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Capabilities and organisational dimensions conducive to green product innovation: Evidence from Croatian and Spanish manufacturing firms

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Abstract

This paper aims to determine which configuration of green innovation capabilities (GICs) and organisational dimensions (ODs) leads to achieving green product innovation (GPI). We used data collected through the European Manufacturing Survey (EMS) from manufacturing firms in Spain and Croatia considered to be innovators. After conducting a cluster analysis, we identified a group of firms that still develop conventional product innovations (CPIs) and three groups of firms at different stages of GPI development. The four clusters were characterised using different variables, or determinants of GPI, associated with seven GICs and five ODs that favour GPI. According to the findings, all the GICs and ODs under analysis have a positive impact on GPI development, which results in the consolidation of a framework that organisations could use to manage green innovation. By empirically showing the relevance of applying these constructs, this study makes contributions to the Resource-Based Theory (RBT), along with its extension to GICs, and points to the need to associate them with the ODs to achieve GPI towards the challenge of sustainable development.

KEYWORDS

determinants, green innovation capabilities, green product innovation, manufacturing firms, organisational dimensions, sustainable development

Abbreviations: AMT-PROD, additive manufacturing technologies for mass production; AUTOMAT, control-automation systems for an energy efficient production; CER, Corporate Environmental Responsibility; CERT-ENER, certified energy management system (EN ISO 50001, previously EN 16001); CPIs, conventional products innovation; DCs, dynamic capabilities; EMS, European Manufacturing Survey; ER, Environmental Regulations; GICs, Green Innovation Capabilities; GMC, Green Marketing Capability; GOIC, Green Organisational Innovation Capability; GOLRC, Green Organisational Learning and Relationship Capability; GPC, Green Production Capability; GPIs, Green Product Innovations; GR&DC, Green Research and Development Capability; GRMC, Green Resource Management Capability; GSPC, Green Strategic Planning Capability; HR, Human Resources; IMP S-E, impact and performance measurements of social and environmental corporate activities; INFORMAT, use information gathered to develop or adapt current products, services or processes; INS-LIFECY, instruments of life-cycle assessment (e.g., EU Ecolabel, C2C, ISO 14020); IT-TRAINING, IT-based self-study programs (e-learning) for continuous training and evaluation of production employees; LINES, customer- or product-oriented lines/cells in the factory; LOGISTIC, practices to improve internal logistics (e.g., method of value stream mapping/design, changes in the spatial arrangement of the production chain); MACHINE, upgrading existing machinery or equipment (e.g., premium efficient motors [IE3], attach insulation, recuperators); NRBV, Natural Resource-Based View; OB, Organisational Behaviour; ODs, Organisational Dimensions; PLAN, software for production planning and scheduling (e.g., ERP system); PLM, product lifecycle management system (PLM) or product/process data management; R&D-COOP, R&D cooperation with customers or suppliers; RBT, Resource-Based Theory; SENSORS, sensors or control elements for machines or components to allow delivery of remote services; SKILLS-PROG, specific programs of competence development; TASK, integration of tasks (planning, operating or controlling functions with the machine operator); VISUAL, visual management (display board in production for work processes and work status); WORK, Method of 5S ("workplace appearance and cleanliness").

[Correction added on 28 March 2022, after first online publication: UPF Barcelona has been added in the fourth affiliation.]

1 | INTRODUCTION

The current environmental issues, which call for greater environmental awareness, have become one of the most pressing challenges faced by governments, institutions and individuals. Firms, in particular, have had to re-evaluate their organisational strategies to lessen their negative environmental impact. A possible solution to this problem for manufacturing firms could be the development of green product innovations (GPIs) (Salim et al., 2021; Shahzad et al., 2021). These products seem to be key to achieve comparative and competitive advantages because they not only provide economic benefits but they also help to preserve natural resources for future generations (Pérez-Pérez et al., 2020; Salim et al., 2021). In addition, GPIs could please socially conscious consumers (Sana, 2020) while also serving as a stimulus for businesses, which could receive incentives such as direct subsidies and tax credits for their development (Long & Liao, 2021).

Many organisations, however, have not yet decided to develop GPI for several reasons: (i) Ecological innovation is only considered after core business problems are addressed (Yin et al., 2020); (ii) firms feel overwhelmed by the imposed environmental regulations, which limits their willingness to voluntarily participate in ecological activities (Collins et al., 2007); (iii) small businesses believe that their contribution to the green economy is insignificant (Mellett et al., 2018); (iv) there is insufficient knowledge about why and how firms could foster corporate environmental sustainability to pursue GPI (Dangelico & Pujari, 2010) and (v) green innovation demands corporate commitment and the implementation of environmental policies and strategic guidelines to materialise ideas for green products (Dangelico & Pujari, 2010).

GPIs require certain determinants for their design, materialisation, production, distribution and disposal, making them different from conventional product innovations (CPIs) (Chkanikova, 2016; de Medeiros et al., 2018; Jasti et al., 2015). Despite the substantial progress made in defining the determinants of GPI, their configuration at the organisational level is considered difficult (Jasti et al., 2015; Tariq et al., 2017) because they affect several organisational functions. Therefore, these determinants must be backed by organisational elements that enable innovation to be managed in a way that results in GPI (Serrano-García et al., 2021).

Various authors have studied how the determinants of GPI can be configured at the organisational level from a variety of research topics such as corporate environmental management (Wee & Quazi, 2005); environmental strategies and green product development (Albino et al., 2009); firms' motivations, environmental policies, goals and challenges in developing and marketing GPI (Dangelico & Pujari, 2010); management of interorganisational relationships aimed at supplying materials for green products (Cheung & To, 2019) and reference models to develop green products at the corporate level (Berchicci & Bodewes, 2005; Ilg, 2019; Jasti et al., 2015; Tariq et al., 2017). Likewise, several theories have been used for this configuration, including organisational identity (Song et al., 2018), consumption values (Lin & Huang, 2012), the institutional theory (Zhang et al., 2020), stakeholder involvement (Zhao et al., 2018), the contingency theory (Saengchai et al., 2019) and the resource-based theory (RBT) using green capabilities (Aboelmaged & Hashem, 2019; Albort-Morant et al., 2016; Chen & Chang, 2013; Salim et al., 2019). The RBT is well known for its potential to support firms in developing green products (Tariq et al., 2017). However, there are still few theoretical and empirical studies on resource management and the use of capabilities oriented toward green innovation (Aboelmaged & Hashem, 2019; Qiu et al., 2020; Salim et al., 2019; Sirmon et al., 2011; Tariq et al., 2017; Teece, 2018).

Moreover, further research is needed on how organisations must restructure themselves to meet the challenge of sustainability and how the necessary adjustments can be made (Millar et al., 2012). In addition, more studies need to be developed to determine how firms' capabilities and the orchestration of organisational assets are the basis for efficiently managing various environmental challenges and implementing environmental sustainability plans at the corporate level (Annunziata et al., 2018; Dangelico et al., 2016; Serrano-García et al., 2021; Sirmon et al., 2011). From the perspective of organisational management, much uncertainty still exists about how environmental protection or going green might become a core competence (Yusr et al., 2020). Furthermore, most analyses based on the Natural Resource-Based View (NRBV) theory have found gaps in empirical studies focused on product stewardship (Hart & Dowell, 2011), which refers to 'practices that reduce environmental risks or problems resulting from the design, manufacturing, distribution, use, or disposal of products' (Berry & Rondinelli, 1998, p. 44).

