Received: 3 August 2023 | Revised: 21 March 2024 | Accepted: 29 April 2024

DOI: 10.1002/csr.2838

RESEARCH ARTICLE

Corporate Social Responsibility and Environmental Management

WILEY

Does digitalisation enable small and medium-sized enterprises to become more sustainable?

Laura Trueba-Castañeda[1,2] | Francisco M. Somohano-Rodríguez[1,2] | Begoña Torre-Olmo[1,2]

[1]Universidad de Cantabria, Santander, Spain

[2]Santander Financial Institute (SANFI), Santander, Spain

Correspondence
Laura Trueba-Castañeda, Universidad de Cantabria, Avda. Los Castros S/N, 39005 Santander, Cantabria, Spain.
Email: laura.trueba@unican.es

Funding information
Santander Financial Institute

Abstract

Environmental sustainability is currently of paramount importance worldwide. In this context, digitalisation has emerged as a transformative force in the business world, and small and medium-sized enterprises (SMEs) need to adapt to sustainability and digitalisation without neglecting performance. The objective of the study is to establish the connection between the positive financial outcomes resulting from digital capabilities and the ability of SMEs to become environmentally sustainable. Additionally, a theoretical framework has been developed to explain the results from the analysis of a reflexive structural equation model using data collected from 975 Spanish SMEs. The results indicate that investing in digitalisation allows companies to become more environmentally responsible and achieve qualitative growth in terms of reputation. Furthermore, digitalisation promotes quantitative growth through improved efficiency, cost savings, enhanced product quality and increased customer satisfaction. Lastly, the study model demonstrates that profitable companies are more likely to be sustainable.

KEYWORDS
digitalisation, efficiency, performance, SDGs, SMEs, sustainability

1 | INTRODUCTION

Sustainability refers to a development model that meets the needs of the present without compromising the ability of future generations to meet their own needs. It is a holistic approach that considers the social, environmental, and economic repercussions of the actions and decisions made today. Specifically, environmental sustainability has emerged as a predominant concern for diverse stakeholders, ranging from businesses and governments to civil and social organisations, scholars and individuals worldwide (Chege & Wang, 2020). Managing sustainability, particularly environmental sustainability, is an increasingly complex challenge, as recognised by scholars and experts (Amel-Zadeh & Serafeim, 2018; Friede et al., 2015).

Corporate Social Responsibility (CSR) or 'sustainable' activities and policies are company actions that assess, manage and govern firms' responsibilities for and impacts on society and the environment. The concept of sustainability has reached paramount importance in our society, exemplified by the idea of 'driving change' (Christensen et al., 2021). Intense demographic and economic growth in an environment of limited resources is a great challenge for public policy-makers, compelling actions that could be considered intrusive since their enforcement frequently involves collecting information about individuals (Kuh, 2011).

In this scenario, there is a growing demand for information about CSR, as well as firms' environmental, social and governance (ESG) activities and policies. In many ways, sustainability intersects with CSR (Nave & Ferreira, 2019). Furthermore, increasing funds in sustainable investments, better access to financial resources and markets and investors' vigilance have led to more CSR disclosures, enhancing firms' contributions to social welfare and their reputation. Promoting sustainable development is equivalent to exercising long-term social responsibility (López-Concepción et al., 2022).

There is a current debate about the meaning of environmental sustainability, how to achieve it and, by extension, about non-financial information and 'levels of voluntariness', especially in SMEs. A company is environmentally sustainable when it develops its activity in a responsible and balanced way, in addition to having a financial strategy for business profitability (Ghisellini et al., 2016).

Incentives and barriers have been extensively analysed in the literature, including the topic's key players, such as regulators (e.g. the European Commission's European Financial Reporting Advisory Group (EFRAG)) and practitioners represented by their professional organisations (Ortiz-Martínez et al., 2023). It is necessary to develop a framework or model explaining how SMEs (or companies in general) can integrate sustainability into their CSR strategies and establish a non-financial information disclosure system, such as the UN's 2030 Agenda and Sustainable Development Goals (SDGs), facilitating implementation and monitoring with consistent, comparable and material information (Somohano-Rodríguez et al., 2023). Presently, the framework of sustainable development comprises 17 SDGs, encompassing 169 targets and over 500 indicators. These goals represent a universal call to action to adopt measures that eradicate poverty, preserve the environment and ensure peace and prosperity for all (Pedersen, 2018). Many of these goals are related to the environment, as environmental sustainability is a cross-cutting issue: Goal 7: Affordable and Clean Energy, Goal 11: Sustainable Cities and Communities, Goal 12: Responsible Consumption and Production, Goal 13: Climate Action, and Goal 15: Life on Land (United Nations, 2023a; 2023b).

The discourse surrounding corporate sustainability has awakened significant interest among academics, professionals and regulators (Orazalin & Baydauletov, 2020), primarily since SMEs produce approximately 60% of the total corporate greenhouse gas emissions in the European Union (European Commission, 2022). In Spain, SMEs produce approximately 67% of emissions (United Nations, 2023a; 2023b). Therefore, active SME participation is a fundamental factor in achieving the SDGs (Bradford & Fraser, 2008).

Sustainability is a transformative force, as digitalisation. Digital transformation is a multifaceted process that encompasses the renewal of processes, products, services, customer relationships, employee training, supplier engagements and, most importantly, a change in the business model (Somohano-Rodríguez & Madrid-Guijarro, 2022). This process facilitates better coordination among operations, potentially adding value by improving user experiences. Digitalisation provides a pathway to augmenting competitive advantages (Melo et al., 2023).

The COVID-19 pandemic has increased the probability of companies adopting digital technologies to manage changes in customer behaviour, market balance and operations and supply chains. Sustainable development, the pathway to sustainability, has become more participatory and inclusive (Isensee et al., 2020; Juergensen et al., 2020), involving initiatives such as integrating SMEs in waste management, developing circular economies, improving social and environmental sustainability and taking advantage of stimulus packages like the EU's Recovery and Resilience Facility (RRF) funding of the Next Generation EU programme, which promotes digitalisation (Bai et al., 2021).

However, despite RRF funding for digitalisation and sustainability and the immense potential of Industry 4.0 enabling technologies, Spanish SMEs have not fully capitalised on these advanced technologies, leading to a noticeable digitalisation gap between SMEs and larger enterprises. Acknowledging this disparity, Heavin and Power (2018) emphasise the importance of SMEs' active involvement and leadership to successfully implement digitalisation. Indeed, managers have become increasingly aware of the need to foster a digitalisation environment that bolsters their company's competitiveness while mitigating its environmental impact. Embracing digital transformation requires more than just incorporating technology; it often involves making a cultural shift, aligning with customer needs, cultivating a pool of skilled professionals well-versed in digital transformation and securing the necessary financial resources for its effective implementation (Matt et al., 2015).

In the sustainability literature, firm performance has traditionally been associated with financial metrics such as profitability and competitiveness, capturing the financial health of a company at the firm level (De-Pablos-Heredero et al., 2018). However, in this research, we focus on efficiency, a robust measure of business performance (Cummins & Weiss, 2000). As a foundational concept, efficiency involves achieving the desired outcomes without unnecessarily wasting energy, resources, effort, time or financial means. It encompasses two critical dimensions: technical efficiency, which delves into the physical aspects (resources) of performance, and economic efficiency, which involves cost-related considerations (Chen et al., 2015). Using efficiency as a performance metric provides a more holistic view of a firm's abilities and resilience, particularly in navigating market downturns and crises.

In this new scenario, SMEs face a dual challenge in today's world, as they need to adapt to sustainability and digital transformation without neglecting performance (Osburg & Lohrmann, 2017). The two transitions are closely related, as digital solutions can help SMEs become more sustainable. Thus, more and more SMEs are making the transition to sustainability, recognising it as an opportunity that must be seized and investing in digitalisation processes (Van der Velden, 2018). Digital transformation and the transition to sustainability are seen as key factors to incorporate into an organisation's strategy, as they can improve company performance (Isensee et al., 2020).

Many studies have shown the positive effect of sustainability on firms' performance and profitability (Magon et al., 2018), the majority of which are positive. However, The United Nations Environment

Programme (UNEP, 2023) has advised about the higher costs of sustainable products. Yang et al. (2011) explained that organisations may respond to regulations, policy and public pressure by taking steps to improve environmental performance that reduce the direct negative effect of environmental management practices on financial performance. The high costs of ecological products and services are a barrier in public procurement (Palm & Backman, 2017). In contrast, according to Zhu et al. (2008) good environmental performance should result in manufacturing companies' ability to reduce waste, pollution, hazardous material consumption and environmental accidents and improve resource efficiency.

The Resource-Based View (RBV) focuses on resources, capabilities and strategic assets as its core concepts (Barney, 1991). Environmental sustainability capabilities can be strategic resources with a positive impact on environmental performance (Dzhengiz & Niesten, 2020), either in terms of the financial aspects or attractiveness to customers (Del Giudice et al., 2017). Specifically, the lack of adequate financial resources deters managers from implementing environmental awareness in SMEs (Gadenne et al., 2009). Since the positive effects of digitisation have been demonstrated in the literature, our research aims to connect the positive performance resulting from IT capabilities and SMEs' ability to become more environmentally sustainable. To our knowledge, this is a research gap that has not been filled. Thus, to address these pertinent issues, this study has sought answers to the following key questions: Does digitalisation promote sustainability in SMEs? Does digitalisation enhance SME performance? Does it enable the positive performance of SMEs to become more sustainable?

An empirical analysis was conducted using a sample of 975 Spanish SMEs, considering certain Industry 4.0 technologies, digitalisation strategies, SME performance indicators and benefits and regulations related to sustainability. Due to the challenges faced by SMEs when adopting technological advances, including a lack of knowledge and financial resources, this study focused on Big Data, Corporate Intranet and Enterprise Resource Planning (ERP) systems. Digitalisation strategies were measured using eight questions concerning employees, managers, process automation and resource availability. Performance was assessed through measures of product quality, customer satisfaction, operational efficiency, adaptability to change and employee satisfaction. The benefits of sustainability were evaluated in terms of profitability, competitive advantage, motivation and satisfaction. Sustainability regulations were examined based on five elements. The fieldwork was conducted over a three-month period, starting in February 2022, and involved phone interviews.

The results indicate that investing in digitalisation allows companies to become more environmentally responsible and achieve qualitative growth in terms of reputation. Furthermore, digital technologies promote quantitative growth through improved efficiency, cost savings, enhanced product quality and increased customer satisfaction. Business success leads to the availability of more financial resources. A successful business tends to generate higher revenues through sales and operations, which, in turn, translates into higher profit margins and an accumulation of capital. Lastly, the study model demonstrates that profitable companies are more likely to be sustainable.

