Green Finance

https://www.aimspress.com/journal/GF

Green Finance, 7(3): 520–544.
DOI: 10.3934/GF.2025020
Received: 10 March 2025
Revised: 11 July 2025
Accepted: 31 July 2025
Published: 03 September 2025

Research article

Green innovation and sustainable performance: The mediating role of sustainability orientation in cluster environments

Jeanneth Marcela Valdivieso-Uvidia[1,*], Manuel Expósito-Langa[1] and José Antonio Belso-Martínez[2]

[1] Department of Business Administration, Universitat Politècnica de València (Campus de Alcoy), Alcoy, Spain
[2] Department of Economic and Financial Studies, Universidad Miguel Hernández, Elche, Spain

* **Correspondence:** Email: marvaluv@upv.edu.es; Tel: +34 625787238.

Abstract: This study addresses the growing global imperative of aligning corporate strategies with environmental sustainability by examining the role of green innovation in fostering sustainable performance. While firms are increasingly pressured to adopt eco-innovative practices, the mechanisms that connect such innovation to actual sustainability outcomes remain insufficiently understood. In response to this issue, this study explores the mediating role of sustainability orientation in the relationship between two distinct dimensions of green innovation, namely green product innovation and green process innovation, and their impact on sustainable performance within the context of industrial clusters. A conceptual model is tested using a sample of 189 industrial firms in the Valencian Community, Spain, a region recognised for its manufacturing tradition and cluster-based economic organisation. Using advanced mediation analysis techniques, the study evaluates three core hypotheses: (H1) green innovation in two dimensions has a direct positive effect on sustainable performance, (H2) sustainability orientation mediates this relationship, and (H3) this mediating effect can be differentiated by its cluster membership. The results indicate that green innovation, both in products and processes, positively impacts firms' sustainable performance. Moreover, the findings reveal that sustainability orientation is a key mediator in this relationship, though this effect is only significant for firms within a cluster. This underscores the importance of collaboration and shared access to knowledge in such environments, fostering more effective green initiatives as sustainable strategies. Ultimately, these findings highlight the importance of a genuine strategic orientation towards sustainability to maximise the long-term benefits of green innovation.

Keywords: green product innovation; green process innovation; sustainable performance; sustainability orientation; industrial cluster

JEL Codes: O31, Q55, L25, R12

Abbreviations: GPI: green product innovation; GPrI: green process innovation; SP: sustainable performance; SO: sustainability orientation; NRBV: natural resource-based view; GDP: gross domestic product; R&D: research and development; AVE: average variance extracted; CR: composite reliability; CI: confidence interval

1. Introduction

The integration of environmental objectives as part of business strategy (Chen, 2008; Cheng, 2020; Expósito-Langa et al., 2024; Mahanta et al., 2024) has positioned green innovation as a key tool for achieving sustainable performance and balancing economic development with environmental sustainability (Chen et al., 2006; Diez-Martinez and Peiró-Signes, 2022; Díez-Vial et al., 2023; Eiadat et al., 2008; Parrilli et al., 2023; Weng et al., 2015). Green innovations encompass a broad range of eco-initiatives, which may include products, processes, or even business models. Although academic research has not overlooked this (Akbari et al., 2022; Anjum et al., 2024; Takalo and Tooranloo, 2021), open debates and unanswered questions remain concerning the determinants and micromechanisms underpinning the relationship between green innovation and sustainable performance (Belso et al., 2024; Hervas-Oliver et al., 2024; Maldonado-Guzmán, 2024; Melander, 2017; Weng et al., 2015).

Recent studies have reaffirmed the relevance of green innovation for improving firms' performance, particularly when supported by internal organisational capabilities (Aftab et al., 2025; Ishaq et al., 2024). Despite these theoretical advances, there remains a lack of comprehensive understanding regarding how internal factors (such as sustainability orientation) and external factors (such as cluster dynamics) interact to drive green innovation and sustainable performance. Much of the existing literature continues to overlook the role of territorial embeddedness or industrial clustering as contextual variables that may condition the effectiveness of green innovation.

Sustainability orientation is particularly relevant. It is understood as the degree to which a company integrates and prioritises sustainability in its decision-making processes (Chung and Wee, 2008; Hervas-Oliver et al., 2024; Zehir et al., 2015). This orientation is closely linked to interorganisational networks, where suppliers, customers, and knowledge agents share expertise and overcome technological barriers (Melander, 2017). However, such collaboration is not without challenges, including opportunism, lack of trust, and the need for adequate governance structures (Melander and Arvidsson, 2022). The literature acknowledges that green innovations, whether in products or processes, are essential tools for aligning competitiveness with environmental responsibility (Chen, 2008; Weng et al., 2015). However, recent studies also suggest that the success of green innovation depends on firms' internal strategic orientation towards sustainability and the external context in which they operate (Melander, 2017; Belso et al., 2024). However, empirical evidence remains fragmented regarding how these micromechanisms function, particularly in territorially embedded business systems such as industrial clusters.

In order to advance the ongoing debate in the literature beyond merely confirming the existence of a differential effect based on firms' location within an industrial cluster, this study aims to open the "black box" of the micromechanisms through which these industrial organisational systems overlap as a "space of places and space of relations" (Belso et al., 2024; Melander, 2017), influencing green innovation and firms' sustainable performance. Specifically, we pay particular attention to the role of sustainability orientation as a determining agent in the interaction between firms and their territorial environment. This study seeks to fill this gap by examining firms located in the Valencian Community (Spain), a region that provides an ideal setting due to its rich concentration of industrial clusters and high innovation activity. This region, a key player in Spain's economic landscape, accounts for 20% of the country's industrial employment and 8.1% of research and development (R&D) expenditure, hosting some of the most prominent international clusters (Boix-Domenech et al., 2015; Peiró-Signes et al., 2011; Ruiz-Ortega et al., 2021, among others). Despite being a key contributor to Spain's manufacturing output and R&D investment, the region faces challenges in uniformly extending the benefits of green innovation beyond the clustered firms. This raises a critical research question: Why does green innovation lead to stronger sustainability outcomes in some firms and not in others, even within the same regional ecosystem?

Our main contribution is to reveal how sustainability orientation mediates the relationship between green innovation and sustainable performance, and how this mediation is differentiated by firms' cluster membership. In doing so, the study transcends conventional analyses focusing only on direct effects, offering a more nuanced understanding of the contextual and strategic factors that influence green innovation outcomes. From a novel perspective, these results align with existing studies on the relationship between applied knowledge and environmental policies (Nguyen, 2023) or between organisational structure and entrepreneurial orientation (Kreiser and Davis, 2010). Additionally, our study provides a more refined perspective compared with previous research that has focused merely on the direct or indirect influence of sustainability orientation on green innovation (Chen et al., 2012; Gupta and Barua, 2018; Tardin et al., 2024; Zehir et al., 2015). Finally, we complement these studies by demonstrating how a strong sustainability orientation also enhances the green dynamic capabilities necessary for green innovation to lead to sustainability (Asante et al., 2024; Cheng, 2020; Ruiz-Ortega et al., 2021).

Furthermore, the evidence obtained clearly differentiates how environmental dynamics contribute to green innovation and sustainability (Gupta and Barua, 2018; Kreiser and Davis, 2010), compared with other perspectives that emphasise firm-level strategies (Molina-Morales et al., 2019). In particular, we expand the limited evidence on the suitability of cluster-specific proximity and institutional contexts for the dissemination of green strategies (Díez-Vial et al., 2023; Martinez-del-Rio et al., 2015; Ratten, 2018). In doing so, we address research gaps related to horizontal collaboration, customer–supplier knowledge transfer, and the role of proximity in fostering the governance structures and trust factors that make clusters conducive environments for green innovation and sustainability (Melander and Arvidsson, 2022). This distinction becomes particularly relevant when comparing firms within and outside clusters, as our findings reveal a significant gap in how sustainability orientation mediates the green innovation performance relationship, depending on the presence or absence of a collaborative territorial environment.

Following these preliminary considerations, we present the conceptual framework and research hypotheses. Subsequently, we describe the study's context, detail the variables analysed, and outline the methodology. Finally, we present a discussion of the results, as well as the study's main conclusions and implications.

2. Literature review and hypotheses

2.1. Green innovation and sustainable performance

Green innovation is broadly understood as the intentional development or modification of products, processes, or practices, aimed at reducing environmental harm. This construct is often anchored in the natural resource-based view (NRBV), which posits that firms can derive a sustained competitive advantage through capabilities that align with environmental objectives (Claudy et al., 2016; Hart, 1995). However, it is essential to recognise that green innovation does not inherently guarantee sustainable performance. Recent studies underscore the fact that environmental innovation must be strategically embedded and contextually supported to translate into measurable social, ecological, and economic gains (Afeltra et al., 2023; Melander and Arvidsson, 2022).