Therefore, GPI, which causes changes at the organisational level (Berchicci & Bodewes, 2005; Dugoua & Dumas, 2021), could be supported by the incorporation of differential green innovation capabilities (GICs) (Serrano-García et al., 2021), which are based on the RBT (Barney, 1991; Barney et al., 2011), the NRBV (Hart, 1995), the dynamic capabilities (DCs) (Leih et al., 2015; Teece, 2007; Teece et al., 1997) and the innovation capabilities (ICs[1]) (Tariq et al., 2020). Nevertheless, having GICs is not enough for firms to achieve a competitive advantage; they also need a variety of assets—or organisational dimensions (ODs)—(e.g., people and their knowledge, processes and procedures, strategies, environmental regulations, corporate environmental responsibility, a structure and an organisational behaviour) to develop and deploy their technological capabilities (Adler & Sbenbar, 1990; Nadler et al., 2011; Serrano-García et al., 2021; Sirmon et al., 2011; Teece, 2018). Furthermore, within the ODs favouring innovation, the relevance of resources and capabilities must be acknowledged (Bogers et al., 2015). A firm's environmental strategy and competitive advantage would therefore depend on how GPI is handled at the organisational level through the innovative management of its determinants, as well as on how the organisational capabilities and dimensions are intertwined to construct and achieve the organisation's strategic goals (Adler & Sbenbar, 1990; Leih et al., 2015; Serrano-García et al., 2021; Teece, 2018; Tushman & Nadler, 1986).

All the above points to the need for more research and empirical validation on how to configure the GICs and the ODs so that they are integrated at the organisational level and recognised for their potential to support the determinants conducive to GPI. In the study by Serrano-García et al. (2021), this aspect is also outlined as future work. Based on the identified descriptions and difficulties, the purpose of this study is to analyse which GICs-ODs configuration leads to achieving GPI. The contribution of this research, therefore, is the practical and experimental orchestration of a complex structural relation between GICs, ODs and GPI to serve as a framework of reference for the management of green innovation in achieving sustainable development.

The rest of this paper is structured as follows. Section 2 provides a theoretical background on the matter. Section 3 describes the methodology we implemented. Section 4 presents the results. Section 5 discusses the findings. Last, Section 6 draws the conclusions and outlines the limitations and future lines of research.

2 | THEORETICAL BACKGROUND AND LITERATURE REVIEW

2.1 | Literature review

Table 1 below is a review of the quantitative studies on managerial concepts towards an understanding of GPI.

These studies are examples of some relevant work done in the field of GPI. Previous studies, mainly using the theoretical lenses of RBV, identify some key elements such as green human resource management, research and development, stakeholders, formal and informal structure, market orientation, together with efforts framed within learning, environmental regulations, strengthening of capabilities and understanding green innovation, in a context of technological turbulence, and with associated performance aims. The cited studies are illustrative of a clear interest and the significant advance made towards understanding the phenomenon of GPI at the organisational level. However, in line with the studies previously conducted, and according to our knowledge, there is a lack of research crossing the boundaries of the structural relation in this case of seven GICs associated with five ODs, such as the ones included in this research, which enables obstacles to be overcome and the promotion of a paradigm shift to pursue environmental strategies in the organisation of meeting the challenge of GPI.

2.2 | Conventional product innovation vs. green product innovation

Innovation is defined as 'a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market' (OECD/Eurostat, 2018, p. 21). When developing CPIs, several characteristics must be considered, including production capacity, product conceptualisation, organisational aptitude and competition (Tsai, 2012). CPI, once conceived, could contribute to the creation of green products (Berchicci & Bodewes, 2005; Pérez-Pérez et al., 2021) because innovation leads to refining technical requirements or aligning them with consumer demands and preferences (such as overcoming current environmental issues) (Dangelico et al., 2021; Niedermeier et al., 2021).

Conversely, GPI is a product with a lesser environmental impact during both its production and its consumption. This product is designed to consume less energy, generate less emissions and be produced with renewable and environmentally friendly raw materials (Melander, 2018). It is currently widely recognised as key in business expansion and competitiveness: society, customers, consumers and governments perceive it as an effective alternative to improve environmental outcomes and, consequently, individuals' quality of life (Tariq et al., 2017). It results from the interaction and coordination between innovation and sustainability (Dangelico & Pontrandolfo, 2010).

GPI represents a business opportunity for today's firms because it has evolved into a strategy for competitiveness and added-value incorporation and growth. Likewise, it allows organisations from the member states of the United Nations to contribute to the 2030 Agenda by directly tackling Sustainable Development Goal 9, which encourages sustainable industrialisation and fosters innovation (United Nations, 2018).

2.3 | Determinants of green product innovation

When it comes to the need to protect the environment, firms must consider a number of determinants that enable them to eliminate barriers and paradigms and thus develop green products while also improving their environmental, economic and social performance (Chen & Chang, 2013; Jasti et al., 2015; Tan et al., 2019). Serrano-García et al. (2021) made headway toward unifying the determinants that characterise and distinguish GPI and that are needed for its development and marketing. They proposed 22 sets of determinants that describe environmental characteristics in relation to organisational challenges. These determinants help firms to restructure themselves to meet current requirements in terms of GPI because the creation, production and commercialization of GPIs can facilitate the generation of businesses with the green focus that consider the strong relation with the preservation of the environment. While these previously analysed determinants will be further explored later in this study, they will be represented here as variables to assess their possible effect on firms' restructuring aimed at GPI development by means of an empirical analysis.

These determinants, however, are not enough to drive GPI; they require the support of certain organisational skills and components for their management (Serrano-García et al., 2021). This is where businesses could assess whether they need to restructure themselves to respond to the various determinants of GPI (Qiu et al., 2020). GICs and ODs become important here because they could help firms to adapt and update to promote a direct relationship with and respond to the determinants of GPI (Serrano-García et al., 2021).

TABLE 1 Review of quantitative studies on the topic of GPI

	Authors	Objective/questions	Theoretical perspectives	Methodology	Key findings
a.	Bhatia and Jakhar (2021)	Do environment regulations affect top management commitment towards GPI?Does organisational learning mediate between top management commitment and GPI practices?Do GPI practices enhance performance?	Dynamic capabilities view and upper echelons theory	96 Indian car manufacturing firms, cross-sectional survey research with partial least squares.	Findings evidence how top management commitment and organisational learning are important when implementing GPI in response to regulations, seeking to achieve better environmental and economic performance. Findings also include how organisational learning is a mediator between top management commitment and GPI.
b.	Awan et al. (2020)	How do buyer-driven knowledge transfer activities affect a firm's green product innovation via knowledge management capabilities? What is the impact of buyer-driven knowledge transfer activities on social performance improvement through knowledge management capabilities?	Absorptive capacity as a theoretical lens	Use of survey data collected from 239 Pakistani export-manufacturing companies, application of structural equation models.	Evidences how buyer-driven knowledge transfer activities contribute significantly to strengthening knowledge management capabilities in combination with resource acquisition capability to achieve GPI.
c.	Zhao et al. (2018)	Investigate the impact of external involvement on green product innovation.	Contingency theory and organisational information processing theory	Employment of survey data collected from 198 Chinese manufacturing firms and use of hierarchical moderated regression analyses	Findings support the importance of client and supplier participation to achieve GPI. Results also show how technological uncertainty and demand positively affect GPI.
d.	Andersén (2021)	To contribute to the development of a relational NRBV (RNRBV) on product innovation by examining the relationships between GPI, green suppliers, and differentiation advantage.	To consider the extensions of the RBV in product innovation, the article applies a relational NRBV (RNRBV) on product innovation.	Employment of survey data collected from 305 small Swedish manufacturing firms.	Among the findings is a direct relationship between GPI and the performance of the organisation, suggesting examining the influence of GPI through the creation of organisational strategies. The author also identifies how suppliers that focus on green provisions contribute with complementary resources that facilitate achieving GPI in the organisation, making the relation between the organization and the green suppliers essential, thereby confirming the importance of the relation between NRBV and product innovation.