This research contributes to the existing literature in two ways. First, it fills a gap by exploring the connection between digitalisation as a resource, sustainability and the mediating effect of efficiency between these constructs. Secondly, it presents a theoretical framework to explain the results obtained from the model analysis. Widely regarded as a valuable theory, the RBV provides a framework for understanding how value is created in companies through digitalisation (Hautala-Kankaanpää, 2022) and environmentally sustainable initiatives (Sarkis et al., 2010). Leveraging the RBV Theory, Wu et al. (2008) investigated the relationship between operational performance and an environmental management system, while Sarkis et al. (2010) recognised its significance in examining environmental practices.

The structure of this paper is as follows: Section 2 provides the theoretical framework for digitalisation, sustainability and performance, focusing on their applications for SMEs. Section 3 introduces the research methodology, sample and data collection processes. Section 4 presents the analysis and results. Section 5 outlines the discussion and theoretical and managerial implications. Section 6 provides the conclusions, limitations and future lines of research.

2 | LITERATURE REVIEW

2.1 | Digitalisation and sustainability

Analytics pervades our digital world, from everyday gadgets to expansive applications, evolving from an afterthought to a fundamental necessity in our data-driven era. Some companies base their entire operations on collecting, analysing and acting on data, recognising its pivotal role. To excel, intelligence must be seamlessly integrated into the customers' journey, products, operations and services. Across organisations, various departments increasingly turn to data and analytics for insights and influence (Król & Zdonek, 2020). Business intelligence and analytics encompass technology, applications and processes aimed at gathering, storing and deciphering data to aid in making informed business decisions (Olszak & Mach-Król, 2018).

Evaluating an organisation's ability to leverage data for innovation and competitive advantage requires understanding its position in the analytics continuum. Data analytics spans five categories, differentiated by tools, techniques and approaches. Descriptive analytics unveils insights and patterns within data, while Diagnostic analytics delves into historical data to uncover relationships, leaving interpretations to managers. Predictive analytics involves modelling and forecasting, while Prescriptive analytics uses machine learning to recommend actions for desired outcomes. Lastly, Cognitive analytics uses artificial intelligence (AI) to automate decision-making and enhance decision efficiency (Krol & Zdonek, 2020).

Due to the challenges faced by SMEs when adopting technological advances, including a lack of knowledge and financial resources, this article focuses on Big Data and the two initial technology categories: corporate intranet as Descriptive analysis and ERP systems for Diagnostic analysis (Limpeeticharoenchot et al., 2022). The corporate intranet is a private network used to securely share information and

computing resources among employees. This technology has been praised for its role in resolving various technology challenges, ranging from faster information system development and data access from legacy systems to integrating incompatible systems and moving closer to a 'paperless office'. In addition, intranets facilitate workflow and project management, serving as a platform for process redesign (Scott, 1998). ERP platforms consolidate essential business functions, such as manufacturing, inventory management, accounting, human resources and supply chain management, amalgamating them into cohesive systems designed for automation and analytics (Kunduru, 2023).

In today's dynamic landscape, digital transformation and sustainability have become challenges for SMEs and academics. The advent of digitalisation has resulted in a plethora of possibilities and research avenues, signifying a fundamental shift in how these enterprises create and capture value (Bouwman et al., 2019). Seele and Lock (2017) underline the importance of analysing the potential and threats of digitalisation in today's global sustainable development. How can these digital tools effectively contribute to achieving sustainable development?

The imperative for environmental protection and sustainable practices has reached a critical juncture. Companies are facing mounting pressure to elevate their corporate sustainability performance (Hanaysha et al., 2022). For our research, we adopt the definition put forth by Younis et al. (2016), where environmental performance encompasses a company's capacity to curtail polluting emissions and waste while reducing material consumption and minimising environmental accidents.

The interplay between digitalisation and sustainability is a dynamic and multidisciplinary area of paramount importance for researchers (Brenner & Hartl, 2021). As both fields continue to advance, the synergies between them hold great promise for shaping a more sustainable future. Despite a growing body of literature exploring the connection between digitalisation and sustainable practices, the genuine contributions of digital paradigms to diverse facets of sustainability are not fully understood, often due to the isolated treatment of these two critical issues (Isensee et al., 2020).

Some studies have found that digitalisation is a resource with positive implications for sustainability (Agrawal et al., 2022). The United Nations (2020) has also emphasised the importance of sustainability and the role of digitalisation in it. In 2015, the UN General Assembly highlighted the cross-cutting contribution of digital technology to the newly define Sustainable Development Goals since digitalisation can accelerate progress towards sustainability.

Divergent viewpoints have emerged concerning digital transformation and sustainability, suggesting a nuanced and even contradictory relationship (Beier et al., 2020). While some studies highlight the potential of digitalisation to drive environmental value creation, others present a contrasting perspective, questioning its benefits (Ardito et al., 2021). Chen et al. (2020) assert that the negative relationship between digitalisation and sustainability stems primarily from heightened resource and energy consumption, as well as the increased waste and emissions associated with manufacturing, using and disposing of technology. Considering this, we propose the following hypothesis:

H1. Digitalisation promotes sustainability in SMEs.

2.2 | Digitalisation and SME performance

The value of digitalisation has attracted significant attention among professionals and academics due to the evident benefits it brings (Scuotto et al., 2017). The need for implementing digital technologies has been intensified by the digitalisation race pushed by the fourth industrial revolution (Maroufkhani et al., 2023). Particularly for SMEs, digitalisation has the potential to initiate a transformative process, compelling companies to recognise the need to digitise their processes, products and services. Indeed, digitalisation is one of the most suitable and readily available options for SMEs to drive innovation and fuel growth (De-Pablos-Heredero et al., 2018). Enhancing business performance is a critical objective for organisations, and the OECD (2017) underlines the myriad benefits of digitalisation in this regard. These advantages include improved access to skills and talent, broader market reach, increased financing opportunities, enhanced collaboration and communication and reduced bureaucratic barriers. All of these aspects mean commercial success and more financial resources (Bourletidis & Triantafyllopoulos, 2014). Moreover, technical efficiency, described as a pivotal outcome of Industry 4.0, becomes possible due to the enabling technologies that digitalisation encompasses (Oláh et al., 2020).

Amidst the existing studies on the subject, doubts persist concerning the positive impact of digitalisation on firm performance. A notable limitation in the literature is the scarcity of studies based on accounting measures, largely due to the challenges associated with conducting causal analyses (Somohano-Rodríguez & Madrid-Guijarro, 2022). According to Kádárová et al. (2023), although research on digitalisation and its implications for SMEs is expanding, the specific influence on performance measures has not been established. This gap underscores the necessity for more rigorous scientific studies that systematically examine the impact of digitalisation on different facets of SME performance, like productivity, innovation, market competitiveness and customer satisfaction. Scientific validation requires empirical evidence derived from stringent research methodologies, such as quantitative analysis, case studies, surveys or experiments. These studies should gather data on SMEs' digitalisation initiatives and impartially evaluate their resulting performance. Researchers have failed to provide conclusive evidence regarding the benefits of digitalisation on firm performance (Kohtamäki et al., 2020). As a result, divergent findings have emerged, with some studies reporting a weak or non-existent role (Hanaysha & Alzoubi, 2022), while others assert a direct positive relationship between implementing digital technology and firm performance (Eller et al., 2020). Finally, some studies point to a negative relationship, highlighting the complexities that arise in this context. Lange et al. (2020) argue that the extent to which digitalisation significantly increases efficiency remains unclear due to multiple rebound effects.

Considering the benefits of digitalisation and its potential contributions to firm performance, we anticipate a positive relationship. Therefore, we hypothesise the following:

H2. Digitalisation enhances SME performance.

2.3 | SME performance and sustainability

Growing concerns about environmental impact and governmental pressure have compelled companies to modify their operational approaches in order to comply with environmental regulations and meet the rising customer demand for sustainable products and services (Siegel et al., 2019). Regulation plays an essential role in promoting environmental sustainability by setting standards, incentives and responsibilities that guide the actions of individuals, businesses and governments towards more sustainable practices. Collaboration between the public and private sectors is essential to achieve a balance between economic development and environmental preservation (Ahmed et al., 2022).

Integrating sustainability into practice to enhance environmental performance remains a significant challenge for both academics and businesses (Morioka & de Carvalho, 2016). This relationship primarily comprises three elements in a business: (1) processes and practices, (2) capabilities and (3) offerings.

Processes and practices pertain to production processes (Trumpp et al., 2015). Companies can make their operations more sustainable and profitable by focusing on efficiency (Rothenberg, 2007). Efficiency has a positive effect on SMEs' performance by reducing resource consumption, mitigating climate change, conserving natural resources and promoting sustainable practices (Mondejar et al., 2021). Beyond the foundational commitment to sustainability, a second crucial element is the capabilities essential for business operations, encompassing skilled and aligned human resources for effective decision-making (Grosvold et al., 2014). The level of individual employee satisfaction affects effort, and subsequently performance, all of which produces a constantly operating performance-satisfaction-effort loop (Huang et al., 2015). This is intrinsically linked to the adaptive capacity of the company (Zollo et al., 2013), as well as the ability of its management to implement transformative changes in the company's organisational culture to seamlessly integrate sustainability into the fabric of the business (Pereira-Moliner et al., 2012).

The next vital element of sustainable business is the company's offerings, encompassing its products, services and the quality of both (Gadenne et al., 2012). The transformative potential of sustainable innovation becomes evident by creating innovative products that prioritise reducing environmental impact and embracing the principles of sustainable development, facts that enhance customer satisfaction (Huang et al., 2014). As has been widely acknowledged, innovation plays a pivotal role in driving sustainability, and its impact is magnified when knowledge management systems, open access and collaborative organisational structures facilitate shared value creation and enable sustainable practices to flourish. It is worth noting that sustainable innovation depends on active participation and engagement at all levels of socioeconomic organisations (Guandalini, 2022).

The connection between SME performance and environmental performance has been the subject of extensive research, yet the debate is inconclusive (Úbeda-García et al., 2021). Shahgholian (2019) highlights the challenges of clarifying the relationship between firm performance and environmental performance, attributing the ambiguity to variations in data and methodologies, which often lead to diverse and non-replicable results. Considering this complexity, we propose the following hypothesis:

H3. SME performance enables the implementation of sustainability practices.

Based on the three hypotheses, the research model shown in Figure 1 is defined.