The primary objective of green innovation is to mitigate or prevent environmental damage (Zhang et al., 2020), protect the environment, and meet emerging consumer demands (Horbach, 2008; Neumann, 2021). It also aims to ensure compliance with increasingly stringent regulations (Aftab et al., 2024; Oduro et al., 2022), achieve differentiation in the market (Eiadat et al., 2008; Huang and Li, 2017; Zhang et al., 2020), and generate value (Huang and Li, 2017). The scope of green innovation extends from the development of sustainable products and processes to broader strategies aimed at optimising corporate sustainability (Albort-Morant et al., 2016).

A significant body of literature classifies green innovation into two main dimensions: green product innovation and green process innovation (Barforoush et al., 2021; Chen et al., 2006; Dangelico, 2016). This distinction allows for a more precise analysis of how firms integrate sustainable strategies. Numerous studies differentiate between firms that seek to improve the environmental performance of their products and those that optimise their production processes to make them more efficient and less polluting (Huang and Li, 2017; Klewitz and Hansen, 2014).

Green product innovation includes the incorporation of environmental criteria into product design (Dangelico, 2016). This may involve creating recyclable or reusable designs, improving energy efficiency, or reducing emissions (Chiarvesio et al., 2015; Chiou et al., 2011; Xie et al., 2019; Zhang et al., 2020). On the other hand, green process innovation involves implementing sustainable practices that enhance efficiency in internal operations, particularly in production activities (Chen, 2008; Chen et al., 2014). This includes adopting clean technologies, optimising use of resources, minimising waste and emissions, and integrating material recycling within production processes (Eiadat et al., 2008; Maldonado-Guzmán, 2024; Xie et al., 2019).

However, despite the increased adoption of these innovations, recent empirical studies point to variability in their actual contribution to long-term sustainability performance, suggesting the existence of organisational and contextual contingencies (Anjum et al 2024; Cheng, 2020; Stucki, 2019). This observation justifies the need for further investigation into the internal and external mechanisms that condition this relationship, particularly in clustered regional environments. In light of this, we propose the following hypothesis:

H1: Green innovation has a significant positive effect on sustainable performance.

H1a: Green product innovation positively impacts firms' sustainable performance.

H1b: Green process innovation positively impacts firms' sustainable performance.

2.2. Green innovation and sustainable performance: The mediating role of sustainability orientation

Sustainability orientation refers to the extent to which sustainability values are systematically embedded in an organisation's strategic, operational, and cultural frameworks (Claudy et al., 2016; Kraus et al., 2017). It is a multidimensional construct that reflects a firm's proactive stance toward social and environmental issues, going beyond compliance to becoming a driver of innovation and transformation (Tardin et al., 2024; Teixeira and Canciglieri Junior, 2019).

Despite its broad and multidimensional nature, sustainable performance generally converges on three fundamental aspects: economic, social, and environmental. On the other hand, sustainability orientation represents a comprehensive organisational strategy to align business activities with these sustainability principles (Shashi et al., 2018). This orientation encompasses strategic, tactical, and operational dimensions (Asante et al., 2024; Tardin et al., 2024); integrating sustainability values into corporate culture; and embedding social, environmental, and economic concerns into both internal processes and external stakeholder interactions (Roxas and Coetzer, 2012). Essentially, it constitutes a new way of conducting business and transforming business models (Teixeira and Canciglieri Junior, 2019).

According to Ruiz-Ortega et al. (2021), sustainability orientation extends beyond environmental concerns. It adopts a multidimensional perspective that fosters balanced and long-term sustainable business development by embedding ethical values and sustainability principles at all levels of the organisation. Furthermore, it acts as a driver of organisational change (Kraus et al., 2017), encouraging the adoption of sustainable innovations that, in turn, lead to improved sustainable performance. Ultimately, sustainability orientation serves as a facilitator in the relationship between green innovation and sustainable performance.

The conceptualisation of sustainability orientation as a guiding philosophy that enables firms to operate sustainably positions it as a source of competitive advantage (Claudy et al., 2016; Hart, 1995; Ruiz-Ortega et al., 2021). According to the NRBV, corporate profitability and environmental awareness evolve beyond mere regulatory compliance to become integral components of long-term business objectives (Benitez-Amado et al., 2015; Claudy et al., 2016; Shehzad et al., 2024), firms that optimise waste management and integrate stakeholders into their sustainability strategies gain both operational and reputational advantages (Amankwah-Amoah et al., 2019; Danso et al., 2020; Zhang et al., 2023). Nonetheless, there is limited empirical consensus on how sustainability orientation operates as a mediating mechanism in the green innovation–performance link. Previous research has focused predominantly on the direct effects, neglecting the strategic interplay between innovation practices and organisational values (Chen et al., 2012; Gupta & Barua, 2018; Shashi et al., 2018). Moreover, few studies have explored how this mediation unfolds in specific territorial contexts such as industrial clusters, where firms are exposed to external knowledge flows and normative pressures (Aftab et al., 2024).

Despite growing research on green innovation, key gaps persist. There is limited empirical evidence on the mediating role of sustainability orientation in the link between green innovation and sustainable performance. Few studies integrate internal behavioural factors with external territorial conditions, and even fewer examine how these dynamics operate in cluster-based industrial regions. On the basis of these theoretical premises, we propose the following hypothesis:

H2: Sustainability orientation mediates the relationship between green innovation and sustainable performance.

H2a: Sustainability orientation mediates the relationship between green product innovation and sustainable performance.

H2b: Sustainability orientation mediates the relationship between green process innovation and sustainable performance.

2.3. The environment and sustainability orientation

The external environment plays a critical role in shaping how firms implement and benefit from sustainability-oriented strategies. Industrial clusters, defined not only by geographic concentration but also by dense inter-firm relations and shared institutional frameworks, represent fertile ground for the diffusion of sustainability practices (Belso et al., 2024; Boix-Domenech et al., 2015; Porter, 1998). External factors, such as industry structure and mandatory regulations, significantly influence firms' performance outcomes (e.g., Delgado et al., 2014; Porter, 1991, 1998). Sustainable performance is no exception, as it extends beyond economic results to incorporate social and environmental dimensions. Empirical evidence shows that cluster-based firms are better positioned than isolated ones to address such multifaceted challenges through collective action, shared resources, and knowledge exchange (Vallet-Bellmunt et al., 2024). Consequently, collaborative networks play a crucial role in shaping the relationship between green innovation and sustainable performance, with variations arising from firms' interactions with their external environment (Cheng, 2020; Roxas and Coetzer, 2012).

Continuous technological, economic, social, or environmental changes force companies to systematically adapt their business strategy and develop their sustainability orientation to cope with them successfully (Kollmann and Stöckmann, 2010; Teixeira and Canciglieri Junior, 2019). Interaction with external knowledge repositories enables sustainably oriented companies to complement their internally developed knowledge and respond to a dynamic environment's challenges (Ye et al., 2022). Thus, continuous interaction with the context makes it easier for sustainability-sensitive companies to address their knowledge gaps, maintain the strength of their sustainable orientation, and reinforce their competitive advantage. In this way, they avoid the risks of cognitive blockage and inertia (Expósito-Langa et al., 2015).

In this regard, industrial clusters have often been approached from a spatial perspective, defined as geographical concentrations of firms, suppliers, and supporting organisations (Boix-Domenech et al., 2015). However, recent literature has highlighted the fact that geographic proximity alone does not fully explain the impact of clusters on innovation and sustainability outcomes. Instead, it is the intensity of interfirm engagement in shared activities, interorganisational networks, and collective learning processes, facilitated by trust and mutual commitment, that truly drives the value of clustering (Belso et al., 2024; Expósito-Langa et al., 2015; Molina-Morales, 2005).

Empirical evidence supports the more substantial capacity of cluster-based firms to address environmental and economic challenges (Sellitto et al., 2020; Vallet-Bellmunt et al., 2024), mainly due to their higher likelihood of engaging in collaborative knowledge-generation projects (Miret-Pastor et al., 2011). In contrast, firms operating outside clusters tend to function in more autonomous environments (Molina-Morales et al., 2019; Valdivieso-Uvidia et al., 2025), which presents more significant challenges in implementing sustainable strategies due to their limited access to collaborative networks and synergistic effects (Camarinha-Matos et al., 2010).

Ultimately, clusters serve as a contextual factor that provides a favourable environment for sustainability orientation to act as a facilitator in the relationship between green innovation and sustainable performance. In light of this, we propose the following hypothesis:

H3: Location within a cluster provides a favourable context for sustainability orientation to mediate the relationship between green innovation and sustainable performance.

3. Methodology

3.1. Sample and data

The study is based on a sample of 189 manufacturing firms from the Valencian Community (Spain), obtained through a cross-sectional electronic questionnaire collected between November 2020 and January 2021. The questionnaire was addressed to general managers, R&D managers, and, where applicable, sustainability or environmental officers, who are considered to have strategic and technical knowledge regarding the implementation of green innovation initiatives in their firms.