TABLE 1 (Continued)

	Authors	Objective/questions	Theoretical perspectives	Methodology	Key findings
e.	Zhang et al. (2021)	'How does the inter-organisational control mechanism contribute to the development of GPI?' 'How does the adoption of GPI impact on organizational performance?'	Inter-organisational control in the green context: Formal structure and informal structure	Based on a sample of 239 senior managers and directors in the Chinese manufacturing industry, testing of the hypotheses using structural equation modelling.	The results show how the interaction between formal control and social control is positive and significant, making it essential to consider this interaction and to follow the philosophies to achieve a better GPI result. They also find how the effect of GPI on financial performance is mediated by environmental and social performance.
f.	Chen and Liu (2020)	To explore the coopting and enabling roles of customer participation in green product innovation in SMEs, and to uncover the indirect impact of customer participation through its influence on opportunity recognition and exploitation	Stakeholder engagement literature	Analysis of a sample of 195 SMEs in China using regression analysis	The findings indicate how participation of the interested parties, including clients, is necessary to group and orchestrate resources that can improve green product innovation. Furthermore, they find that the client participation can facilitate the exploitation of opportunities, and improve creativity and the capacity of the company towards producing green products.
g.	Akhtar et al. (2021)	To answer the question of "how market orientation affects green product innovation with the mediating role of green self-efficacy and the moderating role of resource."	Market orientation	477 SMEs managing green production using structural equation modelling	The results show that the market orientation represented in the environmental practices affects green self-efficacy and GPI. Furthermore, their results indicate how green self-efficacy has a mediating role between the market orientation and GPIs.
h.	Ogbeibu et al. (2020)	Investigation of the predictive powers of green human resource management (GHRM) bundles and green team creativity on green product innovation. Examine the roles of technological turbulence and environmental dynamic capability.	Green human resource management (GHRM)	A cross-sectional survey design with 229 leaders and subordinates in teams from the HRM and R&D departments of 31 manufacturing organisations in Malaysia. Employment of partial least square path modelling for data analysis.	The results indicate that green training, involvement and development is a more significant predictor of green team creativity than green recruitment and selection and technological turbulence. The study also shows how Green Team Creativity positively predicts GPI. However, environmental dynamic capability is identified as a negative predictor.

(Continues)

TABLE 1 (Continued)

	Authors	Objective/questions	Theoretical perspectives	Methodology	Key findings
i.	Agustia et al. (2020)	Determine the effect of research and development intensity (RNDI) on firm performance (FP) with green product innovation (GPI) as an intervening variable.	Research and development	Uses 170 companies listed on the Indonesian Stock Exchange in the period 2013–2017, with regression analysis	The results show that the intensity of research and development and GPI present a significant effect on company performance. Likewise, the intensity of research and development presents a significant effect on GPI.
j.	Zhang and Zhu (2019)	Explore whether environmental pressures from different stakeholders influence green innovation differently and how this is further mediated by organisational learning.	Stakeholder theory and organisational learning theory	259 Chinese manufacturing firms, with confirmatory factor and regression analyses	The results of this work indicate how consumer pressure presents a major effect on GPI, while regulatory pressure is more linked to GPI. Furthermore, they show how organisational learning-exploration and exploitation approaches are necessary and are mediators between the pressures of the interested parties and green innovation.

2.4 | The resource-based theory and the dynamic capability approach

The RBT is well known for its exceptional and powerful ability to predict and explain organisational relationships (Barney et al., 2011). It mainly focuses on making an organisation's internal and coordinated factors valuable, rare, inimitable and non-substitutable (Barney, 1991). This theory links the organisation's resources, capacities and competitive advantage (Hart, 1995). Having said that, Renard and St-amant (2003) identify how capacity is related to organisational aptitude to carry out processes of value creation in combination with resources (Renard & St-amant, 2003) which, at the same time, facilitates organisational reconfiguration favouring competitive advantage.

With the support of organisational components, this theory favours the implementation of strategies focused on corporate environmental actions (Dangelico & Pujari, 2010; Teece, 2010) to achieve long-term advantages (Barney, 1991). Consequently, a current challenge to consider within the organisational context that could be addressed from RBT in association with organisational components with a green focus is the reduction of the negative environmental impact. Therefore, a particularly important pillar for the theoretical grounding of the present work is based on NRBV. According to Hart (1995), competitive strategy and competitive advantage based on the firm's capabilities and the natural environment would be key in promoting environmentally sustainable economic activities. The NRBV therefore extends the RBT to the field of environmental sustainability.

DCs derive from the RBT (Teece, 2018; Teece et al., 1997) and refer to the transformations causing changes in products (Albort-Morant et al., 2016). Creating a synergy for a more successful innovation performance, DCs favour knowledge transformation, particularly in the manufacture of green products (Salim et al., 2019). Hence, firms must build and strengthen the DCs associated with green innovation to make progress in addressing environmental concerns (Huang & Li, 2017), generating new and improved products and respecting the environment from their conception to the way they are eliminated.

2.5 | Green innovation capabilities

The notion of IC derives from DC (Lahovnik & Breznik, 2014), a driver of innovation that enables organisations to adapt to the market (Teece et al., 1997). ICs refers to the capabilities linked to the organisation and its management that are coordinated to start, develop and execute innovation (OECD/Eurostat, 2018) under a systemic corporate approach resulting from a strategic and operational management (Serrano-García et al., 2017; Serrano-García & Robledo-Velásquez, 2013). ICs are considered a special organisational asset that allows firms to create and sustain a competitive advantage (Guan & Ma, 2003; Yam et al., 2004).

To tackle climate change especially through the creation of GPI, organisations must use certain capabilities that support them. Hence, the importance of the green-oriented ICs (GICs) because they could be considered as contributors when facilitating ecological innovation (Wang et al., 2019). These capabilities enable businesses to transform their processes, thus allowing them to develop GPI (Tariq et al., 2020) and to comply with environmental obligations and engage in the emerging green economy (Mellett et al., 2018). In addition, they refer to a firm's ability to pursue an ecological and sustainable development (Tseng et al., 2019) in a challenging environment like the current one.

GICs focus on the integration, construction and reconfiguration of a firms' resources related to environmental protection (Qiu et al., 2020). These capabilities, therefore, must be identified and integrated into each organisational function for organisations to respond to the demands and adjustments necessary to achieve GPI (Serrano-García et al., 2021). Progress in the adoption of GICs helps firms to clarify their processes, techniques and products to reduce environmental damage (Tseng et al., 2019), as these capabilities allow them to better understand the specific aspects that must be adapted. In this case, these capabilities favour the incorporation of skills that lead to an organisational restructuring and that are centred on enabling compliance with the determinants of GPI.