3 | RESEARCH METHOD

3.1 | Sample and data collection

The general sample design was based on the principles of stratified sampling (Neyman, 1934). To achieve this, specific stratification criteria were defined. In this research, the following strata were established: sector (manufacturing, building industry, commerce and consumer services) and size (micro, small and medium-sized companies) (Table 1).

The fieldwork and survey design were conducted in collaboration with the Foundation for Strategic Analysis for the Development of SMEs (FAEDPYME[1]) research group for the Iberoamerican Observatory of SMEs through telephone calls from February to April 2022, resulting in 975 valid questionnaires after data collection and processing. FAEDPYME's aim is to establish a space for collaboration within the economic and social spheres of SMEs at the national and international level to jointly carry out activities and study work, teaching and research.

Given that the final outcome deviates from complete proportionality to the reference population or universe, 268,932 Spanish SMEs in 2022 (from 5 to 249 employees) (INE, 2023), using appropriate scaling factors was necessary to derive the aggregated results. This approach ensures an impartial and comparable process for assessing the sample's suitability to the research goals. However, it is important to highlight that the significance level or precision of the various statistical tests and comparisons conducted throughout the study have been determined by the survey's actual data and aligned with the statistical methodologies and designated level of aggregation in each instance.

The research hypotheses were tested using a quantitative method that involved developing a survey questionnaire to assess SMEs' perception of digitalisation, performance and sustainability. The

[1] http://faedpyme.upct.es.

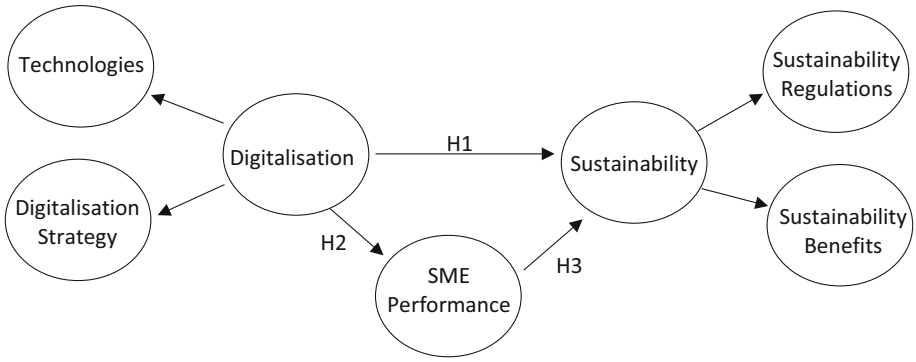

FIGURE 1 Research model.

TABLE 1 Sample profile.

	n	%
Size		
From 1 to 10 employees	300	30.77
From 11 to 50 employees	573	58.77
From 51 to 250	102	10.46
Sector		
Consumer services	311	31.90
Industry	323	33.13
Building industry	165	16.92
Commerce	176	18.05

questionnaire was designed with 5-point Likert scale questions. The selection of this method was based on two factors. First, employing survey research with a structured questionnaire allows specific and primary information to be gathered from the respondents (Martínez et al., 2014). This approach ensures that the data collected is focused and relevant to the research objectives. Second, the survey method's appropriateness is supported by its extensive use in previous research to investigate perceived digitalisation (Cohen, 2018; Dilberoglu et al., 2017), sustainability (Cantele & Zardini, 2020; Chassé & Courrent, 2018) and performance (Parnell & Brady, 2019; Wang et al., 2019). Given its established effectiveness in exploring similar topics, it is a reliable and relevant choice for the current research.

3.2 | Measures

In this research study, the measurement scales employed have been rigorously tested in previous research. The development of the questionnaire was grounded in an extensive literature review, ensuring the inclusion of relevant and well-established items for each construct. Prior to testing the hypotheses, careful deliberation was undertaken to ensure the questionnaire's accuracy and appropriateness. Table 2 presents a comprehensive overview of the questions posed to managers, along with references to previous studies that have used the selected items. This approach not only enhances the reliability of the questionnaire but also allows for comparisons with existing research, enabling a more robust analysis of the data. For most of the constructs, a 5-point Likert scale was used, ensuring a standardised and consistent response format throughout the survey.

The construct of digitalisation was formulated by considering two key items: technologies and strategy. The conceptualisation of these items was drawn from an array of scholarly works, including contributions by Dachs et al. (2019), Santos et al. (2017), Cohen (2018), Müller et al. (2018), Cowling (2016) and Pereira and Romero (2017). By integrating insights from these researchers, we aimed to develop a comprehensive understanding of digitalisation in the context of our research. The digitalisation construct encompassed the importance of implementing effective digital technologies and developing digitalisation strategies. Additionally, allocating human resources to digital activities was deemed a crucial factor in shaping this construct. By considering these facets, we sought to capture a holistic view of digitalisation in SMEs. Our exploration also delved into the realm of Industry 4.0 technologies, drawing from the seminal work of Pereira and Romero (2017). This insightful study highlighted various cutting-edge technologies associated with Industry 4.0, including the Internet of Things, the Internet of Services (IoS), robotics, big data and cloud manufacturing. These technological innovations have the potential to transform SMEs' operations and performance, and hence, they have been integral to our research. Table 2 presents a comprehensive list of the Industry 4.0 technologies investigated in our study. This compilation is the result of a thorough literature review, providing a solid foundation for our examination of the digitalisation construct.

The item concerning digitalisation strategy drew upon the works of Müller et al. (2018), Cowling (2016) and Fraga-Lamas et al. (2018). Recognising the significance of companies having a digitalisation strategy, this item aimed to gauge their awareness of the importance of such a strategy. Having a well-defined digitalisation strategy can enhance efficiency, reduce costs, bolster competitiveness and enhance customer experiences.

The construct of performance was assessed using a reduced version of the model proposed by Quinn and Rohrbaugh (1983), which has been widely employed in previous literature (García-Pérez-de-Lema et al., 2012; Wang et al., 2018). For the purposes of this article, one item was considered for each dimension.

The construct of sustainability was composed of two items: benefits and regulation. These items were based on the works of Cantele and Zardini (2020) and Chassé and Courrent (2018). As highlighted by

TABLE 2 Variable definition.

Digitalisation	Rate the significance of these concepts for the company (1: Not important; 5: Very important)
ERP	Dachs et al. (2019); Santos et al. (2017)
Corporate intranet	Dachs et al. (2019); Santos et al. (2017)
Big data	Cohen (2018)
We allocate financial resources for digitalisation	Müller et al. (2018)
The business model has been modernised through digitalisation	Müller et al. (2018)
The workforce is adequately trained for digital advancements	Cowling (2016)
Managers are trained in digitalisation	Cowling (2016)
The level of process automation is substantial	Müller et al. (2018); Pereira and Romero (2017)
The company's staff is regularly trained	Cowling (2016)
SME performance	Assess the company's position relative to direct competitors concerning the following performance indicators (1 = much worse and 5 = much better).
Product quality	Arda et al. (2019)
Efficiency of production processes	Wang et al. (2018)
Customer satisfaction	Sardana et al. (2020)
Ability to adapt to market changes	Stam and Wennberg (2009)
Employee satisfaction	Salkin et al. (2018); Parnell and Brady (2019)
Sustainability	Express your level of agreement with the provided statements and specify if you have used the given environmental criteria.
Sustainability increases employee motivation	Cantele and Zardini (2020)
Sustainability generates competitive advantages	Cantele and Zardini (2020)
Sustainability improves the company's image and reputation	Cantele and Zardini (2020)
Sustainability improves the company's profitability	Cantele and Zardini (2020)
Sustainability increases customer satisfaction	Cantele and Zardini (2020)
Environmental criteria in the selection of suppliers	Chassé and Courrent (2018)
Environmental criteria in plastics management	Chassé and Courrent (2018)
Environmental criteria in process design	Chassé and Courrent (2018)
Environmental criteria for energy management	Chassé and Courrent (2018)
Environmental criteria in water waste management	Chassé and Courrent (2018)

Siegel et al. (2019), growing concerns about environmental impact and governmental pressure have prompted companies to modify their operational approaches in order to comply with environmental regulations and meet increasing customer demand for sustainable products and services. The objective of these items was to assess whether companies were aware of the benefits associated with sustainability and to determine whether their commitment to sustainability was voluntary or imposed by regulatory authorities.

4 | ANALYSIS AND RESULTS

We used a Structural Equation Modelling (SEM) analysis to examine the direct and indirect effects in our model. Our focus centred on the Partial Least Squares (PLS) form of SEM, renowned for its advantages over other methods (Hair et al., 2017) and widespread use in social science and business research. Recent literature has also highlighted the increasing popularity of PLS-SEM (Haq & Huo, 2023). Estimating

the PLS-SEM model was carried out with SmartPLS 4.0.9.9 using default properties, with the reflective measurement mode applied to all the constructs. As the study's hypotheses aim to investigate the positive and negative but significant relationships among the constructs, a two-tailed test type was employed. PLS-SEM has several advantages. First, it excels in exploratory studies aimed at developing new theories or outcomes. Second, it is preferable when the objective is to explain variation within the model (Hair et al., 2017). Lastly, PLS-SEM can yield reliable output even with a small sample size (Haq & Huo, 2023).

The PLS-SEM analysis proceeded through five essential steps. First, we calculated the Harman's single factor test, the most common test performed by researchers to examine Common Method Variance (CMV). Second, we established the measurement constructs by employing an Exploratory Factor Analysis (EFA). This helped us to identify the underlying dimensions and latent variables that best represent the constructs in our model. In the third step, we estimated the measurement model through a Confirmatory Factor Analysis (CFA), which allowed us to assess the reliability and validity of the identified constructs. By confirming the robustness of the measurement model, we ensured that the selected variables accurately measured the intended concepts, enhancing the credibility of our study. The fourth step involved examining the structural model, where we investigated the hypothesised relationships in the research model (Arda et al., 2019; Salkin et al., 2018). Lastly, we addressed endogeneity.

Researchers commonly employ Harman's Single-Factor Test to evaluate CMV in their studies. After collecting data, a post hoc analysis is performed to ascertain if a sole factor is responsible for the variation observed in the data. During this process, all items related to each construct undergo factor analysis to investigate whether a single factor emerges or if a general factor significantly contributes to the covariance among the measures. If no single factor emerges to account for the majority of the covariance, it indicates that CMV is not a widespread issue in the study (Chang et al., 2010). Principal component analysis in SPSS is the method utilised to execute this test.

The results from the generated output (Table 3) revealed 11 distinct factors explaining 60% of the total variance. However, the first unrotated factor accounted for only 15% of the variance in the data. Consequently, neither of the two underlying assumptions was met – no single factor emerged, and the first factor failed to capture most of the variance. Therefore, these findings indicate that CMV is not a concern in this study.