The Valencian Community is a key region within the Spanish industrial landscape, making it an ideal context for this study. It contributes 9.3% of the national gross domestic product (GDP) and 8.1% of R&D expenditure (IVIE, 2021). Furthermore, the consolidation of numerous industrial clusters in the Valencian Community reinforces its relevance as a research subject. With more than 50 identified industrial districts (Boix-Domenech et al., 2015), the region is responsible for approximately 20% of Spain's industrial employment and significantly contributes to national exports of manufactured products (GECE, 2023; Miret-Pastor et al., 2011).

This substantial economic and employment weight further justifies the selection of manufacturing firms in this region. According to structural business statistics from the Generalitat Valenciana (2020), 25.683 industrial companies were registered in the region, the majority of which belonged to the manufacturing sector. This sector generated €55.006 billion in turnover, accounting for 85.5% of the total industrial revenue, and employed an annual average of 249.770 people, representing 89.8% of industrial employment. These figures underscore the strategic contribution of the manufacturing industry to the regional economy and labour market.

The sampling frame consisted of 22.361 manufacturing firms, based on official records from the Generalitat Valenciana (2020). A simple random sampling procedure was used to ensure that the samples were representative, resulting in a validated sample of 189 firms with a maximum margin of error of ±7% and a 95% confidence level. Before final data collection, a pilot test was conducted with 10 randomly selected firms in order to refine the questionnaire. The final questionnaires were directed to general managers, R&D managers, or sustainability/environmental managers**.** A rigorous datacleaning process was then applied to eliminate incomplete or inconsistent responses. Within the obtained sample, firms were divided into two categories: those that are part of a cluster and those that are not. Specifically, out of the 189 firms, 58.2% (110 firms) belong to a cluster, while 41.8% (79 firms) do not participate in one. The sectoral diversity of the sample is considerable and reflects the productive specialisation of the Valencian Community. The most representative sectors include footwear (12.7%), toys and plastics (12.2%), the food industry (11.1%), and textiles (10.6%). In terms of annual revenue, 48.1% report revenues below €3 million, 22.8% report between €3 and €6 million, and 29.1% exceed €6 million.

3.2. Common method bias

Given that the study's data were collected through a single questionnaire completed by one respondent per firm, and other recent studies in this field (Valdivieso-Uvidia et.al., 2025). This test involved conducting an exploratory factor analysis (EFA) including all items from the scales, forcing the extraction of a single factor.

The results showed a Kaiser-Meyer-Olkin (KMO) value of 0.804, indicating satisfactory sampling adequacy for the factor analysis. Bartlett's test of sphericity was significant ($\chi^2 = 578.625$; df = 28; $p < 0.001$), supporting the appropriateness of the analysis. The first extracted factor accounted for 36.4% of the total variance, a value that is below the 50% threshold, leading to the conclusion that common method bias does not pose a serious threat to the validity of the results obtained.

3.3. Statistical technique

To process the collected data and evaluate the proposed mediation models, we employed the PROCESS macro for SPSS (Model 4), configured with 10.000 bootstrap samples and a 95% confidence level (Hayes, 2022; Hayes and Preacher, 2014). The models were executed independently for the two groups of firms (those within a cluster and those outside a cluster), allowing for appropriate comparisons. The alternate form of green innovation (product or process) was included as a covariate to control for potential confounding effects in the models and ensure greater internal validity (Igartua and Hayes, 2021).

The statistical analysis of mediation is a widely used methodological technique in social sciences (Hayes and Preacher, 2014; Zhang et al., 2023), and is particularly relevant in studies on innovation management and corporate sustainability, which examine critical mediating mechanisms to better understand these phenomena (Cheng, 2020; Maldonado-Guzmán, 2024; Martínez-Falcó et al., 2024). In line with studies by Igartua and Hayes (2021), mediation models allow researchers to explore "how or through what mechanisms an independent variable influences a dependent variable".

Following the latest recommendations by Hayes (2022), we applied ordinary least squares regression analysis in combination with PROCESS version 4.3, a modern bootstrap-based mediation approach that avoids incorrect assumptions regarding the normality of indirect effects. This method enables mediation analysis even in cases where no significant direct effect is observed between the independent and dependent variables, thereby challenging the dependency on the classical approach of Baron and Kenny (1986).

Hayes (2022) highlights bootstrap-based mediation analysis as offering significant advantages over classical statistical inference methods. Unlike Baron and Kenny's (1986) causal steps approach, this method does not require a significant total effect (c) to conduct the analysis. Instead, the bootstrap method allows for an exploration of indirect effects ($a \times b$) without an evident direct relationship between the independent and dependent variables. Additionally, it differs from the Sobel test, which has been widely used in the past but is limited by its dependence on the assumption of normality in the distribution of $a \times b$ (Sobel, 1982) a condition that is rarely met in practice (Hayes, 2022; Hayes and Preacher, 2014).

Under these premises, this technique was selected because it uses an iterative resampling strategy that does not assume normality, generating more precise and reliable confidence intervals to confirm the mediating role of a variable (M) in the relationship between the independent variable (X) and the dependent variable (Y). Thus, mediation occurs when the relationship between X and Y can be explained, at least partially, through a third variable, M (X→M→Y). This analysis distinguishes between two types of mediation.

- Full mediation occurs when the direct effect (c') is insignificant, indicating that the entire relationship between X and Y is explained through M.
- Partial mediation occurs when both the direct effect (c') and the indirect effect ($a \times b$) are significant, suggesting that M explains part, but not all, of the relationship between X and Y (Hayes, 2022; Igartua and Hayes, 2021).

3.4. Variables

3.4.1. Independent variables (X)

Green innovation was assessed in terms of two dimensions, constituting this study's independent variables: green product innovation (GPI) and green process innovation (GPrI). GPI examines how firms integrate environmental aspects into the design and development of their products. This was measured using items adapted from previous research and evaluated through a five-point Likert scale (Chen, 2008; Chen et al., 2006; Dangelico, 2016; Leonidou et al., 2015). GPrI assesses the extent to which firms adopt sustainable practices to reduce environmental impact in their production processes, drawing upon relevant studies (Dangelico, 2016; Huang and Li, 2017). The results of the factor analysis confirm the validity and reliability of the items used to measure each construct, as presented in Table 1.

3.4.2. Mediating variable (M1)

Sustainability orientation (SO), as the mediating variable, assesses the corporate commitment to sustainable practices using a five-point Likert scale composed of four items adapted from previous studies (Claudy et al., 2016; Graafland et al., 2004; Kraus et al., 2017). The results of the factor analysis, presented in Table 1, confirm the validity and reliability of the items used.

3.4.3. Dependent variable (Y)

As the dependent variable, sustainable performance (SP) was assessed using indicators adapted from previous research (Khan and Quaddus, 2015; Kraus et al., 2017). These indicators enable an analysis of the impact of business practices on sustainable outcomes. The items and their composition are presented in Table 1.

Table 1. Results of the factor analysis.

Construct	Items	Factor Loadings	Factor Analysis
Green product innovation (GPI)	1. We use materials that optimise resources and energy	0.729	Cronbach's α = 0.828 KMO = 0.788
	2. We employ biodegradable or recyclable materials	0.822	Bartlett's test of sphericity
	3. We reduce material usage to minimise pollution	0.724	Chi-square = 301.222
	4. We use sustainable packaging	0.753	df = 10
	5. We develop environmentally responsible products	0.811	sig < 0.000 AVE = 59.96% CR = 0.878
Green process innovation (GPrI)	1. We implement actions to reduce waste and residues generated in the manufacturing process	0.782	Cronbach's α = 0.828 KMO = 0.802
	2. We integrate measures into our processes to reduce energy consumption	0.857	Bartlett's test of sphericity Chi-square = 335.475
	3. We optimise water usage in production processes and improve raw material management	0.875	df = 6 sig < 0.000 AVE = 70.35% CR = 0.877
Sustainability orientation (SO)	1. We hire socially disadvantaged employees (e.g., disabled individuals, immigrants, older people)	0.754	Cronbach's α = 0.820 KMO = 0.788
	2. We set important social and environmental sustainability goals and incorporate them into our strategic decisions	0.884	Bartlett's test of sphericity Chi-square = 161.449 df = 6
	3. We engage employees in key decisions and corporate social responsibility activities	0.763	sig < 0.000 AVE = 65.96%
	4. We collaborate with other organisations to reduce environmental impact	0.837	CR = 0.886
Sustainable performance (SP)	1. We promote equality and inclusion in our work environment	0.808	Cronbach's α = 0.853 KMO = 0.800
	2. We develop competencies through employee training and recognition	0.874	Bartlett's test of sphericity Chi-square = 301.12
	3. We actively participate in community activities that connect the company with its social environment	0.834	df = 10 sig < 0.001 AVE = 69.71%
	4. We transmit values of social and environmental responsibility as part of our organisational mission	0.822	CR = 0.902

Note: CR, composite reliability; AVE, average variance extracted.

The effects of the theoretical model represented in Figure 1 highlight the relationships considered in our study.