In this research, we consider the seven GICs proposed (Serrano-García et al., 2021), which are (a) *Green Strategic Planning Capability* (GSPC), (b) *Green Organisational Innovation Capability* (GOIC), (c) *Green Research and Development Capability* (GR&DC), (d) *Green Production Capability* (GPC), (e) *Green Organisational Learning and Relationship Capability* (GOLRC), (f) *Green Resource Management Capability* (GRMC) and (g) *Green Marketing Capability* (GMC). These capabilities are regarded as an alternative for organisations to respond to the determinants of GPI and to design, develop, produce and market sustainable products. Their contribution to the development of GPI, however, must be empirically validated. Furthermore, GICs must be further explored with the help of organisational and managerial dimensions that allow firms to adapt to the requirements of environmental businesses (Salim et al., 2019; Teece, 2007), thus leading them to create GPI and achieve a sustainable competitive advantage.

2.6 | Organisational dimensions

Innovation favours change within organisations (Damanpour, 1991). According to Nadler and Tushman (1999) and Nadler et al. (2011), firms need sufficient diversity and changes in their strategies, structures, people, processes and organisational values to achieve different sorts of innovation. Consequently, developing GPI is a type of innovation that involves creating and taking organisational actions aimed at preventing, minimising, mitigating or eliminating a firm's negative impact on the environment.

The challenge is, therefore, to create congruent organisational components that allow for the achievement of strategic objectives that drive innovation (Nadler et al., 2011; Nadler & Tushman, 1980). Based on this, firms are structured in such a way as to seek coherence between goals and innovation—a coherence that is supported by the ODs (Galbraith, 1982). These dimensions, which involve the entire organisation, represent the establishment of provisions concerning organisational characteristics of structure, processes, hierarchy, people, functions and interdepartmental relationships (Daft, 2011). Likewise, they are shaped by aspects such as values, culture, the surroundings and organisational behaviours (Herrera-Baltazar, 2015). Firms, therefore, should reconsider what types of ODs would allow them to efficiently manage their work to meet their strategic goals (Nadler & Tushman, 1999) aimed at GPI development. By evaluating the ODs, managers can identify the means and possible pitfalls that could be avoided to implement the environmental strategy (Rothenberg et al., 1992).

Serrano-García et al. (2021) point out the need for organisations to have the following five ODs, which focus on the innovation requirements necessary to manage the determinants of GPI: (a) *Human Resources* (HR), (b) *Organisational Behaviour* (OB), (c) *Technology* (T), (d) *Corporate Environmental Responsibility* (CER) and e) *Environmental Regulations* (ER). The authors also emphasise the importance of relating the various ODs with the GICs as a fundamental support and complement for firms to achieve innovation, in this case to achieve GPI.

Therefore, by means of an empirical analysis, we examine the contributions of the different ODs and GICs to the management of the determinants of GPI as a system that would facilitate the achievement of GPI. In formulating the environmental strategies, it is necessary to be consistent with the organisational characteristics, capacities and operational context of the company (Rothenberg et al., 1992).

3 | RESEARCH METHODOLOGY

To fulfil the objective set out in this paper, we use a combination of the approaches proposed in Serrano-García et al. (2021), who created a matrix associating GICs-ODs to identify and select the variables representing the determinants. Bikfalvi et al. (2013) used data collected by means of the same instrument and method and conducted a similar analysis—but with a different purpose—classifying companies according to certain characteristics by means of forming clusters. From the EMS, each of the variables corresponding to the intersection between each capacity and dimension were then extracted. The items employed and the procedures followed are described below.

3.1 | Data collection

We used data from the 2015 European Manufacturing Survey (EMS) to conduct the empirical and descriptive analysis. This survey is structured by thematic areas to measure characteristics and effects of organisational and environmental concepts in manufacturing firms. The purpose of the EMS is to collect up-to-date information from European firms to contribute to improving production processes. The survey's questions are developed by the members of a consortium made up of European research centres and universities and managed by the Fraunhofer Institute for Systems and Innovation Research (ISI) (Fraunhofer Institute for Systems and Innovation Research ISI, 2021).

The data provided by the EMS have been employed to analyse and execute projects under environmental approaches. This is the case of the study carried out by Pons et al. (2018), who characterised patterns between GPI and CPI in manufacturing firms. Likewise, Sartal et al. (2017) demonstrated that the role of environmental and information technologies in the lean manufacturing capability can lead to a better industrial performance. For their part, Palčič and Prester (2020) showed that advanced manufacturing technologies can contribute to both firm performance and ecological innovation. Pons et al. (2013) also mapped the adoption of technologies that help to reduce energy and resource consumption, verifying the relationship between their implementation and the performance of manufacturing firms.

3.2 | Sample

The data used in this study come from 101 and 105 firms in Spain and Croatia, respectively, representing the business population of the two nations. The samples were addressed under the same approach for three main reasons: (a) The EMS questions were equally applied in both countries, and the same criteria were considered to select the samples; (b) in 2015, Spain and Croatia were classified as *moderate innovators* by the European Innovation Scoreboard, which assesses research and innovation performance across the member states of the European Union (EU) (Hollanders et al., 2015) and (c) in 2014, Spain and Croatia fell into the *Average Eco-I performers group*, with scores of 111 and 91, respectively (close to the average EU score of 100), according to the results of the Eco-Innovation Index, which evaluates eco-innovation performance in the EU member states and promotes a holistic view of economic, environmental and social performance (European Commission, 2021).

The set of firms analysed here carries out the industrial manufacturing activities listed in NACE Rev. 2 (codes 10 to 32) and have at least 20 employees; see Table 2.

TABLE 2 Geographical, sectoral and firm size distribution of the sample

	Frequency	Percentage
Country		
Spain	101	49.0
Croatia	105	51.0
Total	206	
Manufacturing industry		
Food products and beverages	39	18.9
Textiles, wearing apparel, leather and related products	22	10.7
Furniture, products of wood, and articles of straw and plaiting materials	14	6.8
Paper and paper products; printing and reproduction of recorded media	15	7.3
Chemicals, rubber and plastic products and other non-metallic mineral products	36	17.5
Basic pharmaceutical products and pharmaceutical preparations	2	1.0
Basic metals and fabricated metal products	37	18.0
Manufacture of computer, electronic, electrical and optical equipment	10	4.9
Machinery and equipment n.e.c.	23	11.2
Motor vehicles, trailers and semi-trailers and other transport equipment	7	3.4
Other manufacturing industries	1	0.5
Total	206	100.0
Number of employees		
Up to 49	77	37.4
From 50 to 249	84	40.8
250 and more	45	21.8
Total	206	100.0

3.3 | GIC-OD matrix and selection of variables representing the determinants of GPI

Given the several relationships between the various definitions of GICs and ODs, they must be structured using a graphical and descriptive approach. For this reason, we constructed a matrix that established the relationship between each GIC (in rows) and OD (in columns), extracting 63 dichotomous measurable variables from the EMS and analytically placing them at the intersections between each GIC and OD. These variables represent the determinants necessary for an organisational restructuring aimed at developing GPI, as proposed by Serrano-García et al. (2021). For a more thorough understanding of the process of creating the matrix, Appendix A shows the classification of variables (in representation of the determinants) within a specific GIC and related to each of the five proposed ODs, where the typology of each variable is binary (Yes/No).