4.1 | Measurement model

Following the approach of prior studies (El-Kassar & Singh, 2019; Haq & Huo, 2023), we executed two steps to estimate the model's parameters. Initially, we established measurement constructs through EFA, identifying underlying dimensions and latent variables representing our model's constructs. Subsequently, CFA was employed to estimate the measurement model, ensuring the reliability and validity of our identified constructs. This step bolstered our study's credibility by confirming the accuracy of the selected variables in measuring intended concepts.

To thoroughly assess the measurement constructs, we conducted an EFA using IBM SPSS Statistics 24. The EFA results, specifically, the factor loadings of all five factors were above the recommended threshold of 0.50, indicating strong associations between the observed variables and their respective underlying constructs. These results are presented in Table 4.

To gauge the overall suitability of the data for factor analysis, we used the Kaiser-Meyer-Olkin (KMO) measure, a critical assessment of sampling adequacy. The KMO value obtained was 0.877, surpassing the recommended threshold of 0.8 and indicating that the data was highly suitable for factor analysis. This result further reinforces the reliability and validity of our EFA findings (Dilberoglu et al., 2017).

PLS-SEM introduces a range of methods and empirical criteria aimed at evaluating reflective measurement models. The cornerstone of this evaluation is construct validity, which principally scrutinises the measurements' reliability, convergent validity and discriminant validity

TABLE 3 Harman's single-factor test.

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	8.246	15.271	15.271	4.118	7.625	7.625
2	5.212	9.652	24.923	7.675	14.213	21.838
3	3.685	6.824	31.748	3.266	6.048	27.558
4	3.203	5.931	37.679	2.756	5.105	31.990
5	2.390	4.426	42.105	1.664	3.082	26.072
6	1.988	3.681	45.785	1.502	2.781	38.853
7	1.911	3.538	49.324	1.848	3.423	42.276
8	1.806	3.345	52.669	1.309	2.424	44.700
9	1.664	3.082	55.752	1.213	2.246	46.945
10	1.147	2.125	57.876	0.923	1.709	48.655
11	1.058	1.959	59.835	0.630	1.167	49.822

TABLE 4 Results of the exploratory factor analysis.

Factors	Items	Loadings
Technology	Degree of importance of an ERP for your company (Tech 1)	0.534
	Degree of importance of a corporate intranet for your company (Tech 2)	0.556
	Degree of importance of Big data for your company (Tech 3)	0.595
	We allocate financial resources for digitalisation (Str 1)	0.722
	The business model has been modernised through the implementation of digitalisation (Str 2)	0.718
	Staff members are equipped for digital advancements (Str 3)	0.762
	Managers are trained in digitalisation (Str 4)	0.788
	The level of process automation is significant (Str 5)	0.646
	The company's staff is regularly trained (Str 6)	0.651
SME Performance	Product quality (Perf 1)	0.723
	Efficiency of production processes (Perf 2)	0.630
	Customer satisfaction (Perf) 3	0.753
	Ability to adapt to market changes (Perf 4)	0.601
	Employee satisfaction (Perf 5)	0.563
Sustainability Benefits	Sustainability increases employee motivation (Ben 1)	0.551
	Sustainability generates competitive advantages (Ben 2)	0.738
	Sustainability improves the company's image and reputation (Ben 3)	0.696
	Sustainability improves the company's profitability (Ben 4)	0.717
	Sustainability increases customer satisfaction (Ben 5)	0.768
Sustainability Regulations	Environmental criteria in the selection of suppliers (Reg 1)	0.650
	Environmental criteria in plastics management (Reg 2)	0.666
	Environmental criteria in process design (Reg 3)	0.725
	Environmental criteria for energy management (Reg 4)	0.793
	Environmental criteria in water waste management (Reg 5)	0.822

(Peter, 1981). With PLS-SEM, assessing reliability involves examining repeatability, indicator reliability and internal consistency reliability. Indicator reliability is gauged based on the loadings, which are commonly recommended to exceed 0.5 (Steenkamp & Van Trijp, 1991). The internal consistency reliability in the CB-SEM models has been evaluated based on the widely adopted Cronbach's α coefficient (Fabrigar & Wegener, 2011) and the Average Variance Extracted (AVE) (Cronbach, 1951). The values for these statistics surpassed the minimum recommended thresholds of 0.7 and 0.5, respectively (Cantele & Zardini, 2020). Thus, PLS-SEM also adopts composite reliability (CR) to appraise the internal consistency reliability of the constructs. CR values ranging from 0.6 to 0.7 in exploratory research are generally deemed satisfactory (Hair et al., 2011).

As can be observed in the following table (Table 5), all the analyses conducted surpass the thresholds set by the literature, thus indicating that our research model is robust and reliable.

To ensure the goodness of fit of our analysis, we used the Satorra–Bentler χ^2 test ($p < 0.05$) and the fit indices, including the Normed Fit Index (NFI), the Non-Normed Fit Index (NNFI) or Tucker-Lewis Index (TLI) (Bentler & Bonett, 1980), the Comparative Fit Index (CFI) (Bentler, 1990) and the Incremental Fit Index (IFI) (Bollen, 1989). All the values exceeded the recommended threshold of 0.8 (Bentler, 1992), indicating that our model provides an excellent fit to the data (Table 5). These fit indices demonstrate that our measurement model accurately reflects the relationships among the observed variables, confirming the robustness of our research findings.

Discriminant validity assesses the distinctiveness of a construct from others, often evaluated using the Fornell–Larcker criterion (Fornell & Larcker, 1981) as a primary metric (Hair et al., 2011). This criterion scrutinises whether a latent construct shares more variance with its designated indicators than with other constructs, specifically requiring that the square root of the Average Variance Extracted (AVE) of each latent construct exceeds its highest correlation with other constructs (Hair et al., 2011). The comparisons presented in Table 6 demonstrate that, consistently, the square root of the AVE for each factor surpasses its correlations with other factors. This compelling evidence supports the discriminant validity of our measurement model, indicating that each factor captures a unique aspect of the studied constructs without unnecessary overlap or redundancy.

Additionally, cross-loadings are evaluated, necessitating that an indicator's loading with its corresponding latent construct exceeds its loadings with all other constructs (Hair et al., 2011) (refer to Table 7). It is expected that the factor loadings demonstrate a greater value with their respective variables than with the others assessed in the model, as outlined by Barclay et al. (1995).

4.2 | Structural model

In our research model, we employed a reflective indicators approach to gauge the latent variables. Following this methodology, each

TABLE 5 Results of the Measurement Scale Analysis.

Construct	Items	Standardised loadings (λ)	R^2	Cronbach alpha (α)	Composite reliability	AVE
(1) Digitalisation	Tech 1	0.555	0.308	0.789	0.902	0.509
	Tech 2	0.713	0.508			
	Tech 3	0.659	0.434			
	Str 1	0.782	0.611			
	Str 2	0.788	0.621			
	Str 3	0.741	0.549			
	Str 4	0.759	0.576			
	Str 5	0.686	0.471			
	Str 6	0.710	0.505			
(2) SME Performance	Perf 1	0.735	0.540	0.799	0.801	0.502
	Perf2	0.687	0.472			
	Perf 3	0.690	0.476			
	Perf 4	0.662	0.438			
	Perf 5	0.557	0.310			
(3) Sustainability	Ben 1	0.695	0.482	0.802	0.929	0.568
	Ben 2	0.630	0.396			
	Ben 3	0.793	0.628			
	Ben 4	0.839	0.704			
	Ben 5	0.851	0.724			
	Reg 1	0.629	0.396			
	Reg 2	0.785	0.617			
	Reg 3	0.727	0.528			
	Reg 4	0.766	0.587			
	Reg 5	0.788	0.621			

Note: Goodness of fit: S-B$\chi^2 = 821.77$; $p = 0.00$; NFI = 0.916; NNFI = 0.930; CFI = 0.939; IFI = 0.939; RMSEA = 0.050.

TABLE 6 Discriminant validity (Fornell & Larcker criteria).

Construct	Digitalisation	SME performance	Sustainability
Digitalization	0.650		
SMEs performance	0.205	0.737	
Sustainability	0.308	0.149	0.604

indicator in the proposed model functions as a reflective indicator, offering a direct measurement of the variables under scrutiny (Edwards & Bagozzi, 2000). Reflective indicators play a crucial role in elucidating observed variances or covariances, and they aid in reducing the residual variances in the outer measurement equations (Fornell & Bookstein, 1982). The choice to use reflective indicators was driven by the software's capabilities, as SmartPLS statistical software specifically handles reflective indicators (Jöreskog & Goldberger, 1975). According to the literature, this technique is typically used in studies on digitalisation (Pereira-Moliner et al., 2012), performance (Hussey & Eagan, 2007) and sustainability (Úbeda-García et al., 2021). By using reflective indicators, we ensured a robust and effective measurement approach that enabled us to accurately capture the complexities and interconnections among digitalisation, performance and sustainability.

In view of the results in Table 8, the use of digitalisation in SMEs (Industry 4.0 technologies, including ERP systems, Big data and Corporate Intranet and digitalisation strategy) to further environmental conservation and comply with current environmental regulations is confirmed. Our study reveals a positive relationship between digitalisation and SME performance, indicating that increased investment in digitalisation leads to enhanced efficiency and improved sustainability for companies. As illustrated in Figure 2, digitalisation strategies emerge as significant factors in explaining digitalisation intensity ($\beta = 0.880^*$). This underscores the pivotal role of a well-defined digitalisation strategy in driving successful digital technology use and transforming business operations. Moreover, our findings confirm that the functional dimension of sustainability benefits has more influence on overall sustainability ($\beta = 0.760^*$) than effective sustainability regulations ($\beta = 0.616^*$).

TABLE 7 Cross-factorial loadings.