Direct effect (c'): This assesses the direct influence of green innovation (X) on SP (Y) without the mediation of sustainability orientation (M), allowing for the evaluation of Hypothesis H1.

Indirect effect ($a \times b$): This examines the influence of green innovation (X) on SP (Y) through SO (M), providing evidence for Hypothesis H2. This effect is further divided into two paths:

- $a_1 \times b$ captures the influence of GPI on SP through SO;
- $a_2 \times b$ represents the impact of GPrI on SP mediated by SO.

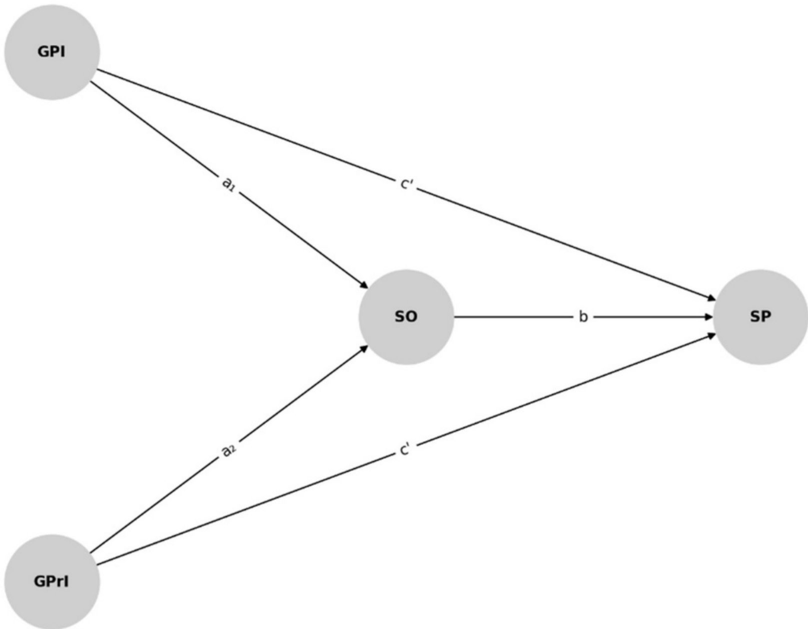

Figure 1. Theoretical model representing the effects and relationships considered in the study.

Finally, the role of the cluster (Hypothesis H3) is evaluated by comparing the mediation effects between firms within and outside the cluster, identifying potential differences in the strength of the indirect relationships according to industrial location, represented as a theoretical model.

4. Empirical results

Before the mediation analysis, the correlations between variables (Table 2) were assessed to rule out possible multicollinearity problems. The values obtained did not exceed the threshold of 0.7, indicating that the variables can be included in the model without risk of multicollinearity (Cohen, 1988; Kim, 2019).

Table 2. Descriptive statistics, Cronbach's alpha, and Pearson's correlations.

Variables	[a]Belonging to a Cluster					[b]Do not Belong to a Cluster				
	α	GPI	GPrI	SO	SP	α	GPI	GPrI	SO	SP
GPI	0.752	**1**				0.741	**1**			
GPrI	0.743	0.491**	**1**			0.718	0. 370**	**1**		
SO	0.724	0.391**	0.484**	**1**		0.711	0.329**	0.369**	**1**	
SP	0.853	0.520**	0.455**	0.562	**1**	0.847	0.460**	0.430**	0.478**	**1**

Note: [a]N= 110; [b]N= 79. * $p < 0.05$, **$p < 0.01$

Following the methodological recommendations for mediation analysis by Hayes (2022), Hayes and Preacher (2014) and Igartua and Hayes (2021), the direct (c') and indirect ($a \times b$) effects on the proposed trajectories were assessed. The coefficients obtained in both groups (in-cluster and out-of-cluster firms) were compared to identify significant differences in the direct and indirect effects. Table 3 shows the path coefficients, showing the direct effects of GPI and GPrI on SD. These results allow us to study the first hypothesis, i.e. the direct effect of green innovation on sustainable performance.

Table 3. Path coefficients of the variables.

[a]Belonging to a Cluster					[b]Do not Belong to a Cluster			
Path	***β***	***SE***	***t***	***p***	***β***	***SE***	***t***	***p***
GPI → SO	0.4002***	0.0783	5.1111	0.0000	0.1802*	0.1000	1.8020	0.0480
GPrI → SO	0.3004**	0.0992	3.0282	0.0031	0.2013**	0.0900	2.2367	0.0070
GPI → SP	0.2063**	0.0749	2.7543	0.0025	0.1749*	0.1138	1.5369	0.0301
GPrI → SP	0.1551**	0.0602	2.5764	0.0073	0.1613**	0.1125	1.5616	0.0012
SO → SP	0.4519***	0.1147	3.9398	0.0002	–0.0837	0.1172	–0.7142	0.4775

Note: [a]N= 110; [b]N= 79. *$p < 0.05$, **$p < 0.01$, *** $p < 0.001$.

The results show that GPrI has a positive and significant impact on sustainable performance in firms within the cluster (β = 0.2063, p = 0.0025), suggesting that those that develop green product initiatives and operate in a cluster environment can achieve improvements in sustainability. This effect is also significant in firms outside the cluster (β = 0.1749, p = 0.030), although of smaller magnitude, indicating that the positive impact of GPrI on sustainable performance is more pronounced within the cluster. These findings support H1a.

As for GPI, a positive impact on sustainable performance is observed for both in-cluster (β = 0.1551, p = 0.0073) and out-of-cluster (β = 0.1613, p = 0.0012) firms. Since the coefficients are similar, these results suggest that green process initiatives favour the sustainability of firms regardless of their cluster location. In this sense, the findings are consistent with H1b.

Table 4 shows the results of the indirect effect (X → M → Y), which is calculated as the product of the regression coefficients of the paths X → M (a) and M → Y (b). Its significance was assessed using bootstrap confidence intervals. An interval that does not include the value zero is interpreted as evidence of mediation according to the methodological guidelines of Hayes (2022). Thus, we analysed whether sustainability orientation mediates the relationship between green innovation and sustainable performance (H2).

Table 4. Mediating effects of variables.

Path	Type of effect	[a]Belonging to a Cluster				[b]Do not Belong to a Cluster			
		β	**SE**	**Lower CI**	**Upper CI**	***β***	**SE**	**Lower CI**	**Upper CI**
GPI → SP	Total effect	0.4036	0.0818	0.2407	0.5560	0.1394	0.1101	−0.0704	0.3700
GPI → SP	Direct effect	0.2063	0.0749	0.0597	0.3535	0.1749	0.1138	−0.0519	0.4016
GPrI → SP	Total effect	0.3057	0.0792	0.162	0.438	0.1975	0.1254	−0.0601	0.6085
GPrI → SP	Direct effect	0.1551	0.0602	−0.1504	0.1814	0.1613	0.1125	−0.0528	0.4354
GPI →SO→ SP	Indirect effect	0.2501	0.0559	0.1540	0.3934	0.0146	0.0233	−0.0291	0.2180
GPrI →SO→ SP	Indirect effect	0.1603	0.0413	0.0848	0.2834	0.1174	0.0585	−0.0161	0.0185

Note: [a]N = 110; [b]N = 79. CI refers to the confidence interval used (95%).

The results show differences depending on the business context. In companies belonging to clusters, the indirect effect of GPrI on sustainable performance through sustainability orientation is significant and higher than the direct effect (β = 0.2501, confidence interval (CI) [0.1540, 0.3934]). Similarly, the indirect effect of GPI on sustainable performance mediated by sustainability orientation is significant and higher than the direct effect (β = 0.1603, CI [0.0848, 0.2834]). These results allow us to validate H2a and H2b in the context generated by the cluster.

On the other hand, in firms outside the cluster, the relationship between GPrI and sustainable performance through sustainability orientation shows a coefficient β = 0.0146 with a confidence interval that includes the value zero (CI [−0.0291, 0.2180]), indicating that the mediation effect does not occur. Similarly, the relationship between GPI and sustainable performance through sustainability orientation (β = 0.1174, CI [−0.0161, 0.0185]) confirms the absence of mediation. These findings lead to rejecting H2a and H2b in noncluster firms, as sustainability orientation does not mediate in this context. Consequently, H2 is partially supported: Mediation only occurs in firms that are part of clusters, while not in those operating outside these collaborative networks (see Table 5).

