc8010047>.
- Van Auken, H., Madrid-Guijarro, A., Garcia-Perez-de-Lema, D., 2008. Innovation and performance in Spanish manufacturing SMEs. *Int. J. Enterpren. Innovat. Manag.* 8 (1), 36–56. <https://doi.org/10.1504/IJEIM.2008.018611>.
- Van Nguyen, T., Pham, H.T., Ha, H.M., Tran, T.T.T., 2022. An integrated model of supply chain quality management, industry 3.5 and innovation to improve manufacturers' performance—a case study of Vietnam. *Int. J. Logist. Res. Appl.* 1–23. <https://doi.org/10.1080/13675567.2022.2059457>.
- Virglerová, Z., Kramoliš, J., Capolupo, N., 2022. The impact of social media use on the internationalisation of SMEs. *Economics and Sociology* 15 (1), 268–283. <https://doi.org/10.14254/2071-789X.2022/15-1/17>.
- Wang, Y., 2022. The impact of digital strategic orientation on enterprise sustainable performance against the background of 2030 sustainable performance goal. *Math. Probl. Eng.* <https://doi.org/10.1155/2022/2263222>, 2022.
- Wang, M., Li, Y., Li, J., Wang, Z., 2021. Green process innovation, green product innovation and its economic performance improvement paths: a survey and structural model. *J. Environ. Manag.* 297, 113282. <https://doi.org/10.1016/j.jenvman.2021.113282>.
- Yang, J., Zhang, F., Jiang, X., Sun, W., 2015. Strategic flexibility, green management, and firm competitiveness in an emerging economy. *Technol. Forecast. Soc. Change* 101, 347–356. <https://doi.org/10.1016/j.techfore.2015.09.016>.
- Yang, Y., Yang, X., Xiao, Z., Liu, Z., 2022. Digitalization and environmental performance: an empirical analysis of Chinese textile and apparel industry. *J. Clean. Prod.* 382 (January). <https://doi.org/10.1016/j.jclepro.2022.135338>.
- Yun, J.J., Jeong, E.S., Lee, Y.K., Kim, K.H., 2018. The effect of open innovation on technology value and technology transfer: a comparative analysis of the automotive, robotics, and aviation industries of Korea. *Sustainability* 10 (7), 1–16. <https://doi.org/10.3390/su10072459>.
- Zameer, H., Wang, Y., Yasmeen, H., Mubarak, S., 2022. Green innovation as a mediator in the impact of business analytics and environmental orientation on green competitive advantage. *Manag. Decis.* 60 (2), 488–507. <https://doi.org/10.1108/MD-01-2020-0065>.