	DIG	PERF	SOST
Tech 1	0.17	0.05	0.04
Tech 2	0.23	0.02	0.06
Tech 3	0.25	0.03	0.06
Str 1	0.56	0.15	0.16
Str 2	0.81	0.18	0.26
Str 3	0.81	0.15	0.27
Str 4	0.78	0.13	0.20
Str 5	0.80	0.16	0.23
Str 6	0.74	0.16	0.27
Reg 1	0.09	0.03	0.49
Reg 2	0.05	0.08	0.51
Reg 3	0.11	0.05	0.47
Reg 4	0.10	0.05	0.51
Reg 5	0.07	0.00	0.52
Ben 1	0.28	0.16	0.62
Ben 2	0.25	0.14	0.71
Ben 3	0.28	0.10	0.69
Ben 4	0.27	0.13	0.69
Ben 5	0.25	0.10	0.73
Perf 1	0.09	0.71	0.08
Perf2	0.16	0.76	0.09
Perf 3	0.09	0.68	0.06
Perf 4	0.20	0.82	0.15
Perf 5	0.16	0.72	0.13

Addressing endogeneity is challenging when employing regression-based methods such as PLS-SEM. In the context of PLS-SEM, endogeneity arises when a predictor construct correlates with the error term of the corresponding dependent construct. This implies that the predictor construct not only explains the dependent construct but also influences its error term. The roots of endogeneity can originate from various sources. They mainly stem from omitted constructs that demonstrate correlations with one or more predictor constructs and the dependent construct in a partial regression of the PLS path model (Sarstedt et al., 2020).

We apply Hult et al.'s (2018) systematic approach to investigate potential endogeneity, initiating the process with the implementation of Park and Gupta's (2012) Gaussian copula method. The original model's latent variable scores are utilised as input in this assessment. Initially, we assess whether the variables prone to endogeneity exhibit non-normal distributions. To determine this, we conduct the Kolmogorov–Smirnov test with Lilliefor's correction (Sarstedt & Mooi, 2019) on the latent variable scores utilised as independent variables in the partial regressions of the PLS path model. The results indicate that none of the constructs have normally distributed scores, allowing us to proceed with Park and Gupta's (2012) Gaussian copula method. Table 9 demonstrates that none of the Gaussian copulas are statistically significant (p-value >0.05). It is crucial to emphasise that we have examined all combinations of the Gaussian copulas included in the model, and none of them exhibit significance. Consequently, we conclude that endogeneity is not present in this study, thereby reinforcing the robustness of the structural model results in this context (Hult et al., 2018).

5 | DISCUSSION

In today's management landscape, sustainability has become a pivotal focus across various social sciences, including economics, political science and sociology. It encompasses theoretical research and practical applications, shaping the agendas and discussions of organisations. The primary challenge faced by businesses and society is to transform company operations, objectives and business models to meet stakeholders' demands and expectation. Effectively addressing the sustainability challenge requires firms to have sufficient motivation to embark on a potentially profound transformation process that disrupts operational routines. It is also necessary to identify the catalysts that contribute to the success of these transformative endeavours. The aim of this study is to explore the connection between digitalisation as a resource, sustainability and the mediating effect of efficiency between these constructs. To examine this potential effect, a comprehensive study was conducted, formulating three hypotheses.

Our findings provide compelling empirical evidence to support hypothesis 1, establishing a robust positive association between digitalisation and sustainability. This outcome underscores the critical role played by digitalisation in achieving sustainable practices, corroborating prior research (Lee & Saen, 2012). Haq and Huo (2023) assert that digitalisation plays a favourable role in enhancing environmental performance, serving as a significant driver, particularly in improving environmental standards within European countries.

Implementing ERP systems, big data analytics and corporate intranet systems emerges as a crucial driver in reducing waste, energy consumption and resource use while improving working conditions. Big Data Analytics are flooring the SMEs' path by making them able to be more optimised (Mangla et al., 2021). These outcomes confirm that companies' knowledge of technology and the market are essential factors in facilitating resource optimisation and firm growth. Notably, sustainability is an additional outcome of digitalisation, enabling companies to enhance their reputation and grow qualitatively. Digital technologies empower Spanish organisations and improve their image among customers. From a strategic standpoint, reputation stands out as one of the most vital intangible assets, enabling companies to attain sustained competitive advantages over time, as confirmed by the existing literature (Hao et al., 2022).

The findings of this study also present empirical evidence that supports hypothesis 2, affirming a positive correlation between digitalisation and the performance of Spanish SMEs. The opportunities arising from adopting digital technologies positively impact Spanish SME performance. This outcome aligns with the insights of Müller et al. (2018), as users of these technologies primarily focus on optimising operational processes and reaping the associated benefits, which are

TABLE 8 Structural equation model results.

Hypotheses	Causal relationship	λ	*t*-value	Contrast
H1	Digitalisation - > Sustainability	0.495	8.052*	Accepted
H2	Digitalisation - > SME performance	0.255	5.636*	Accepted
H3	SME performance - > Sustainability	0.141	3.235*	Accepted

Note: S-Bχ^2 (243 df) = 1032.93 (p = 0.000); NFI = 0.914; NNFI = 0.929; CFI = 0.937; IFI = 0.938.
*p-value <0.05.

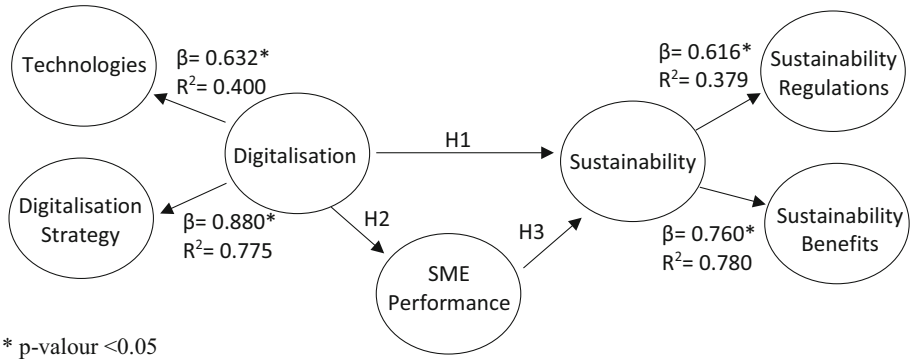

FIGURE 2 Relationship test.

TABLE 9 Gaussian copula results.

	Value	*p*-Value
DIG - > PERF	−0.605	0.227
DIG - > SOST	0.779	0.040
PERF - > SOST	−0.025	0.000
GC (DIG) - > SOST	−0.500	0.196
GC (DIG) - > PERF	0.824	0.106
GC (PERF) - > SOST	0.116	0.493

directly linked to efficiency and performance. According to Beier et al. (2020), efficiency is a significant consequence of digitalisation, made feasible by implementing these technologies. In our model, the positive relationship between digitalisation and performance can be attributed to enhancements in various aspects, as described in the literature (Cowling, 2016). Digital technologies enable improvements in production process efficiency, reduced operating times, enhanced flexibility to navigate uncertain circumstances, improved product quality and increased satisfaction among employees and customers. These advancements contribute to the overall performance of Spanish SMEs. Furthermore, in line with Del Giudice et al. (2017), firms' investment decisions are typically guided by their desire to maximise long-term profits. Hence, firms often reinvest a significant portion of their profits internally, aiming for expansion and higher profitability in the future.

Our study's findings offer empirical evidence that supports hypothesis 3, confirming a positive correlation between SME performance and sustainability. As stated by Zollo et al. (2013), a firm's adaptive capacity is constrained by its economic capabilities. For Spanish SMEs, achieving environmental sustainability and qualitative growth requires adequate financial resources. A more efficient company benefits from lower costs and increased profitability. Building on this notion, Grosvold et al. (2014) highlighted that management can introduce sustainability-oriented changes into the organisational culture if sufficient financial resources are available.

Our results also indicate a performance-linked mediating effect in the relationship between digitalisation and sustainability. This mediating effect emerges from the collaborative nature of digitalisation, characterised by data sharing, strategic partnerships and interconnected value chains that facilitate smooth functioning across all organisational levels. This aspect is particularly advantageous for resource-constrained SMEs.

Additionally, it presents opportunities for larger companies to explore untapped markets and drive technological innovations.

5.1 | Theoretical implications

This study provides valuable theoretical insights into the interplay between digitalisation, operational performance and sustainability. In today's business landscape, managers increasingly recognise the importance of fostering a digitalisation-friendly environment to enhance their company's competitiveness and reduce its environmental footprint. Thus, the knowledge gained from this article is essential for SMEs. Furthermore, this research should serve as a catalyst for further investigations, enabling both academics and managers to comprehend the implications of sustainable behaviour.

Previous research has incompletely explained the effect of digitalisation on environmental sustainability and efficiency. This line of research warrants further attention to understand whether to increase digitalisation and/or environmental actions when initiating/developing innovation projects. Therefore, this study builds on previous work (Schmidt et al., 2024) and extends it to include efficiency in the Spanish SMEs context, an area that remains under-researched.

This study's implications extend to digital transformation and the shift towards corporate sustainability. While most studies on digital transformation primarily examine innovation through a technical or information systems perspective, only a handful consider managerial elements as strategic priorities. We discern that the benefits of digitalisation lie in their strategic rather than purely technological value (Kane et al., 2015). Our effort to delve deeper into the relationship between environmental orientation and innovation performance helps to conceptualise the firm-level decision to 'go green'. It emphasises the role of an environmental strategy with strategic elements focused on broader concerns such as customers and human rights (Ardito et al., 2021).

5.2 | Managerial implications

From a practical standpoint, this research has significant implications for Spanish SMEs. It emphasises their need to analyse the efficiency of their production systems and resource consumption while identifying the potential benefits that digital technologies can bring in achieving sustainability-related objectives. We shed light on the positive expectations that arise from fostering a long-term approach and establishing a strong connection between digitalisation and sustainability within a firm's strategic planning. We also enhance performance expectations by showcasing how positive digital performance encourages risk-taking in sustainability-related decision-making. This study helps managers craft strategies to adopt digital technologies and achieve the Sustainable Development Goals by enhancing organisational information processing capabilities, such as connectivity and computing power, analysis and intelligence, human-machine interface and digital-physical transformation.

Heavin and Power (2018) emphasise the importance of SMEs' active involvement and leadership to successfully implement digitalisation. Indeed, managers have become increasingly aware of the need to foster a digitalisation environment that bolsters their company's competitiveness while mitigating its environmental impact. It is important that SME managers or owners actively participate and lead the implementation of digitalisation, even in cases where it depends on raising external resources, such as subsidies.

The need for digitalisation and environmental sustainability transcends a company's boundaries. Spanish SMEs must acknowledge not only their own commitment to digital and environmental ventures but also that of their stakeholders. These external entities serve as significant resource pools, and their interest and expertise in digitalisation and environmental sustainability profoundly impact SME innovation. Consequently, the innovative performance of SMEs is significant for various stakeholders, especially policymakers. In Spain, SMEs play a fundamental role in fostering more inclusive and sustainable growth, prompting the government to support companies in embracing digital infrastructures, adhering to environmental regulations and accessing global technology and commercialisation opportunities. Hence, Spanish policymakers ought to strengthen their strategies to encourage digitalisation. This can be achieved by tailoring messages according to company size, supporting initial investments and fostering cross-disciplinary training and learning. It is crucial to support and develop tools while showcasing successful implementations through policy-driven plans. Spanish policymakers should be aware of the hurdles facing their nation's SMEs as they pursue digital and environmental strategies.