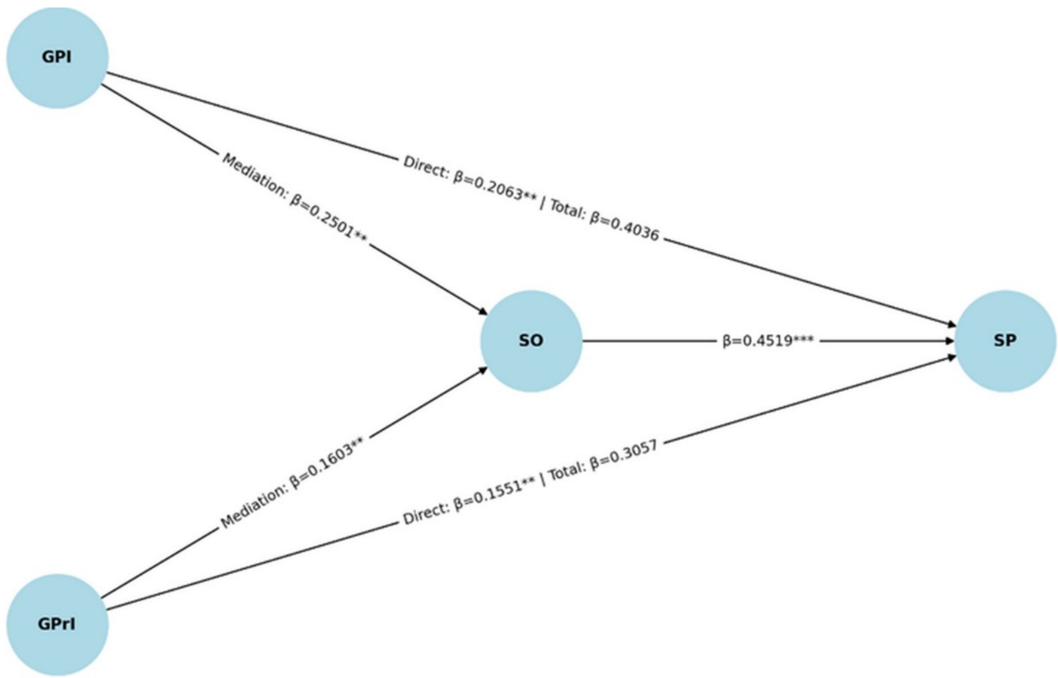

Figure 2. Empirical results: In-cluster firms' path coefficients and mediation effects.

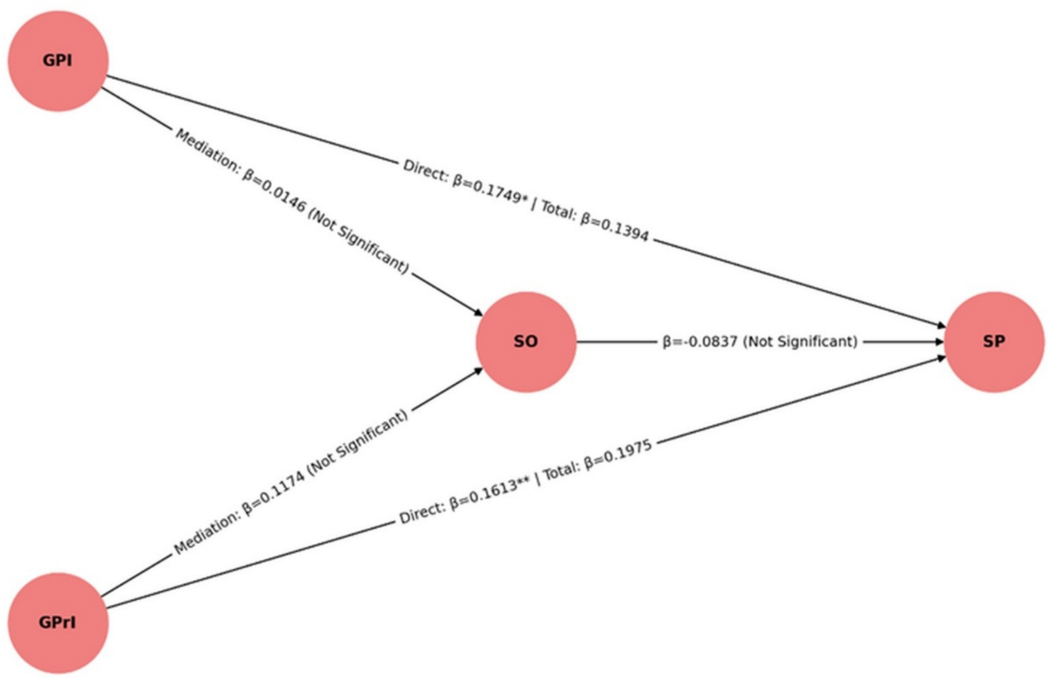

Figure 3. Empirical results: Noncluster firms' path coefficient and mediation effects.

To evaluate Hypothesis H3, mediation coefficients were compared between firms belonging to a cluster and those not part of these collaborative networks. In in-cluster firms, sustainability orientation significantly mediates the relationship between GPrI and sustainable performance, with a mediation coefficient of β = 0.2501 and CI [0.1540, 0.3934]. In contrast, this indirect effect is insignificant for noncluster firms, as the coefficient is $\beta = 0.0146$, and its CI includes the zero value, CI [−0.0291, 0.2180]. Similarly, sustainability orientation significantly mediates the relationship between GPI and sustainable performance in firms within clusters, with $\beta = 0.1603$, CI [0.0848, 0.2834]. However, this indirect effect is insignificant in firms that are not part of a cluster, given its CI, which includes zero ($\beta = 0.1174$, CI [−0.0161, 0.0185]).

Given that the mediation of sustainability orientation only occurs in firms within a cluster (Figure 2) and is absent in those that do not belong to these industrial networks (Figure 3), the results suggest that location in a cluster provides a favourable context for sustainability orientation to act as a mediating mechanism in the relationship between green innovation and sustainable performance. This indicates that firms located in a cluster can benefit from this environment, which facilitates sustainability. Therefore, the findings support Hypothesis H3, confirming that the cluster context is a determining element in mediating sustainability orientation.

Table 5. Summary of hypotheses.

Hypothesis		Outcome	Justification
H1	Green innovation has a significant effect on sustainable performance	Supported in all contexts	GPI and GPrI significantly directly affect SP in firms within and outside clusters.
H1a	Does green product innovation directly impact sustainable performance?	Supported	
H1b	Does green process innovation directly impact sustainable performance?	Supported	
H2	Sustainability orientation mediates the relationship between green innovation and sustainable performance	Partially supported	Mediation only occurs in firms within the cluster. It is not significant outside the cluster.
H2a	Does the SO mediate the relationship GPI → SP?	Supported in-cluster; not supported out-of-cluster	
H2b	Does the SO mediate the relationship GPrI → SD?	Supported in-cluster; not supported out-of-cluster	
H3	Location in a cluster provides a favourable context for sustainability orientation to mediate the relationship between green innovation and sustainable firm performance.	Supported	SO's mediation is intense within the cluster and absent outside the cluster.

5. Discussion and conclusions

Our results allow us to reach several conclusions. First, they reinforce the empirical evidence on the progress of the manufacturing sector in the Valencian Community in the adoption of green initiatives, which could serve as a benchmark for other Spanish communities or regions that are starting to implement these innovations on the road to sustainability. According to Albort-Morant et al. (2016)

and Segarra-Oña et al. (2011), green innovation plays a key role in transforming the manufacturing sector in Spain by strengthening the entire national industry through sustainable strategies. Our findings further elaborate on this, as we provide specific data on the Valencian Community, highlighting its consolidation as an advanced industrial ecosystem regarding sustainability.

The differentiation between GPrI and GPI reveals the differences in their impact mechanisms on sustainable performance. While GPrI influences consumer perception and market differentiation (Chen et al., 2012), GPI aims to improve operational efficiency by reducing costs and optimising resources (Xie et al., 2019). Our results indicate that the latter requires a strong sustainability orientation to translate into real improvements in sustainable performance. In firms within the cluster, GPrI already significantly impacts sustainability. However, its effect is strengthened by sustainability orientation (Shashi et al., 2018), which aligns with recent evidence from emerging economies showing that strong leadership skills and green entrepreneurial orientation positively influence green innovation and sustainable performance (Aftab et al., 2024; Ishaq et al., 2024), suggesting that firms can benefit even more if they integrate sustainability-aligned organisational practices. In contrast, GPI fails to achieve a direct impact without sustainability orientation, supporting the idea that its contribution to sustainable performance depends entirely on a structured organisational approach (Ruiz-Ortega et al., 2021). Our findings reinforce the importance of consolidating a corporate culture of sustainability to maximise the impact of green innovation, especially in optimising production processes.

In addition, support organisations play a fundamental role in consolidating sustainable strategies within these industrial environments. Institutions such as sectoral associations, technology centres, and government agencies facilitate the dissemination of knowledge, training in sustainable practices, and access to incentives for green innovation, hand in hand with the cluster. Their intervention is key to reducing the barriers faced by companies outside the cluster, as only in this way can they access knowledge and support networks that enhance their green innovation capabilities and are more beneficial for sustainable performance.