3.4 | GPI-specific attributes

To evaluate GPI development, we only considered the firms that claim to have introduced completely new products or significant technological improvements in existing products, resulting in a drop from 206 to 140 firms. We analysed whether the new or improved products cause a lesser environmental impact when used or discarded, as well as the environmental improvements they deliver in relation to six attributes: (a) reduction of health risks for users; (b) reduction of energy consumption when in use; (c) easier to maintain or to retrofit; (d) extended product lifetime; (e) reduction of environmental pollution when in use and (f) improved recycling, redemption or disposal properties.

Firms were given a score ranging from 0 to 100 based on how many environmental improvements they achieved. A score of 100 indicated that they had achieved all the improvements, while a score of 0 meant they had achieved none. The *GPI achievement* variable was thereby created, which assigns each firm a score depending on the number of environmental improvements it achieves in its GPI. The purpose of these attributes is to identify which firms already create products with GPI-specific characteristics.

3.5 | Statistical method

The next step was to perform a cluster analysis, which is a multivariate statistical technique that organises input data by categorising cases (individuals) into homogeneous groups and delivers results from the cases that share similar content characteristics and are classified into the four clusters (Pérez-López, 2008). As a result, it is possible to obtain as many clusters as similarities are contained and identified in the analysed data (Pérez-López, 2008).

The six attributes of *GPI achievement* were studied using multiple correspondence analysis (MCA), given that by their very nature the data are qualitative. The MCA results sought to study the association between the companies, or which of them had similar responses in the six attributes. The results of the associations between companies were used to form the clusters. The possibility of creating six groups of companies was considered, but it was decided to stay with four groups because of the homogeneity they presented. The clusters are shown in the dendrogram. The data were processed using the statistics software *R-Project*. Subsequently, the 61 variables identified in the matrix and representing the determinants necessary for an organisational restructuring aimed at developing GPI were integrated into each cluster. The aim was to identify which variables were more closely related to GPI development and to determine the relevance or involvement of each GIC and OD. Additionally, we identified the main differences between the clusters and intra-clusters, in addition to the influence of the industrial sector in the clusters to further characterise them.

4 | RESULTS

The results are organised below in five stages. First, the dendrogram is presented, followed by the content of the four resulting clusters and of the determinants of GPI with GICs and ODs. Next, each of the groups and the influence of the industrial sector in the clusters are characterised.

Following the result of the statistical process, Figure 1 is the dendrogram resulting from the hierarchical analytical analysis of the six attributes of *GPI achievement*.

From the statistical analysis, four clusters were formed based on the number of average environmental improvements (AEI) that the firms had implemented. *Cluster 1* includes firms that had not achieved environmental improvements in their new or improved products and that were considered to develop CPI. Although classified as innovative, CPIs do not favourably contribute to the environment. For their part, *Clusters 2–4* comprise firms that had achieved some type of environmental improvement in their new or improved products and that are considered to be developing GPI. The AEI of *Clusters 1–4* were 0 (0 improvements), 1.6 (between 1 and 2), 3.0 (all with three improvements) and 4.4 (between 4 and 5), respectively.

Afterwards, the 61 matrix variables related to the GICs, the ODs and the determinants of GPI were incorporated into the clusters. From Table 3, in 18 of the 61 variables, we observed a tendency in which the percentage of firms that use the resource described by the variable increases as the AEI value increases.

Figure 2 shows the overall percentage of firms (from the sample addressed in this study) that implemented and did not implement each variable. As can be observed, visual management (display board in production for work processes and work status) and integration of tasks (planning, operating or controlling functions with the machine operator) were the most implemented practice or resource, while certified energy management systems (ISO 50001) was the least implemented one.

Table 4 presents the configuration matrix that relates the determinants of GPI to each GIC and OD. In this matrix, each of the identified 18 variables representing the determinants is placed at the intersections between each GIC and OD, thus showing the existing interrelationships between the components.

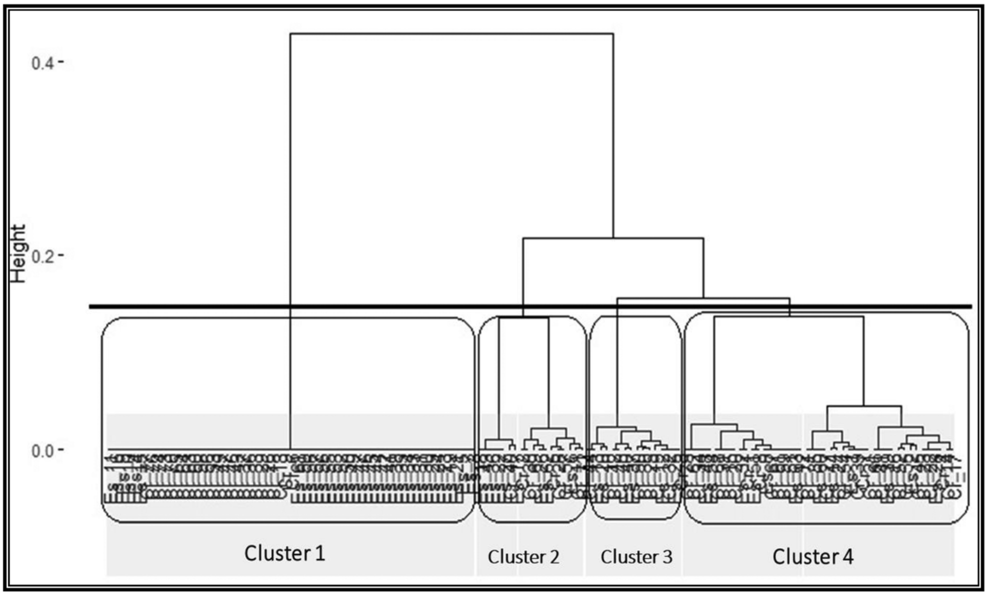

FIGURE 1 Dendrogram of clusters, in accordance with GPI achievement

TABLE 3 Cluster analysis results

Variable	Dimension-Capability	CPI	GPI		
		Cluster 1 (AEI=0)	Cluster 2 (AEI=1.6)	Cluster 3 (AEI=3.0)	Cluster 4 (AEI=4.4)
		AEI →			
		Variable →			
VISUAL: Visual management (display board in production for work processes and work status)	OB/GPC	80%	80%	88%	94%
TASK: Integration of tasks (planning, operating or controlling functions with the machine operator)	HR/GSPC	53%	79%	75%	83%
R&D-COOP: R&D cooperation with customers or suppliers	OB/GR&DC	60%	64%	75%	94%
WORK: Method of 5S ("workplace appearance and cleanliness")	HR/GOIC	57%	66%	88%	83%
INFORMAT: Use information gathered to develop or adapt current products, services or processes	CER/GOLRC	50%	72%	93%	82%
SKILLS-PROG: Specific programs of competence development	HR/GOLRC	53%	68%	73%	72%
LOGISTIC: Practices to improve internal logistics (e.g. method of value stream mapping / design, changes in the spatial	OB/GSPC	50%	59%	75%	83%
PLAN: Software for production planning and scheduling (e.g. ERP system)	T/GSPC	58%	51%	75%	72%
LINES: Customer- or product-oriented lines/cells in the factory	CER/GMC	47%	50%	69%	83%
IMP S-E: Impact and performance measurements of social and environmental corporate activities	CER/GSPC	30%	53%	67%	67%
MACHINE: Upgrading existing machinery or equipment (e.g. premium efficient motors (IE3), attach insulation, recuperators)	T/GRC	45%	44%	50%	53%
IT-TRAINING: IT-based self-study programs (e-learning) for continuous training and evaluation of production employees	HR/GMC	37%	50%	56%	56%
AUTOMAT: Control-automation systems for an energy efficient production	ER/GRC	18%	30%	38%	44%
AMT-PROD: Additive manufacturing technologies for mass production	T/GPC	10%	9%	25%	50%
PLM: Product lifecycle management system (PLM) or product/process data management	ER/GSPC	12%	16%	19%	28%
INS-LIFECY: Instruments of life-cycle assessment (e.g. EU Ecolabel, C2C, ISO 14020)	ER/GPC	9%	12%	13%	28%
SENSORS: Sensors or control elements for machines or components to allow delivery of remote services	T/GMC	9%	11%	20%	24%
CERT-ENER: Certified energy management system (EN ISO 50001, previously EN 16001)	ER/GOIC	4%	14%	20%	22%
N		61	45	16	18
%		44%	32%	11%	13%

Table 5 shows the practices or resources (variables) involved in each of the clusters, ordered from the highest to the lowest percentage of companies that use or implement them, identifying the most outstanding in each group.