6 | CONCLUSIONS

The findings from our analysis of SMEs highlight the tangible benefits of integrating sustainability and digital technologies, underscoring the value of their interaction. The results demonstrate that increased digitalisation positively influences sustainable and economic development by fostering innovation and facilitating compliance with environmental regulations. Pursuing sustainability is a consequential outcome of digitalisation, empowering companies to enhance their reputation by adhering to regulations and improving their image among customers.

Companies possess various resources, and these resources can serve as potential catalysts for improving management efficiency. Digitalisation amplifies SME performance. This observation holds great significance in promoting digital technologies, as there is a positive relationship between digitalisation and performance through enhanced efficiency.

Financial resources play a crucial role in fostering sustainability, particularly for SMEs, given their limited availability. As companies become more efficient, their costs decrease, leading to greater profitability and enabling qualitative growth that can be invested in sustainable practices. Added to this, business success leads to the availability of more financial resources. A successful company tends to generate higher revenues from sales and operations, which in turn translates into higher profit margins and capital accumulation. Therefore, SME performance is instrumental in fostering sustainable business practices.

By recognising the positive link between digitalisation, performance and sustainability, SMEs can harness these factors to drive their success. Embracing digital technologies not only enhances SME operational efficiency but also empowers these companies to embrace sustainability practices, ultimately contributing to their long-term growth and competitiveness.

Although our hypotheses are supported, this study does have some limitations that point the way for future research. Firstly, this study tests the proposed model in a specific country. Future research should aim to validate this model in different contexts, such as non-European countries with different environmental regulations. Secondly, while this study focuses on three digital technologies, there are others that SMEs can integrate into their daily operations. Therefore, it is crucial to expand the model to incorporate additional technologies relevant to SMEs (e.g. supply-chain and customer relationship management software for front office, artificial intelligence or production process integration). Additionally, augmenting the model with new variables would enhance its explanatory power. Notably, including financial performance as a mediator of SME

performance would be of interest, as the relationship between these variables, especially between financial performance and sustainability, remains relatively unexplored.

ACKNOWLEDGMENTS

This work was supported by the Santander Financial Institute (SANFI). No sources played a role in the study design beyond funding.

ORCID

Laura Trueba-Castañeda https://orcid.org/0000-0002-4293-8641

REFERENCES

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

Ahmed, Z., Ahmad, M., Rjoub, H., Kalugina, O. A., & Hussain, N. (2022). Economic growth, renewable energy consumption, and ecological footprint: Exploring the role of environmental regulations and democracy in sustainable development. *Sustainable Development*, *30*(4), 595–605. https://doi.org/10.1002/sd.2251

Amel-Zadeh, A., & Serafeim, G. (2018). Why and how investors use ESG information: Evidence from a global survey. *Financial Analysts Journal.*, *74*(3), 87–103. https://doi.org/10.2469/faj.v74.n3.2

Arda, O. A., Bayraktar, E., & Tatoglu, E. (2019). How do integrated quality and environmental management practices affect firm performance? Mediating roles of quality performance and environmental proactivity. *Business Strategy and the Environment*, *28*(1), 64–78. https://doi.org/10.1002/bse.2190

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. *Journal of Business Research*, *123*, 44–56. https://doi.org/10.1016/j.jbusres.2020.09.022

Bai, C., Quayson, M., & Sarkis, J. (2021). COVID-19 pandemic digitization lessons for sustainable development of micro-and small-enterprises. *Sustainable Production and Consumption*, *27*, 1989–2001. https://doi.org/10.1016/j.spc.2021.04.035

Barclay, D., Higgins, C., & Thompson, R. (1995). The partial least squares (PLS) approach to casual modeling: personal computer adoption and use as an Illustration. *Technology Studies*, *2*(2), 285–309.

Barney, J. (1991). Special theory forum the resource-based model of the firm: Origins, implications, and prospects. *Journal of Management*, *17*(1), 97–98. https://doi.org/10.1177/014920639101700010

Beier, G., Ullrich, A., Niehoff, S., Reißig, M., & Habich, M. (2020). Industry 4.0: How it is defined from a sociotechnical perspective and how much sustainability it includes—A literature review. *Journal of Cleaner Production*, *259*, 120856. https://doi.org/10.1016/j.jclepro.2020.120856

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246. https://doi.org/10.1037/0033-2909.107.2.238

Bentler, P. M. (1992). On the fit of models to covariances and methodology to the bulletin. *Psychological Bulletin*, *112*(3), 400–404. https://doi.org/10.1037/0033-2909.112.3.400

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*(3), 588–606. https://doi.org/10.1037/0033-2909.88.3.588

Bollen, K. A. (1989). *Structural equations with latent variables*. John Wiley & Sons. https://doi.org/10.1002/9781118619179

Bourletidis, K., & Triantafyllopoulos, Y. (2014). SMEs survival in time of crisis: Strategies, tactics and commercial success stories. *Procedia-Social and Behavioral Sciences*, *148*, 639–644. https://doi.org/10.1016/j.sbspro.2014.07.092

Bouwman, H., Nikou, S., & De Reuver, M. (2019). Digitalization. Business models. And SMEs: How do business model innovation practices improve performance of digitalizing SMEs? *Telecommunications Policy.*, *43*(9), 101828. https://doi.org/10.1016/j.telpol.2019.101828

Bradford, J., & Fraser, E. D. (2008). Local authorities, climate change and small and medium enterprises: Identifying effective policy instruments to reduce energy use and carbon emissions. *Corporate Social Responsibility and Environmental Management.*, *15*(3), 156–172. https://doi.org/10.1002/csr.151

Brenner, B., & Hartl, B. (2021). The perceived relationship between digitalization and ecological, economic and social sustainability. *Journal of Cleaner Production.*, *315*, 128128. https://doi.org/10.1016/j.jclepro.2021.128128

Cantele, S., & Zardini, A. (2020). What drives small and medium enterprises towards sustainability? Role of interactions between pressures, barriers, and benefits. *Corporate Social Responsibility and Environmental Management*, *27*(1), 126–136. https://doi.org/10.1002/csr.1778

Chang, S. J., Van Witteloostuijn, A., & Eden, L. (2010). From the editors: Common method variance in international business research. *Journal of International Business Studies*, *41*(2), 178–184. https://doi.org/10.1057/jibs.2009.88

Chassé, S., & Courrent, J. M. (2018). Linking owner–managers' personal sustainability behaviors and corporate practices in SMEs: The moderating roles of perceived advantages and environmental hostility. *Business Ethics: A European Review*, *27*(2), 127–143. https://doi.org/10.1111/beer.12176

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

Chen, C. M., Delmas, M. A., & Lieberman, M. B. (2015). Production frontier methodologies and efficiency as a performance measure in strategic management research. *Strategic Management Journal*, *36*(1), 19–36. https://doi.org/10.1002/smj.2199

Chen, X., Despeisse, M., & Johansson, B. (2020). Environmental sustainability of digitalization in manufacturing: A review. *Sustainability*, *12*(24), 10298. https://doi.org/10.3390/su122410298

Christensen, H. B., Hail, L., & Leuz, C. (2021). Mandatory CSR and sustainability reporting: Economic analysis and literature review. *Review of Accounting Studies*, *26*(3), 1176–1248. https://doi.org/10.1007/s11142-021-09609-5

Cohen, M. C. (2018). Big data and service operations. *Production and Operations Management*, *27*(9), 1709–1723. https://doi.org/10.1111/poms.12832

Cowling, M. (2016). You can lead a firm to R&D but can you make it innovate? UK evidence from SMEs. *Small Business Economics*, *46*(4), 565–577. https://doi.org/10.1007/s11187-016-9704-2

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297–334. https://doi.org/10.1007/BF02310555

Cummins, J. D., & Weiss, M. A. (2000). Analyzing firm performance in the insurance industry using frontier efficiency and productivity methods. In G. Dionne (Ed.), *Handbook of insurance. Huebner international series on risk, insurance, and economic security* (Vol. 22). Springer. https://doi.org/10.1007/978-94-010-0642-2_24

Dachs, B., Kinkel, S., & Jäger, A. (2019). Bringing it all back home? Backshoring of manufacturing activities and the adoption of industry 4.0 technologies. *Journal of World Business*, *54*(6), 101017. https://doi.org/10.1016/j.jwb.2019.101017

Del Giudice, M., Khan, Z., De Silva, M., Scuotto, V., Caputo, F., & Carayannis, E. (2017). The microlevel actions undertaken by owner-managers in improving the sustainability practices of cultural and creative small and medium enterprises: A United Kingdom–Italy

comparison. *Journal of Organizational Behavior*, *38*(9), 1396–1414. https://doi.org/10.1002/job.2237

De-Pablos-Heredero, C., Montes-Botella, J. L., & García-Martínez, A. (2018). Sustainability in smart farms: Its impact on performance. *Sustainability*, *10*(6), 1713. https://doi.org/10.3390/su10061713

Dilberoglu, U. M., Gharehpapagh, B., Yaman, U., & Dolen, M. (2017). The role of additive manufacturing in the era of industry 4.0. *Procedia Manufacturing*, *11*, 545–554. https://doi.org/10.1016/j.promfg.2017.07.148

Dzhengiz, T., & Niesten, E. (2020). Competences for environmental sustainability: A systematic review on the impact of absorptive capacity and capabilities. *Journal of Business Ethics*, *162*(4), 881–906. https://doi.org/10.1007/s10551-019-04360-z

Edwards, J. R., & Bagozzi, R. P. (2000). On the nature and direction of relationships between constructs and measures. *Psychological Methods*, *5*(2), 155–174. https://doi.org/10.1037/1082-989x.5.2.155

El-Kassar, A. N., & Singh, S. K. (2019). Green innovation and organizational performance: The influence of big data and the moderating role of management commitment and HR practices. *Technological Forecasting and Social Change*, *144*, 483–498. https://doi.org/10.1016/j.techfore.2017.12.016

Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, *112*, 119–127. https://doi.org/10.1016/j.jbusres.2020.03.004

European Commission. (2022). Annual report on European SMEs 2021/2022. SMEs and environmental sustainability.