From this perspective, our results highlight the role of sustainability orientation as a key mechanism in amplifying the impact of green innovation on sustainable performance, particularly in firms located within an industrial cluster, where its indirect effect is stronger than the direct one. This highlights the capacity of these industrial ecosystems to facilitate the generation of synergies between firms and the transfer of knowledge (Belso et al., 2024; Delgado et al., 2014; Expósito-Langa et al., 2024; Porter, 1998). However, it is important to recognise that the effects attributed to clusters go beyond mere spatial proximity. As highlighted by recent studies, the real influence of clusters stems from the intensity of firms' engagement in shared activities, interorganisational collaboration, and collective learning, all of which depend heavily on absorptive capacity and relational embeddedness (Belso et al., 2024; Expósito-Langa et al., 2015; Molina-Morales, 2005).

While firms outside the cluster also benefit from green innovation (Melander and Arvidsson, 2022), their sustainability impact is lower, suggesting that they face structural barriers and limitations in accessing key resources, such as specialised information, advanced technologies, and collaborative networks (Abdullah et al., 2016; Stucki, 2019). Moreover, these firms may not have a sufficiently developed organisational culture to integrate sustainability into their core strategy, reinforcing the relevance of fostering support networks beyond traditional clusters. Thus, our results contribute positively to the open debate on how clusters and the relational intensity within them generate positive externalities for green innovation and business sustainability (Expósito-Langa et al., 2015; Hervas-Oliver et al., 2024). It also warns of the importance of recognising that cluster environments may foster mimetic learning dynamics that homogenise organisational behaviour. The reinforcement of sustainability orientation within clusters may stem more from institutional pressures than from a deliberate strategic positioning. Research such as that by Aftab et al. (2025) shows that many firms adopt sustainable practices in response to coercive, normative, or mimetic institutional pressures, rather than because of a genuine strategic conviction. As a result, firms may converge towards similar practices, potentially limiting the emergence of distinctive innovations and sustainable competitive advantages.

Finally, we conclude that manufacturing companies that are part of a cluster in the Valencian Community, where some of the most influential national and international clusters are located (e.g., the Footwear Cluster, the Toy Valley Cluster, and the Plastics Cluster of the Valencian Community), have a significant structural advantage. These companies perceive their sustainability orientation as a strategic asset and capitalise better on green innovation, transforming it into concrete sustainable improvements.

This study has limitations that will be addressed in future work. First, its exclusive focus on the Valencian Community, Spain, could reduce the applicability of the results to other geographical and economic contexts. Nevertheless, they could be replicated in future studies in different regions or countries. Moreover, the focus on manufacturing firms excludes sectors with differentiated characteristics, such as services or technology. This research approaches sustainability from a construct-specific perspective, prioritising the social dimensions of sustainable performance as part of a deliberate theoretical and methodological delimitation. Although this study applies a geographical operationalisation of cluster membership, we acknowledge this as a limitation and recommend that future research include more nuanced indicators, such as network centrality, relational intensity, or participation in joint sustainability initiatives to better capture the underlying mechanisms that drive sustainable outcomes in clustered contexts. An additional limitation is the temporal scope of the data, which were collected during 2020–2021, which may not fully capture recent developments in corporate sustainability.

For future research directions, longitudinal studies should be carried out to analyse the evolution of the factors influencing sustainability over time and the impact of other contextual variables. This approach would also help to address the temporal limitation of the present study. In addition, it would also be interesting to examine each category of barriers and dynamics that hinder or limit the benefit of green innovation in the manufacturing sector, as this is a complex strategy subject to multiple constraints.

6. Theoretical implications

This study contributes to the theoretical framework of green innovation by demonstrating that its effects on sustainable performance vary according to its type: While GPrI shows a direct and immediate impact, process innovation requires a strong sustainability orientation to be effective. This distinction enriches the NRBV by clarifying that different types of green innovation may rely on distinct internal capabilities and strategic conditions to generate sustainable outcomes.

Through a comparative analysis of firms operating within industrial clusters and those outside such environments, the study further provides insights into how organisational context may influence the mediating role of sustainability orientation. The results indicate that this orientation tends to play a more prominent role in clustered firms, where collaboration, trust, and access to shared resources are more common. These findings underscore the importance of sustainability orientation as an enabling strategic condition, particularly in firms where sustainability is not yet deeply integrated into the corporate structure. Overall, this perspective encourages further theoretical exploration into how internal organisational values and external territorial factors interact in shaping the effectiveness of green innovation strategies.

7. Practical Implications

From a practical perspective, the findings highlight the strategic relevance of sustainability orientation as a key internal condition that enhances the impact of green innovation on sustainable performance. This is particularly evident in the case of process innovations, whose effectiveness appears to depend more strongly on the presence of such an orientation.

Moreover, the results show that firms located within industrial clusters tend to benefit more from the interaction between green innovation and sustainability orientation. The collaborative environment and relational dynamics typical of clusters may contribute to reinforcing the organisational commitment to sustainability and, consequently, to improving performance outcomes. These insights underline the importance for firms of cultivating a genuine sustainability orientation and, where possible, of participating in ecosystems that support shared learning and interorganisational cooperation around green innovation strategies.

8. Policy Implications

The findings of this study provide relevant guidance for public policy aimed at promoting sustainable innovation in the industrial sector. Specifically, the results underline the importance of fostering sustainability orientation within firms as a strategic capacity that enhances the effectiveness of green innovation, particularly in achieving long-term sustainable performance.

Moreover, the study shows that the presence of industrial clusters creates a more favourable context for this orientation to develop and operate effectively. Policymakers can draw from this by strengthening the institutional conditions that support collaborative environments, such as encouraging the formation of sectoral associations, facilitating access to shared sustainability resources, and promoting interorganisational learning platforms within clusters. These measures can help amplify the strategic role of sustainability orientation and increase the likelihood that green innovation initiatives result in meaningful environmental, social, and economic outcomes.

Author contributions

Jeanneth Marcela Valdivieso Uvidia: Conceptualization, Methodology, Data curation, Validation, Writing – original draft, Formal analysis, Writing – review & editing, Supervision. Manuel Expósito Langa: Conceptualization, Methodology, Data curation, Validation, Writing – original draft, Formal analysis, Writing – review & editing, Supervision. José Antonio Belso-Martínez: Conceptualization, Methodology, Data curation, Validation, Writing – original draft, Formal analysis, Writing – review & editing, Supervision.

Use of AI tools declaration

The authors declare they have not used artificial intelligence (AI) tools in the creation of this article.

Conflict of interest

The authors declare no conflicts of interest in this paper.

References

Abdullah M, Zailani S, Iranmanesh M, et al. (2016). Barriers to green innovation initiatives among manufacturers: the Malaysian case. *Rev Manag Sci* 10: 683–709. https://doi.org/10.1007/s11846-015-0173-9

Afeltra G, Alerasoul SA, Strozzi F (2023) The evolution of sustainable innovation: from the past to the future. *Eur J Innov Manag* 26: 386–421. https://doi.org/10.1108/EJIM-02-2021-0113

Aftab J, Veneziani M, Sarwar H, et al. (2024) Do green practices drive business excellence in SMEs? Investigating how green entrepreneurial orientation improves firm's performance. *Total Qual Manag Bus Excell* 35: 529–558. https://doi.org/10.1080/14783363.2024.2315442

Aftab J, Veneziani M, Wei F, et al. (2025) Corporate Social Responsibility and Business Excellence: Examining the Serial Mediation of Green Entrepreneurial Orientation and Differentiation Strategy. *Corp Soc Responsib Environ Manag* 32: 3621–3638. https://doi.org/10.1002/csr.3152

Akbari M, Padash H, Shahabaldini Parizi Z, et al. (2022) A bibliometric review of green innovation research: identifying knowledge domain and network. *Qual Quant* 56: 3993–4023. https://doi.org/10.1007/s11135-021-01295-4

Albort-Morant G, Leal-Millán A, Cepeda-Carrión G (2016) The antecedents of green innovation performance: A model of learning and capabilities. *J Bus Res* 69: 4912–4917. https://doi.org/10.1016/j.jbusres.2016.04.052

Amankwah-Amoah J, Danso A, Adomako S (2019) Entrepreneurial orientation, environmental sustainability and new venture performance: does stakeholder integration matter? *Bus Strateg Environ* 28: 79–87. https://doi.org/10.1002/bse.2191

Anjum NA, Shahid ZA, Mubarik MS, et al. (2024) Role of green innovation and sustainable supply chain management in firm internationalization. *Rev Int Bus Strateg* 34: 292–310. https://doi.org/10.1108/RIBS-06-2023-0056

Asante K, Novak P, Kwarteng MA (2024) Environmental Sustainability Orientation, Dynamic Capability, Entrepreneurial Orientation, and Green Innovation in Small-and Medium-sized Enterprise, In: *Sustainable and Resilient Global Practices: Advances in Responsiveness and Adaptation,* Emerald Publishing Limited, 55–79. https://doi.org/10.1108/978-1-83797-611-920241004

Barforoush N, Etebarian A, Naghsh A, et al. (2021) Green innovation a strategic resource to attain competitive advantage. *Int J Innov Sci* 13: 645–663. https://doi.org/10.1108/IJIS-10-2020-0180

Baron RM, Kenny DA (1986) The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *J Pers Soc Psychol* 51: 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Belso JA, Díez-Vial I, Martín-de Castro G, et al. (2024) How much do cluster institutions drive a firm's green innovation? A multi-level analysis. *Reg Stud* 59: 2298317. https://doi.org/10.1080/00343404.2023.2298317

Benitez-Amado J, Llorens-Montes FJ, Fernandez-Perez V (2015) IT impact on talent management and operational environmental sustainability. *Inf Technol Manag* 16: 207–220. https://doi.org/10.1007/s10799-015-0226-4

Boix-Domenech R, Sforzi F, Galletto Ciocia V, et al. (2015) Sistemas locales de trabajo y distritos industriales en España 2001–2011. *Int Conf Reg Sci*: 1–30.