Each cluster was named according to the average number of variables (which include resources or and practices) implemented by firms and the percentage of firms that use each variable. *Cluster 1*, which comprises firms that develop CPI, was called *Low implementation of practices or resources* because firms in this cluster used an average of 6.10 of the 18 resources or practices under analysis. Additionally, in this cluster, only the *visual management (display board in production for work processes and work status)* variable is in the fourth quartile of the data (75–100%), while the other variables have less percentages of firms that implement the resource or practice.

The other three clusters, which include firms geared towards GPI development, were characterised in an equivalent manner. *Cluster 2* was named *Limited implementation of practices or resources* because the average number of resources or practices used by firms in this cluster was 7.31. Only the *visual management (display board in production for work processes and work status)* and *integration of tasks*

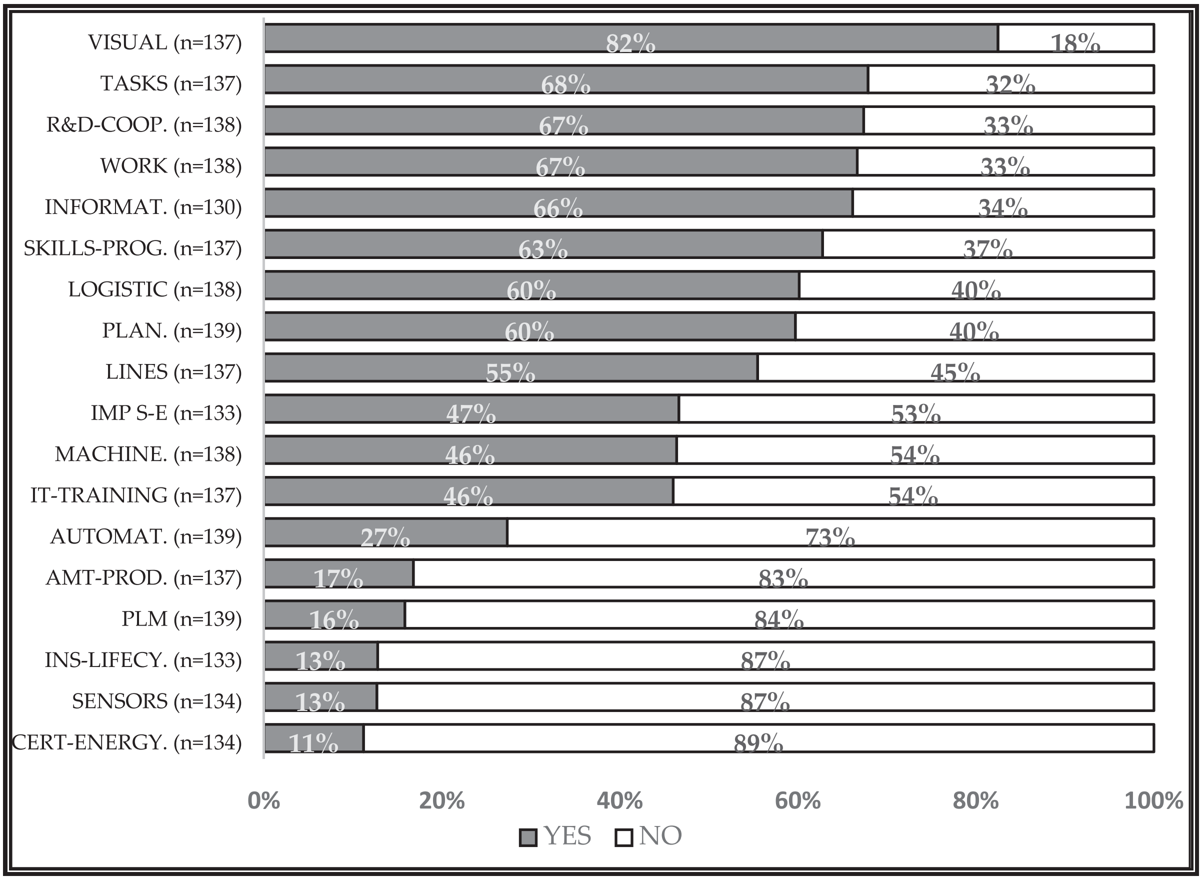

FIGURE 2 Concepts contributing to GPI development

TABLE 4 Configuration matrix between the determinants of GPI, the GICs, and the ODs

		Organisational Dimensions (ODs)					
		HR	OB	T	CER	ER	No. of variables - GICs
Green Innovation Capabilities (GICs)	GSPC	TASKS.	LOGISTICS.	PLAN.	IMP S-E.	PLM	5
	GOIC	WORK.				CERT-ENER.	2
	GR&DC		R&D-COOP.				1
	GPC		VISUAL.	AMT-PRODU.		INS-LIFECY.	3
	GOLRC	SKILLS-PROG.			INFORMAT.		2
	GRMC			MACHINE.		AUTOMAT.	2
	GMC	IT-TRAINING.		SENSORS.	LINES.		3
	No. of variables - ODs	4	3	4	3	4	

(planning, operating or controlling functions with the machine operator) variables were found to have an implementation above 75% in this cluster. *Cluster 3* was called *Moderate implementation of practices or resources*, with firms in this cluster using an average of 9.19 resources or practices and with the *integration of tasks (planning, operating or controlling functions with the machine operator), practices to improve internal logistics (e.g., method of value stream mapping/design, changes in the spatial arrangement of the production chain), software for production planning and scheduling (e.g., ERP system), method of 5S (workplace appearance and cleanliness), R&D cooperation with customers or suppliers, visual management (display board in production for work processes and work status and use information gathered to develop or adapt current products, services or processes* variables having an implementation above 75%. Last, *Cluster 4* was named *High implementation of practices or resources*, with firms in this cluster using an average of 10.28 resources or practices and with the *integration of tasks (planning, operating or controlling functions with the machine operator, practices to improve internal logistics (e.g., method of value stream mapping/design,*