Fabrigar, L. R., & Wegener, D. T. (2011). *Exploratory factor analysis*. Oxford University Press.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research*, *19*(4), 440–452. https://doi.org/10.2307/3151718

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.2307/3151312

Fraga-Lamas, P., Fernández-Caramés, T. M., Blanco-Novoa, O., & Vilar-Montesinos, M. A. (2018). A review on industrial augmented reality systems for the industry 4.0 shipyard. *IEEE Access*, *6*, 13358–13375. https://doi.org/10.1109/ACCESS.2018.2808326

Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, *5*(4), 210–233. https://doi.org/10.1080/20430795.2015.1118917

Gadenne, D., Mia, L., Sands, J., Winata, L., & Hooi, G. (2012). The influence of sustainability performance management practices on organisational sustainability performance. *Journal of Accounting & Organizational Change*, *8*(2), 210–235. https://doi.org/10.1108/18325911211230380

Gadenne, D. L., Kennedy, J., & McKeiver, C. (2009). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics*, *84*, 45–63. https://doi.org/10.1007/s10551-008-9672-9

García-Pérez-de-Lema, D., Alfaro-Cortes, E., Manzaneque-Lizano, M., & Banegas-Ochovo, R. (2012). Strategy, competitive factors and performance in small and medium enterprise (SMEs).

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, *114*, 11–32. https://doi.org/10.1016/j.jclepro.2015.09.007

Grosvold, J., Hoejmose, U., & Roehrich, J. (2014). Squaring the circle: Management, measurement and performance of sustainability in supply chains. *Supply Chain Management: An International Journal*, *19*(3), 292–305. https://doi.org/10.1108/SCM-12-2013-0440

Guandalini, I. (2022). Sustainability through digital transformation: A systematic literature review for research guidance. *Journal of Business Research*, *148*, 456–471. https://doi.org/10.1016/j.jbusres.2022.05.003

Hair, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS-SEM or CB-SEM: Updated guidelines on which method to use. *International Journal of Multivariate Data Analysis*, *1*(2), 107–123. https://doi.org/10.1504/IJMDA.2017.087624

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202

Hanaysha, J. R., Al-Shaikh, M. E., Joghee, S., & Alzoubi, H. M. (2022). Impact of innovation capabilities on business sustainability in small and medium enterprises. *FIIB Business Review*, *11*(1), 67–78. https://doi.org/10.1177/23197145211042232

Hanaysha, J. R., & Alzoubi, H. M. (2022). The effect of digital supply chain on organizational performance: An empirical study in Malaysia manufacturing industry. *Uncertain Supply Chain Management*, *10*(2), 495–510. https://doi.org/10.5267/j.uscm.2021.12.002

Hao, X., Chen, F., & Chen, Z. (2022). Does green innovation increase enterprise value? *Business Strategy and the Environment*, *31*(3), 1232–1247. https://doi.org/10.1002/bse.2952

Haq, I. U., & Huo, C. (2023). Digital strategy and environmental performance: The mediating role of digitalization in SMEs. *Digital Economy and Sustainable Development*, *1*(1), 1–13. https://doi.org/10.1007/s44265-023-00010-5

Hautala-Kankaanpää, T. (2022). The impact of digitalization on firm performance: Examining the role of digital culture and the effect of supply chain capability. *Business Process Management Journal.*, *28*(8), 90–109. https://doi.org/10.1108/BPMJ-03-2022-0122

Heavin, C., & Power, D. J. (2018). Challenges for digital transformation–towards a conceptual decision support guide for managers. *Journal of Decision Systems.*, *27*, 38–45. https://doi.org/10.1080/12460125.2018.1468697

Huang, M., Li, P., Meschke, F., & Guthrie, J. P. (2015). Family firms, employee satisfaction, and corporate performance. *Journal of Corporate Finance*, *34*, 108–127. https://doi.org/10.1016/j.jcorpfin.2015.08.002

Huang, Y. C., Wong, Y. J., & Yang, M. L. (2014). Proactive environmental management and performance by a controlling family. *Management Research Review*, *37*(3), 210–240. https://doi.org/10.1108/MRR-09-2012-0196

Hult, G. T. M., Hair, J. F., Proksch, D., Sarstedt, M., Pinkwart, A., & Ringle, C. M. (2018). Addressing endogeneity in international marketing applications of partial least squares structural equation modeling. *Journal of International Marketing*, *26*(3), 1–21. https://doi.org/10.1509/jim.17.0151

Hussey, D. M., & Eagan, P. D. (2007). Using structural equation modeling to test environmental performance in small and medium-sized manufacturers: Can SEM help SMEs? *Journal of Cleaner Production*, *15*(4), 303–312. https://doi.org/10.1016/j.jclepro.2005.12.002

INE. (2023). *Explotación estadística del directorio central de empresas. DIRCE*. Instituto Nacional de Estadística. https://www.ine.es/jaxiT3/Tabla.htm?t=32955&L=0

Isensee, C., Teuteberg, F., Griese, K. M., & Topi, C. (2020). The relationship between organizational culture. Sustainability. And digitalization in SMEs: A systematic review. *Journal of Cleaner Production.*, *275*, 122944. https://doi.org/10.1016/j.jclepro.2020.122944

Jöreskog, K. G., & Goldberger, A. S. (1975). Estimation of a model with multiple indicators causes of a single latent variable. *Journal of the American Statistical Association.*, *70*(351), 631–639. https://doi.org/10.2307/2285946

Juergensen, J., Guimón, J., & Narula, R. (2020). European SMEs amidst the COVID-19 crisis: Assessing impact and policy responses. *Journal of Industrial and Business Economics*, *47*, 499–510. https://doi.org/10.1007/s40812-020-00169-4

Kádárová, J., Lachvajderová, L., & Sukopová, D. (2023). Impact of digitalization on SME performance of the EU27: Panel data analysis. *Sustainability*, *15*(13), 9973. https://doi.org/10.3390/su15139973

Kane, G. C., Palmer, D., Phillips, A. N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. *MIT Sloan Management Review*.

Kohtamäki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization. *Technological Forecasting and Social Change*, *151*, 119804. https://doi.org/10.1016/j.techfore.2019.119804

Król, K., & Zdonek, D. (2020). Analytics maturity models: An overview. *Information*, *11*(3), 142. https://doi.org/10.3390/info11030142

Kuh, K. F. (2011). When government intrudes: Regulating individual behaviours that harm the environment. *Duke LJ*, *61*, 1111.

Kunduru, A. R. (2023). Blockchain technology for ERP systems: A review. *American Journal of Engineering, Mechanics and Architecture*, *1*, 56–63.

Lange, S., Pohl, J., & Santarius, T. (2020). Digitalization and energy consumption. Does ICT reduce energy demand? *Ecological Economics*, *176*, 106760. https://doi.org/10.1016/j.ecolecon.2020.106760

Lee, K. H., & Saen, R. F. (2012). Measuring corporate sustainability management: A data envelopment analysis approach. *International Journal of Production Economics*, *140*(1), 219–226. https://doi.org/10.1016/j.ijpe.2011.08.024

Limpeeticharoenchot, S., Cooharojananone, N., Chavarnakul, T., Charoenruk, N., & Atchariyachanvanich, K. (2022). Adaptive big data maturity model using latent class analysis for small and medium businesses in Thailand. *Expert Systems with Applications*, *206*, 117965. https://doi.org/10.1016/j.eswa.2022.117965

López-Concepción, A., Gil-Lacruz, A. I., & Saz-Gil, I. (2022). Stakeholder engagement, CSR development and SDGs compliance: A systematic review from 2015 to 2021. *Corporate Social Responsibility and Environmental Management*, *29*(1), 19–31. https://doi.org/10.1002/csr.2170

Magon, R. B., Thomé, A. M. T., Ferrer, A. L. C., & Scavarda, L. F. (2018). Sustainability and performance in operations management research. *Journal of Cleaner Production*, *190*, 104–117. https://doi.org/10.1016/j.jclepro.2018.04.140

Mangla, S. K., Raut, R., Narwane, V. S., Zhang, Z., & Priyadarshinee, P. (2021). Mediating effect of big data analytics on project performance of small and medium enterprises. *Journal of Enterprise Information Management*, *34*(1), 168–198. https://doi.org/10.1108/JEIM-12-2019-0394

Maroufkhani, P., Iranmanesh, M., & Ghobakhloo, M. (2023). Determinants of big data analytics adoption in small and medium-sized enterprises (SMEs). *Industrial Management & Data Systems*, *123*(1), 278–301. https://doi.org/10.1108/IMDS-11-2021-0695

Martínez, P., Pérez, A., & Del Bosque, I. R. (2014). CSR influence on hotel brand image and loyalty. *Academia Revista Latinoamericana de Administración.*, *27*(2), 267–283. https://doi.org/10.1108/ARLA-12-2013-0190

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering.*, *57*(5), 339–343. https://doi.org/10.1007/s12599-015-0401-5

Melo, I. C., Queiroz, G. A., Junior, P. N. A., de Sousa, T. B., Yushimito, W., & Pereira, J. (2023). Sustainable digital transformation in small and medium enterprises (SMEs): A review on performance. *Heliyon.*, *9*, e13908. https://doi.org/10.1016/j.heliyon.2023.e13908

Mondejar, M. E., Avtar, R., Diaz, H. L. B., Dubey, R. K., Esteban, J., Gómez-Morales, A., … Garcia-Segura, S. (2021). Digitalization to achieve sustainable development goals: Steps towards a smart green planet. *Science of the Total Environment*, *794*, 148539. https://doi.org/10.1016/j.scitotenv.2021.148539

Morioka, S. N., & de Carvalho, M. M. (2016). A systematic literature review towards a conceptual framework for integrating sustainability performance into business. *Journal of Cleaner Production*, *136*, 134–146. https://doi.org/10.1016/j.jclepro.2016.01.104

Müller, J. M., Kiel, D., & Voigt, K. I. (2018). What drives the implementation of industry 4.0? The role of opportunities and challenges in the context of sustainability. *Sustainability*, *10*(1), 247. https://doi.org/10.3390/su10010247

Nave, A., & Ferreira, J. (2019). Corporate social responsibility strategies: Past research and future challenges. *Corporate Social Responsibility and Environmental Management*, *26*(4), 885–901. https://doi.org/10.1002/csr.1729

Neyman, J. (1934). On the two different aspects of the representative method: The method of stratified sampling and the method of purposive selection. *Journal of the Royal Statistical Society*, *97*(4), 558–625. https://doi.org/10.2307/2342192

OECD. (2017). *Key issues for digital transformation in the G20*. Germany. https://www.oecd.org/g20/key-issues-for-digital-transformation-inthe-g20.pdf