Camarinha-Matos LM, Afsarmanesh H, Boucher X (2010) The role of collaborative networks in sustainability, In: *Working Conference on Virtual Enterprises*, Berlin, Heidelberg: Springer Berlin Heidelberg, 1–16. https://doi.org/10.1007/978-3-642-15961-9_1

Chen YS (2008) The driver of green innovation and green image - Green core competence. *J Bus Ethics* 81: 531–543. https://doi.org/10.1007/s10551-007-9522-1

Chen YS, Chang CH, Lin YH (2014) The determinants of green radical and incremental innovation performance: Green shared vision, green absorptive capacity, and green organizational ambidexterity. *Sustainability* 6: 7787–7806. https://doi.org/10.3390/su6117787

Chen YS, Chang CH, Wu FS (2012) Origins of green innovations: The differences between proactive and reactive green innovations. *Manag Decis* 50: 368–398. https://doi.org/10.1108/00251741211216197

Chen YS, Lai SB, Wen CT (2006) The influence of green innovation performance on corporate advantage in Taiwan. *JBus Ethics* 67: 331–339. https://doi.org/10.1007/s10551-006-9025-5

Cheng CCJ (2020) Sustainability Orientation, Green Supplier Involvement, and Green Innovation Performance: Evidence from Diversifying Green Entrants. *J Bus Ethics* 161: 393–414. https://doi.org/10.1007/s10551-018-3946-7

Chiarvesio M, De Marchi V, Maria ED (2015) Environmental Innovations and Internationalization: Theory and Practices. *Bus Strateg Environ* 24: 790–801. https://doi.org/10.1002/bse.1846

Chiou TY, Chan HK, Lettice F, et al. (2011) The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. *Transp Res E Logist Transp Rev* 47: 822–836. https://doi.org/10.1016/j.tre.2011.05.016

Chung CJ, Wee HM (2008) Green-component life-cycle value on design and reverse manufacturing in semi-closed supply chain. *Int J Prod Econ* 113: 528–545. https://doi.org/10.1016/j.ijpe.2007.10.020

Claudy MC, Peterson M, Pagell M (2016) The Roles of Sustainability Orientation and Market Knowledge Competence in New Product Development Success. *J Prod Innov Manag* 33: 72–85. https://doi.org/10.1111/jpim.12343

Cohen J (1988) Statistical Power Analysis for the Behavioral Sciences. *Stat Power Anal Behav Sci.* https://doi.org/10.4324/9780203771587

Dangelico RM (2016) Green Product Innovation: Where we are and Where we are Going. *Bus Strateg Environ* 25: 560–576. https://doi.org/10.1002/bse.1886

Danso A, Adomako S, Lartey T, et al. (2020) Stakeholder integration, environmental sustainability orientation and financial performance. *J Bus Res* 119: 652–662. https://doi.org/10.1016/J.JBUSRES.2019.02.038

Delgado M, Porter ME, Stern S (2014) Clusters, convergence, and economic performance. *Res Policy* 43: 1785–1799. https://doi.org/10.1016/j.respol.2014.05.007

Diez-Martinez I, Peiro-Signes A (2022) Transitioning towards sustainability: The 'what', 'why' and 'how' of the integration of sustainable practices into business models. *Tec Empresarial* 16: 44–86.

Díez-Vial I, Belso-Martínez JA, Gregorio MDC (2023) Extending Green Innovations Across Clusters: HOW can Firms Benefit Most? *Int Reg Sci Rev* 46: 149–178. https://doi.org/10.1177/01600176221106132

Eiadat Y, Kelly A, Roche F, et al. (2008) Green and competitive? An empirical test of the mediating role of environmental innovation strategy. *J World Bus* 43: 131–145. https://doi.org/10.1016/j.jwb.2007.11.012

Expósito-Langa M, Belso-Martínez JA, Valdivieso-Uvidia MJ, et al. (2024) Green Innovation, Internationalization and Territorial Networks: In Search for Sustainable Business Performance, In: *Networks and Foreign Markets: How Relationships Shape the SME's Internationalization Process, Cham: Springer International Publishing,* 85–105. https://doi.org/10.1007/978-3-031-45659-6_4

Expósito-Langa M, Tomás-Miquel JV, Molina-Morales F (2015) Innovation in clusters: exploration capacity, networking intensity and external resources. *J Organ Change* 28: 26–42. https://doi.org/10.1108/JOCM-10-2013-0192

GECE (2023) Evolución de los niveles de competitividad en las empresas de la Comunitat Valenciana (2014–2021).

Generalitat Valenciana. (2020) *Estadística estructural de empresas: Sector industrial 2020*. Portal Estadístico de la Generalitat Valenciana. Available from: https://pegv.gva.es/es/estadistica-estructural-de-empresas-sector-industrial.

Graafland JJ, Eijffinger SCW, Smidjohan H (2004) Benchmarking of corporate social responsibility: Methodological problems and robustness. *J Bus Ethics* 53: 137–152. https://doi.org/10.1023/B:BUSI.0000039404.67854.e1

Gupta H, Barua MK (2018) A framework to overcome barriers to green innovation in SMEs using BWM and Fuzzy TOPSIS. *Sci Total Environ* 633: 122–139. https://doi.org/10.1016/j.scitotenv.2018.03.173

Hart SL (1995) A Natural Resource View of the Firm. *Acad Manag Rev* 20: 986–1014. https://doi.org/10.2307/258963

Hayes AF (2022) *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*, The Guilford Press (3rd ed.)

Hayes AF, Preacher KJ (2014) Statistical mediation analysis with a multicategorical independent variable. *Br J Math Stat Psychol* 67: 451–470. https://doi.org/10.1111/bmsp.12028

Hervas-Oliver JL, Márquez García JAA, García-Chamizo F, et al. (2024) Are clusters and industrial districts really driving sustainability innovation? *Competit Rev* 34: 896–915. https://doi.org/10.1108/CR-06-2024-0109

Horbach J (2008) Determinants of environmental innovation-New evidence from German panel data sources. *Res Policy* 37: 163–173. https://doi.org/10.1016/j.respol.2007.08.006

Huang JW, Li YH (2017) Green Innovation and Performance: The View of Organizational Capability and Social Reciprocity. *J Bus Ethics* 145: 309–324. https://doi.org/10.1007/s10551-015-2903-y

Igartua JJ, Hayes AF (2021) Mediation, Moderation, and Conditional Process Analysis: Concepts, Computations, and Some Common Confusions. *Span J Psychol* 24: 1–23. https://doi.org/10.1017/SJP.2021.46

Ishaq MI, Sarwar H, Aftab J, et al. (2024) Accomplishing sustainable performance through leaders' competencies, green entrepreneurial orientation, and innovation in an emerging economy: Moderating role of institutional support. *Bus Strateg Environ* 33: 1515–1532. https://doi.org/10.1002/bse.3557

IVIE (2021) *Economía Circular en la región Comunitat Valenciana, España 2020. REDUCES - Inst Valenc Investig Econ.*

Khan EA, Quaddus M (2015) Development and validation of a scale for measuring sustainability factors of informal microenterprises - A qualitative and quantitative approach. *Entrep Res J* 5: 347–372. https://doi.org/10.1515/erj-2014-0017

Kim JH (2019) Multicollinearity and misleading Statistical Results. *Korean J Anesthesiol* 72: 558–569. https://doi.org/10.4097/kja.19087

Klewitz J, Hansen EG (2014) Sustainability-oriented innovation of SMEs: a systematic review. *J Clean Prod* 65: 57–75. https://doi.org/10.1016/J.JCLEPRO.2013.07.017

Kollmann T, Stöckmann C (2010) Antecedents of strategic ambidexterity: Effects of entrepreneurial orientation on exploratory and exploitative innovations in adolescent organisations. *Int J Technol Manag* 52: 153–174. https://doi.org/10.1504/IJTM.2010.035860

Kraus S, Niemand T, Halberstadt J, et al. (2017) Social entrepreneurship orientation: development of a measurement scale. *Int J Entrep Behav Res* 23: 977–997. https://doi.org/10.1108/IJEBR-07-2016-0206

Kreiser PM, Davis J (2010) Entrepreneurial Orientation and Firm Performance: The Unique Impact of Innovativeness, Proactiveness, and Risk-taking. *J Small Bus Entrep* 23: 39–51. https://doi.org/10.1080/08276331.2010.10593472