TABLE 5 Characterisation of each cluster

CPI				GPI			
Cluster 1 (AEI=*0.0*)		Cluster 2 (AEI=*1.6*)		Cluster 3 (AEI=*3.0*)		Cluster 4 (AEI=*4.4*)	
%	*Low implementation of practices or resources*	%	*Limited implementation of practices or resources*	%	*Moderated implementation of practices or resources*	%	*High implementation of practices or resources*
	VISUAL		VISUAL		INFORMAT.		R&D-COOP.
	R&D-COOP.		TASKS		WORK		VISUAL
	PLAN.		INFORMAT.		VISUAL		TASKS
	WORK		SKILLS-PROG.		TASKS		LOGISTIC
	TASKS		WORK		LOGISTIC		WORK
	SKILLS-PROG.		R&D-COOP.		PLAN.		LINES
	LOGISTIC		LOGISTIC		R&D-COOP.		INFORMAT.
	INFORMAT.		IMP S-E		SKILLS-PROG.		PLAN.
	LINES		PLAN.		LINES		SKILLS-PROG.
	MACHINE.		IT-TRAINING		IMP S-E		IMP S-E
	IT-TRAINING		LINES		IT-TRAINING		IT-TRAINING
	IMP S-E		MACHINE.		MACHINE.		MACHINE.
	AUTOMAT.		AUTOMAT.		AUTOMAT.		AMT-PRODU.
	PLM		PLM		AMT-PRODU.		AUTOMAT.
	AMT-PRODU.		CERT-ENER.		CERT-ENER.		PLM
	INS-LIFECY.		INS-LIFECY.		SENSORS		INS-LIFECY.
	SENSORS		SENSORS		PLM		SENSORS
	CERT-ENER.		AMT-PRODU.		INS-LIFECY.		CERT-ENER.

changes in the spatial arrangement of the production chain), method of 5S (workplace appearance and cleanliness), R&D cooperation with customers or suppliers, visual management (display board in production for work processes and work status), use information gathered to develop or adapt current products, services or processes and customer- or product-oriented lines/cells in the factory variables having an implementation above 75% of all the firms under analysis.

Table 5 also shows three behaviours referring to the implementation of these concepts at the inter-cluster level. To this effect, the variables *visual management (display board in production for work processes and work status), R&D cooperation with customers or suppliers, method of 5S (workplace appearance and cleanliness), integration of tasks (planning, operating or controlling functions with the machine operator), practices to improve internal logistics (e.g., method of value stream mapping/design, changes in the spatial arrangement of the production chain), specific programs of competence development, software for production planning and scheduling (e.g., ERP system) and use information gathered to develop or adapt current products, services or processes* present an implementation of practices or improvements in greater percentages in all four clusters, with the greatest proportion generally in clusters three and four. At an intermediate level of implementation, *customer- or product-oriented lines/cells in the factory, upgrading existing machinery or equipment (e.g., premium efficient motors [IE3], attach insulation, recuperators), IT-based self-study programs (e-learning) for continuous training and evaluation of production employees, impact and performance measurements of social and environmental corporate activities* stand out, while the variables *control-automation systems for an energy efficient production, product lifecycle management system (PLM) or product/process data management, additive manufacturing technologies for mass production, instruments of life-cycle assessment (e.g., EU Ecolabel, C2C, ISO 14020), sensors or control elements for machines or components to allow delivery of remote services and certified energy management system (ISO 50001)* present an implementation in lower proportions in all the clusters, and especially in clusters 1 and 2.

In accordance with the hierarchical clustering of the companies in the four groups, and illustrated in Tables 3 and 5, differences are presented regarding the implementation of practices and resources at the level of industrial sectors. The companies in the sectors *basic pharmaceutical products and pharmaceutical preparations* are all in cluster 1, or in other words, they have a low implementation of practices and resources. Around 90% of the companies in the sectors *food products and beverages* have low and limited levels (clusters 1 and 2) and 10% moderate and high levels (clusters 3 and 4). Regarding companies in the sectors, *textiles*, *wearing apparel*, *leather*, *and related products*, *furniture*, *products of wood*, *and articles of straw and plaiting materials*, *paper and paper products*, *printing*, *and reproduction of recorded media*, *chemicals*, *rubber and plastic products and other non-metallic mineral products*, *machinery and equipment n.e.c.*, some 80% have a low or limited implementation and 20% moderate or high levels. Around 65% of the companies in the sectors *basic metals and fabricated metal products* have low and moderate levels, and 35% have high levels. Half (50%) of the companies in the sectors *motor vehicles*, *trailers and semi-trailers and other transport equipment* have low levels and the other half have moderate levels. Some 30% of the companies in the sectors *manufacture of computer*, *electronic*, *electrical and optical equipment* have low and limited levels, while 80% have moderate and high levels.

5 | DISCUSSION

In this paper, we aim to analyse which GIC-OD configuration leads to a better GPI development. Because each determinant of GPI, depending on its nature, is associated with each GIC and OD, and based on the result given by the statistical process, we identify 18 key determinants. In addition, we show which GICs and ODs are the most closely related to GPI development.

According to the results obtained in this study, the *Environmental Regulations* dimension is strongly associated with GPI development. In particular, the group of firms that are in the most advanced stage of GPI are found to highly implement practices or resources such as *product lifecycle management (PLM) systems or product/process data management*, *instruments of lifecycle assessment (ISO 14020 or Ecolabel)*, *certified energy management systems (ISO 50001)* and *control-automation systems for an energy efficient production*, while these resources are less implemented in firms in the CPI group. This is in line with the findings of Comoglio and Botta (2012), who find that flexible environmental regulations, such as *environmental management systems*, have a positive effect on firms' environmental performance because they increase firms' commitment to environmental improvement.

The *Human Resources* dimension also proves to be key in organisations seeking to restructure themselves to achieve GPI. In fact, several firms in the group with the greatest advance in GPI follow practices like *integration of tasks (planning, operating or controlling functions with the machine operator)* and implement resources such as the *method of 5S (workplace appearance and cleanliness)*, *specific programs of competence development* and *IT-based self-study programs (e-learning) for continuous training and evaluation of production employees* more than those in the CPI group. This finding is consistent with that of del Giudice and Della Peruta (2016), who report that green human resource management (GHRM) influences firms' environmental progress. Additionally, this result corroborates the ideas of Úbeda-García et al. (2021) and Zhang et al. (2019), who state that GHRM has a positive impact on environmental management. In light of the above, firms' personnel must be qualified in green matters and organisational practices geared towards environmental innovation management so that organisations can strengthen skills and take on environmental management as a responsibility.

Furthermore, the *Technology* dimension, which includes practices like *upgrading existing machinery or equipment*, as well as resources such as *software for production planning and scheduling (e.g., ERP system)*, *additive manufacturing technologies for mass production* and *sensors or control elements for machines or components to allow delivery of remote services*, is shown to have a higher implementation in firms with the greatest progress in GPI. According to Palčič and Prester (2020), some of these technologies, which are considered to be advanced manufacturing technologies, are positively related to the development of green products. This is in agreement with the findings of Jabbour et al. (2015), who find that the various technological advances favourably influence GPI.

The *Corporate Environmental Responsibility* dimension is also found to be necessary for GPI. It is supported by practices such as *impact and performance measurements of social and environmental corporate activities*, *use information gathered to develop or adapt current products*, *services or processes* and *customer- or product-oriented lines/cells in the factory*. This result is in line with that of Awan et al. (2017), who demonstrate that social development programs and practices such as assessing the impact of processes and management actions on the environment lead to a higher market share and an improved environmental performance. Likewise, this corroborates the ideas of Shahzad et al. (2020), who conclude that, by efficiently managing information or knowledge, firms can achieve greater corporate sustainability. Additionally, as stated by Abbas (2020), corporate social responsibility integrates social and environmental concerns and is crucial to achieve a better environmental performance.