Oláh, J., Aburumman, N., Popp, J., Khan, M. A., Haddad, H., & Kitukutha, N. (2020). Impact of industry 4.0 on environmental sustainability. *Sustainability*, *12*(11), 4674. https://doi.org/10.3390/su12114674

Olszak, C. M., & Mach-Król, M. (2018). A conceptual framework for assessing an organization's readiness to adopt big data. *Sustainability*, *10*(10), 3734. https://doi.org/10.3390/su10103734

Orazalin, N., & Baydauletov, M. (2020). Corporate social responsibility strategy and corporate environmental and social performance: The moderating role of board gender diversity. *Corporate Social Responsibility and Environmental Management*, *27*(4), 1664–1676. https://doi.org/10.1002/csr.1915

Ortiz-Martínez, E., Marín-Hernández, S., & Santos-Jaén, J. M. (2023). Sustainability, corporate social responsibility, non-financial reporting and company performance: Relationships and mediating effects in Spanish small and medium-sized enterprises. *Sustainable Production and Consumption*, *35*, 349–364. https://doi.org/10.1016/j.spc.2022.11.015

Osburg, T., & Lohrmann, C. (2017). *Sustainability in a digital world*. Springer International. https://doi.org/10.1007/978-3-319-54603-2

Palm, J., & Backman, F. (2017). Public procurement of electric vehicles as a way to support a market: Examples from Sweden. *International Journal of Electric and Hybrid Vehicles*, *9*(3), 253–268. https://doi.org/10.1504/IJEHV.2017.087587

Park, S., & Gupta, S. (2012). Handling endogenous regressors by joint estimation using copulas. *Marketing Science*, *31*(4), 567–586. https://doi.org/10.1287/mksc.1120.0718

Parnell, J., & Brady, M. (2019). Capabilities, strategies and firm performance in the United Kingdom. *Journal of Strategy and Management.*, *12*(1), 153–172. https://doi.org/10.1108/JSMA-10-2018-0107

Pedersen, C. S. (2018). The UN sustainable development goals (SDGs) are a great gift to business! *Procedia CIRP*, *69*, 21–24. https://doi.org/10.1016/j.procir.2018.01.003

Pereira, A. C., & Romero, F. (2017). A review of the meanings and the implications of the industry 4.0 concept. *Procedia Manufacturing*, *13*, 1206–1214. https://doi.org/10.1016/j.promfg.2017.09.032

Pereira-Moliner, J., Claver-Cortés, E., Molina-Azorín, J. F., & Tarí, J. J. (2012). Quality management, environmental management and firm performance: Direct and mediating effects in the hotel industry. *Journal of Cleaner Production*, *37*, 82–92. https://doi.org/10.1016/j.jclepro.2012.06.010

Peter, J. P. (1981). Construct validity: A review of basic issues and marketing practices. *Journal of Marketing Research*, *18*(2), 133–145. https://doi.org/10.1177/002224378101800201

Quinn, R. E., & Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. *Management Science*, *29*(3), 363–377. http://www.jstor.org/stable/2631061

Rothenberg, S. (2007). Sustainability through servicizing. *MIT Sloan Management Review*., *48*(2), 1532–9194.

Salkin, C., Mahir, O., Ustundag, A., & Cevikcan, E. (2018). A conceptual framework for industry 4.0. In A. Ustundag & E. Cevikcan (Eds.), *Industry 4.0: Managing the digital transformation* (pp. 3–23). Springer. https://doi.org/10.1007/978-3-319-57870-5

Santos, C., Mehrsai, A., Barros, A. C., Araújo, M., & Ares, E. (2017). Towards industry 4.0: An overview of European strategic roadmaps. *Procedia Manufacturing*, *13*, 972–979. https://doi.org/10.1016/j.promfg.2017.09.093

Sardana, D., Gupta, N., Kumar, V., & Terziovski, M. (2020). CSR sustainability' practices and firm performance in an emerging economy. *Journal of Cleaner Production*, *258*(June), 120766. https://doi.org/10.1016/j.jclepro.2020.120766

Sarkis, J., Gonzalez-Torre, P., & Adenso-Diaz, B. (2010). Stakeholder pressure and the adoption of environmental practices: The mediating effect of training. *Journal of Operations Management*, *28*(2), 163–176. https://doi.org/10.1016/j.jom.2009.10.001

Sarstedt, M., & Mooi, E. (2019). The market research process: The process, data, and methods using ibm spss statistics. *Springer Texts in Business and Economics*, *10*, 978.

Sarstedt, M., Ringle, C. M., Cheah, J. H., Ting, H., Moisescu, O. I., & Radomir, L. (2020). Structural model robustness checks in PLS-SEM. *Tourism Economics*, *26*(4), 531–554. https://doi.org/10.1177/1354816618823921

Schmidt, D., Casagranda, L. F., Butturi, M. A., & Sellitto, M. A. (2024). Digital technologies, sustainability, and efficiency in grain post-harvest activities: A bibliometric analysis. *Sustainability*, *16*(3), 1244. https://doi.org/10.3390/su16031244

Scott, J. E. (1998). Organizational knowledge and the intranet. *Decision Support Systems*, *23*(1), 3–17. https://doi.org/10.1016/S0167-9236(98)00032-3

Scuotto, V., Santoro, G., Bresciani, S., & Del Giudice, M. (2017). Shifting intra-and inter-organizational innovation processes towards digital business: An empirical analysis of SMEs. *Creativity and Innovation Management*, *26*(3), 247–255. https://doi.org/10.1111/caim.12221

Seele, P., & Lock, I. (2017). The game-changing potential of digitalization for sustainability: Possibilities perils and pathways. *Sustainability Science*, *12*, 183–185. https://doi.org/10.1007/s11625-017-0426-4

Shahgholian, A. (2019). Unpacking the relationship between environmental profile and financial profile; literature review toward methodological best practice. *Journal of Cleaner Production*, *233*, 181–196. https://doi.org/10.1016/j.jclepro.2019.05.365

Siegel, R., Antony, J., Garza-Reyes, J. A., Cherrafi, A., & Lameijer, B. (2019). Integrated green lean approach and sustainability for SMEs: From literature review to a conceptual framework. *Journal of Cleaner Production*, *240*, 118205. https://doi.org/10.1016/j.jclepro.2019.118205

Somohano-Rodríguez, F. M., David, F., & Azevedo, T. C. (2023). Spanish business commitment to the 2030 agenda in uncertain times. AIMS environmental. *Science*, *10*(2), 246–266. https://doi.org/10.3934/environsci.2023015

Somohano-Rodríguez, F. M., & Madrid-Guijarro, A. (2022). Do industry 4.0 technologies improve Cantabrian manufacturing SMEs performance? The role played by industry competition. *Technology in Society*, *70*, 102019. https://doi.org/10.1016/j.techsoc.2022.102019

Stam, E., & Wennberg, K. (2009). The roles of R&D in new firm growth. *Small Business Economics*, *33*(1), 77–89. https://doi.org/10.1007/s11187-009-9183-9

Steenkamp, J. B., & Van Trijp, H. C. M. (1991). The use of LISREL in validating marketing constructs. *International Journal of Research in Marketing*., *8*(4), 283–299. https://doi.org/10.1016/0167-8116(91)90027-5

Trumpp, C., Endrikat, J., Zopf, C., & Guenther, E. (2015). Definition, conceptualization, and measurement of corporate environmental performance: A critical examination of a multidimensional construct. *Journal of Business Ethics*, *126*, 185–204. https://doi.org/10.1007/s10551-013-1931-8

Úbeda-García, M., Claver-Cortés, E., Marco-Lajara, B., & Zaragoza-Sáez, P. (2021). Corporate social responsibility and firm performance in the hotel industry. The mediating role of green human resource management and environmental outcomes. *Journal of Business Research*, *123*, 57–69. https://doi.org/10.1016/j.jbusres.2020.09.055

UNEP. (2023). UNEP IN 2022. Annual Report 2022. https://www.unep.org/resources/annual-report-2022

United Nations. (2023a). Department of Economic and Social Affairs. Sustainable Development. THE 17 GOALS. https://sdgs.un.org/goals

United Nations. (2023b). Anuario climático 2023. Acción de las empresas españolas en la Agenda Climática. https://www.pactomundial.org/biblioteca/anuario-clima-2023-empresas-espanolas-cambio-climatico-calentamiento-global/#descargar_frm

United Nations Conference on Trade and Development. (2020). UNGIS dialogue on the role of digitalization in the decade of action. Accelerating the Achievement of the SDGs through Better Collaboration in the UN System. https://unctad.org/system/files/official-document/dtlstictinf2020d3en.pdf

Van der Velden, M. (2018). Digitalisation and the UN sustainable development goals: What role for design. *ID&A Interaction Design & Architecture*, *37*, 160–174. https://doi.org/10.55612/s-5002-037-008

Wang, T., Thornhill, S., & Zhao, B. (2018). Pay-for-performance, employee participation, and SME performance. *Journal of Small Business Management*, *56*(3), 412–434. https://doi.org/10.1111/jsbm.12268

Wang, Y., Towara, T., & Anderl, R. (2019). Technology landscape 4.0. In S. I. Ao, H. Kim, & M. Amouzegar (Eds.), *Transactions on engineering technologies*, *WCECS 2017* (pp. 31–45). Springer. https://doi.org/10.1007/978-981-13-2191-7_3

Wu, S. J., Melnyk, S. A., & Calantone, R. J. (2008). Assessing the core resources in the environmental management system from the resource perspective and the contingency perspective. *IEEE Transactions on Engineering Management*, *55*(2), 304–315. https://doi.org/10.1109/TEM.2008.919727

Yang, M. G. M., Hong, P., & Modi, S. B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of Production Economics*, *129*(2), 251–261. https://doi.org/10.1016/j.ijpe.2010.10.017

Younis, H., Sundarakani, B., & Vel, P. (2016). The impact of implementing green supply chain management practices on corporate performance. *Competitiveness Review*, *26*(3), 216–245. https://doi.org/10.1108/CR-04-2015-0024

Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics*, *111*(2), 261–273. https://doi.org/10.1016/j.ijpe.2006.11.029

Zollo, M., Cennamo, C., & Neumann, K. (2013). Beyond what and why: Understanding organizational evolution towards sustainable enterprise models. *Organization & Environment*, *26*(3), 241–259. https://doi.org/10.1177/1086026613496433

How to cite this article: Trueba-Castañeda, L., Somohano-Rodríguez, F. M., & Torre-Olmo, B. (2024). Does digitalisation enable small and medium-sized enterprises to become more sustainable? *Corporate Social Responsibility and Environmental Management*, *31*(5), 4893–4909. https://doi.org/10.1002/csr.2838