Leonidou LC, Leonidou CN, Fotiadis TA, et al. (2015) Dynamic capabilities driving an eco-based advantage and performance in global hotel chains: The moderating effect of international strategy. *Tour Manag* 50: 268–280. https://doi.org/10.1016/J.TOURMAN.2015.03.005

Mahanta A, Chandra Sahu N, Kumar Behera P, et al. (2024) Variations in financial performance of firms with ESG integration in business: The mediating role of corporate efficiency using DEA. *Green Financ* 6: 518–562. https://doi.org/10.3934/gf.2024020

Maldonado-Guzmán G (2024) Green innovation mediates between financial innovation and business sustainability? Proof in the mexican manufacturing industry. *Green Financ* 6: 563–584. https://doi.org/10.3934/gf.2024021

Martinez-del-Rio J, Antolin-Lopez R, Cespedes-Lorente JJ (2015) Being Green Against the Wind? The Moderating Effect of Munificence on Acquiring Environmental Competitive Advantages. *Organ Environ* 28: 181–203. https://doi.org/10.1177/1086026615573082

Martínez-Falcó J, Sánchez-García E, Marco-Lajara B, et al. (2024) Green intellectual capital and sustainable competitive advantage: unraveling role of environmental management accounting and green entrepreneurship orientation. *J Intellect Cap* 26: 104–129. https://doi.org/10.1108/JIC-07-2024-0204

Melander L (2017) Achieving Sustainable Development by Collaborating in Green Product Innovation. *Bus Strateg Environ* 26: 1095–1109. https://doi.org/10.1002/bse.1970

Melander L, Arvidsson A (2022) Green innovation networks: A research agenda. *J Clean Prod* 357: 131926. https://doi.org/10.1016/j.jclepro.2022.131926

Miret-Pastor L, Segarra-Oña MV, Peiró-Signes Á (2011) Identificación de sectores de servicios y de alta tecnología en la Comunidad Va- lenciana : ¿ Un nuevo cluster mapping ? *Rev Estud Reg* 7585: 71–96.

Molina-Morales FX (2005) The territorial agglomerations of firms: A social capital perspective from the spanish tile industry. *Growth and Change* 36: 74–99. https://doi.org/10.1111/j.1468-2257.2005.00267.x

Molina-Morales FX, Martínez-Cháfer L, Valiente-Bordanova D (2019) Disruptive technology adoption, particularities of clustered firms. *Entrep Reg Dev* 31: 62–81. https://doi.org/10.1080/08985626.2018.1537147

Neumann T (2021) The impact of entrepreneurship on economic, social and environmental welfare and its determinants: a systematic review. *Manag Rev Q* 71: 553–584. https://doi.org/10.1007/s11301-020-00193-7

Nguyen DD (2023) Evaluating the Consumer Attitude and Behavioral Consumption of Green Products in Vietnam. *Sustainability* 15: 7612. https://doi.org/10.3390/su15097612

Oduro S, Maccario G, De Nisco A (2022) Green innovation: a multidomain systematic review. *Eur J Innov Manag* 25: 567–591. https://doi.org/10.1108/EJIM-10-2020-0425

Parrilli MD, Balavac-Orlić M, Radicic D (2023) Environmental innovation across SMEs in Europe. *Technovation* 119*:* 102541. https://doi.org/10.1016/j.technovation.2022.102541

Peiró-Signes Á, Segarra-Oña MDV, Miret-Pastor L, et al. (2011) Eco-innovation attitude and industry's technological level - an important key for promoting efficient vertical policies. *Environ Eng Manag J* 10: 1893–1901. https://doi.org/10.30638/eemj.2011.253

Podsakoff PM, MacKenzie SB, Podsakoff NP (2012) Sources of method bias in social science research and recommendations on how to control it. *Annu Rev Psychol* 63: 539–569. https://doi.org/10.1146/annurev-psych-120710-100452

Porter ME (1991) Towards a dyamic theory of strategy. *Strateg Manag J* 12: 95–117. https://doi.org/10.1002/smj.4250121008

Porter ME (1998) Clusters and the New Economics of Competition. *Harvard Bus Rev*.

Ratten V (2018) Eco-innovation and competitiveness in the Barossa Valley wine region. *Competit Rev* 28: 318–331. https://doi.org/10.1108/CR-01-2017-0002

Roxas B, Coetzer A (2012) Institutional Environment, Managerial Attitudes and Environmental Sustainability Orientation of Small Firms. *J Bus Ethics* 111: 461–476. https://doi.org/10.1007/s10551-012-1211-z

Ruiz-Ortega MJ, Parra-Requena G, García-Villaverde PM (2021) From entrepreneurial orientation to sustainability orientation: The role of cognitive proximity in companies in tourist destinations. *Tour Manag* 84: 104265. https://doi.org/10.1016/j.tourman.2020.104265

Segarra-Oña M, Peiró-Signes A, Miret-Pastor L, et al. (2011) ¿Eco-innovación, una evolución de la innovación? Análisis empírico en la industria cerámica española. *Bol Soc Esp Ceram Vidr* 50: 253–260. https://doi.org/10.3989/cyv.332011

Sellitto MA, Camfield CG, Buzuku S (2020) Green innovation and competitive advantages in a furniture industrial cluster: A survey and structural model. *Sustain Prod Consum* 23: 94–104. https://doi.org/10.1016/j.spc.2020.04.007

Shashi Cerchione R, Centobelli P, Shabani A (2018) Sustainability orientation, supply chain integration, and SMEs performance: a causal analysis. *Benchmarking* 25: 3679–3701. https://doi.org/10.1108/BIJ-08-2017-0236

Shehzad MU, Jianhua Z, Naveed K, et al. (2024) Sustainable transformation: An interaction of green entrepreneurship, green innovation, and green absorptive capacity to redefine green competitive advantage. *Bus Strateg Environ* 33: 7041–7059. https://doi.org/10.1002/bse.3859

Sobel ME (1982) Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models. *Sociol Methodol* 13: 290. https://doi.org/10.2307/270723

Stucki T (2019) Which firms benefit from investments in green energy technologies? – The effect of energy costs. *Res Policy* 48: 546–555. https://doi.org/10.1016/j.respol.2018.09.010

Takalo SK, Tooranloo HS (2021) Green innovation: A systematic literature review. *J Clean Prod* 279: 122474. https://doi.org/10.1016/J.JCLEPRO.2020.122474

Tardin MG, Perin MG, Simões C, et al. (2024) Organizational Sustainability Orientation: A Review. *Organ Environ* 37: 298–324. https://doi.org/10.1177/10860266231226144

Teixeira GFG, Canciglieri Junior O (2019) How to make strategic planning for corporate sustainability? *J Clean Prod* 230: 1421–1431. https://doi.org/10.1016/J.JCLEPRO.2019.05.063

Valdivieso-Uvidia JM, Expósito-Langa M, Belso-Martínez JA (2025) The role of technological intensity , cluster membership , and internationalisation for greater green innovation : The case of the Valencian Community. *Tec Empresarial* 19: 71–89. https://doi.org/https://doi.org/10.18845/te.v19i2.7940

Vallet-Bellmunt T, Del-Corte-Lora V, Martínez-Fernández MT (2024) Do we have to choose between economic or environmental performance? The case of the ceramic industry cluster. *Corp Soc Responsib Environ Manag* 31: 5815–5836. https://doi.org/10.1002/csr.2890

Weng HHR, Chen JS, Chen PC (2015) Effects of green innovation on environmental and corporate performance: A stakeholder perspective. *Sustainability* 7: 4997–5026. https://doi.org/10.3390/su7054997

Xie X, Huo J, Zou H (2019) Green process innovation, green product innovation, and corporate financial performance: A content analysis method. *J Bus Res* 101: 697–706. https://doi.org/10.1016/J.JBUSRES.2019.01.010

Ye F, Yang Y, Xia H, et al. (2022) Green entrepreneurial orientation, boundary-spanning search and enterprise sustainable performance: The moderating role of environmental dynamism. *Front Psychol* 13: 1–17. https://doi.org/10.3389/fpsyg.2022.978274

Zehir C, Can E, Karaboga T (2015) Linking Entrepreneurial Orientation to Firm Performance: The Role of Differentiation Strategy and Innovation Performance. *Procedia Soc Behav Sci* 210: 358–367. https://doi.org/10.1016/j.sbspro.2015.11.381

Zhang J, Gazi M Badiuzzaman SH, Rahman MS, et al. (2023) Does corporate reputation play a mediating role in the association between manufacturing companies' corporate social responsibility (CSR) and financial performance? *Green Financ* 5: 240–264. https://doi.org/10.3934/GF.2023010

Zhang J, Liang G, Feng T, et al. (2020) Green innovation to respond to environmental regulation: How external knowledge adoption and green absorptive capacity matter? *Bus Strateg Environ* 29: 39–53. https://doi.org/10.1002/bse.2349