Last, the *Organisational Behaviour* dimension also proves to be an important organisational aspect in boosting environmental innovation. Resources such as *practices to improve internal logistics (e.g., method of value stream mapping/design, changes in the spatial arrangement of the production chain)*, *R&D cooperation with customers or suppliers*, and *visual management (display board in production for work processes and work status)* stand out in this dimension. This finding is in agreement with that of Isensee et al. (2020), who state that there is a high interdependence between organisational behaviour and firms' level of environmental sustainability, hence the need for an organisational approach towards environmental protection. This is also supported by the study of Hallstedt et al. (2010), who confirm that creating an environmentally sustainable culture within organisations is key to making progress in developing green products.

Regarding GICs, the *Green Strategic Planning Capability* is shown to be the most closely related to GPI development. This points to the need to define aspects such as goals, programs, projects, activities, tasks and deadlines that lead firms to an organisational restructuring focused on sustainability. According to Landrum (2018), since business-oriented corporate sustainability is not enough to address the environmental crisis, environmental science and ecology must be integrated into firms' strategic planning to achieve progress in managing corporate sustainability.

The *Green Production Capability* is found to be the second most related aspect to GPI development. This suggests that organisations should maintain or increase their productivity levels while using biodegradable raw materials and generating less waste and pollution (Bogue, 2014). Moreover, based on our results, the *Green Marketing Capability* also influences the development of green products. This is confirmed by the study of Guoyou et al. (2013), who demonstrate that marketing pressures drive corporate sustainability.

Likewise, the *Green Organisational Innovation Capability*, which is concerned with a firm's operations, is found to help to respond to environmental concerns by incorporating and implementing GPI. This finding is in line with that of Qiu et al. (2020), who state that GPI can be consolidated at the organisational level through its institutionalisation, thus encouraging and leading to an organisational restructuring.

Furthermore, the *Green Organisational Learning and Relationship Capability* shows a positive effect on GPI development, which concurs with the results of Karman and Savanevičienė (2020), who report that gaining knowledge and skills in environmental matters, cooperating with partners and developing employee best practices influence firms' environmental performance. Since creating GPI is often new to most organisations, the role of organisational learning in achieving this type of innovation should be given considerable attention (Qiu et al., 2020).

The *Green Resource Management Capability* also proves to influence the development of green products because investing, for instance, in resources to strengthen ecological skills, laboratories, equipment, qualified personnel and the research and development of cleaner technologies could favour the creation of GPI (Chen & Chang, 2013; de Medeiros et al., 2014).

Last, the *Green Research and Development Capability* is also found to have a favourable impact on the development of green products. This is consistent with the findings of Liao (2017), who state that green-oriented R&D positively influences firms' environmental development. R&D plays a key role in helping firms to exploit their existing invention skills and explore new technological creations (Tushman, 2017) that could lead to GPI.

Although some of the proposed capabilities and dimensions stand out more than the others, it does not mean that some are more important than the others. In other words, this paper does not try to analyse the contribution of each OD and GIC but rather their overall configuration as a systemic approach aimed at achieving GPI.

In light of the above, all the ODs (i.e., *ER*, *HR*, *T*, *OB* and *CER*) and GICs (i.e., *GSPC*, *GOIC*, *GPC*, *GOLRC*, *GRC*, *GMC* and *GR&DC*) proposed by (Serrano-García et al., 2021) play a part, from their own perspective and technical nature, in the management of the determinants leading to GPI. This results in a system of interrelated elements, each of which contributes to the organisational restructuring necessary to transform processes and direct them towards an innovation management conducive to GPI.

During the characterisation of the clusters, firms that already implement environmental improvements in their products are shown to better manage their work compared to those that have not yet implemented environmental improvements. In fact, the former extensively employ strategies such as planning, logistics and order at work; R&D cooperation; development of specific new production lines and learning from accumulated experience and errors. However, we also find that even firms with better environmental management still need to strengthen those green-oriented determinants–variables that could lead them to better respond to GPI. Regarding the influence of the industrial sector, differences were found in the sense that within and between sectors the companies presented low, limited, moderate and high levels of environmental practices and improvements. More specifically, no sector stands out in any of these levels.

6 | CONCLUSIONS

In this paper, we analyse how the GIC-OD configuration proposed by (Serrano-García et al., 2021) serves as a reference framework for managing innovation, in an attempt to respond to the green-oriented determinants and thereby encourage an organisational restructuring focused towards GPI development. By means of a matrix, we establish a connection between the different GIC and OD to build a structural relationship associated with the determinants of GPI in a practical and experimental way.

Our findings empirically confirm the positive impact of each GIC and OD on GPI development. Hence, the framework proposed in Serrano-García et al. (2021) is found to influence the environmental management of the firms under analysis. For an innovation management focused on GPI development, organisations should be considered under a systemic approach that encompasses each of the aforementioned capabilities and dimensions and directs them towards the green purpose.

6.1 | Theoretical and management implications

These findings evidence a series of theoretical repercussions and managerial practices that could be useful for academics, government entities and professionals in different fields. From an academic perspective, this research makes contributions to the RBT, the NRBV and the DCs, along with their extension to the GICs, and supports the need to associate them with the ODs. Moreover, all the proposed GICs and ODs are found to be necessary and to contribute to the design of a governance mechanism focused on an innovation management aimed at achieving the determinants of GPI to favour environmental sustainability. This study also demonstrates that the configuration of the seven GICs and five ODs constitutes a means to achieve GPI. It therefore opens up new fields of research for academia to explore and further examine the relationship between GICs and ODs and green innovation management.

Last, from the perspective of managers of manufacturing firms and government organisations interested in environmental sustainability, we found how, as firms boost GPI development at the organisational level under the strategic support of the different GICs and ODs, they could reduce their negative impacts and help to solve the environmental problems they cause. This would, indeed, encourage a transition from CPI to GPI.

6.2 | Limitations and future work

Although this study proposes and empirically validates a GIC-OD configuration for GPI development, it has various limitations. The EMS provides representative empirical evidence and evaluates key variables in the field of environmental management. However, since the data collected come from a survey, the variables under analysis are not measured directly but are limited to the responses provided by respondents. Additionally, even though large-scale surveys can contribute to the validity and strength of the evidence in this strategic matter, it would be interesting to include data from other countries where the EMS has also been applied, as each country may have unique characteristics that could lead to differences in the results, to discover patterns of as yet unobserved behaviour in the companies and industrial sectors analysed in the present document.

Furthermore, we identify a number of possible future works that could significantly contribute to this line of research. On the basis of the link between GICs and ODs, future studies could use other variables that can be operated and controlled by organisations to represent the determinants of GPI. Moreover, further research might consider addressing GPI development under other conceptual perspectives (e.g., the stakeholder, contingency, value chain and business model theories) in combination with the GICs and the ODs. Likewise, it would be interesting to extend the association between the GICs and green-oriented ODs to other economic sectors, such as the construction, health, tourism and education sectors, which are also seeking to reduce their environmental impact. Last, it is recommended that future studies consider different variables or criteria to evaluate the characteristics of a constituted GPI to assess firms' environmental performance and their impact on financial performance.

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ENDNOTE

[1] Although, in the literature, 'ICs' and 'TICs' are frequently employed to refer to a similar set of capabilities, we consider them equivalent terms here. However, 'ICs' will be mostly used to allude to innovation capabilities, in accordance with the terminology defined in the Oslo Manual 2018 (OECD/Eurostat, 2018).

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