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Identifying the impact of stakeholder and top management support on shaping environmental innovation, green product development, and environmental performance in Brazil and Portugal's plastics industry

Identificando o impacto das partes interessadas e da alta administração no desenvolvimento da inovação ambiental, produtos verdes e no desempenho ambiental na indústria de plásticos do Brasil e de Portugal

Identificar el impacto del apoyo de stakeholders y de la alta dirección en la configuración de la innovación ambiental, el desarrollo de productos ecológicos y el desempeño ambiental en la industria del plástico de Brasil y Portugal

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ABSTRACT

Goal: This paper aims to identify the influence of stakeholders and top management support on environmental innovation strategy, green product innovation, and environmental performance in the context of the plastics industry of Brazil and Portugal. **Methodology/approach:** For the research, a survey was conducted with 94 companies in the industry, using the Partial Least Square (PLS) for data analysis. **Originality/relevance:** The study contributes fill the gaps in the influence of top management and external actors on sustainability-related strategies and innovations in companies in the plastics industry in Brazil and Portugal. **Main findings:** The results demonstrated that the stakeholders' pressure and top management support positively influence the environmental innovation strategy of green products, and both innovations influence the environmental performance of companies in the Portuguese and Brazilian plastics industries. **Theoretical contributions:** The implications emphasize the impact of external elements and companies that influence environmental sustainability, enabling greater quality of life and sustainability on a global scale. **Management contributions:** The practical implications of the results emphasize the need for alignment between top management and the stakeholders for strategies and innovations linked to sustainability.

Keywords: Environmental strategic innovation. Stakeholder pressure. Green product innovation. Top management support. Environmental performance.

RESUMO

Objetivo: Este artigo tem como objetivo identificar a influência dos stakeholders e do apoio da alta administração na estratégia de inovação ambiental, inovação de produtos verdes e desempenho ambiental no contexto da indústria de plásticos do Brasil e de Portugal. **Metodologia/abordagem:** Para efeito da pesquisa foi realizado um levantamento com 94 empresas do setor, utilizando o Mínimos Quadrados Parciais (PLS, Partial Least. Square)) para análise dos dados. **Originalidade/relevância:** O estudo contribui para sanar as lacunas na influência da alta gestão e, principalmente, de atores externos para estratégias e inovações relacionadas à sustentabilidade em empresas da indústria de plásticos no Brasil e em Portugal. **Principais resultados:** Os resultados demonstraram que a pressão dos stakeholders e o apoio da gestão de topo influenciam positivamente a estratégia de inovação ambiental, a inovação de produtos verdes, e ambas as inovações influenciam o desempenho ambiental das empresas da indústria de plásticos portuguesa e brasileira. **Contribuições teóricas:** As implicações destacam o impacto de elementos externos e empresas que influenciam a sustentabilidade ambiental, possibilitando maior qualidade de vida e sustentabilidade em escala global. **Contribuições para a gestão:** As implicações práticas dos resultados destacam a necessidade de alinhamento entre a alta administração e as partes interessadas para estratégias e inovações ligadas à sustentabilidade.

Palavras-chave: Inovação estratégica ambiental. Pressão das partes interessadas. Inovação de produtos verdes. Apoio à alta gestão. Desempenho ambiental.

RESUMEN

Objetivo: Identificar la influencia de las partes interesadas y el apoyo de la alta dirección en la estrategia de innovación ambiental, la innovación de productos verdes y el desempeño ambiental en el contexto de la industria del plástico en Brasil y Portugal. **Metodología/enfoque:** Se realizó una encuesta a 94 empresas del sector, utilizando Mínimos Cuadrados Parciales (PLS) para el análisis de datos. **Originalidad/relevancia:** El estudio contribuye a las lagunas en la influencia de la alta dirección y, principalmente, de los actores externos sobre las estrategias e innovaciones relacionadas con la sostenibilidad en empresas de la industria del plástico en Brasil y Portugal. **Principales resultados:** La presión de las partes interesadas y el apoyo de la alta dirección influyen positivamente en la estrategia de innovación ambiental, la innovación de productos verdes, y ambas innovaciones influyen en el desempeño ambiental de las empresas de la industria del plástico portuguesa y brasileña. **Contribuciones teóricas**: Las implicaciones resaltan el impacto de elementos externos y empresas que influyen en la sostenibilidad ambiental, permitiendo una mayor calidad de vida y sostenibilidad a escala global. **Contribución a la gestión:** Necesidad de alineación entre la alta dirección y las partes interesadas para las estrategias e innovaciones vinculadas a la sostenibilidad.

Palabras clave: Innovación estratégica ambiental. Presión de las partes interesadas. Innovación de productos ecológicos. Apoyo a la alta dirección. Rendimiento ambiental.

INTRODUCTION

Since the 1970s, discussions on sustainability have become more generalized, centering the debate around three main dimensions: economic, environmental, and social (Mores et al., 2018). Academic research on green product innovation has also grown in interest, including studies dealing with the environmental impact of new product designs in North America (Pujari, 2006), new product strategies and company performance in Taiwan (Chung & Tsai, 2007), the reasons for environmental innovation in companies in Italy and Canada (Dangelico & Pujari, 2010), the impact of innovation in green products on the competitive advantage and image of the electronics company in China (Wong, 2012), impact of environmental pressures and performance in UK companies (Yu et al., 2017) and green product innovation and performance impact in Chinese manufacturing companies (Ma et al., 2018).

In addition, production that considers stakeholders and the pressure and importance exerted by them for the strategies of innovation and operation of sustainable products has also increased (Borsato & Bazani, 2021; Chan et al., 2016; Chu et al., 2017; Mores et al., 2018; Seman et al., 2019; Yu et al., 2017), as well as the relationship between top management support and strategic proposals for environmental innovation (Kitsis & Chen, 2021; Tarigan et al., 2020; Yusliza et al., 2019).

Innovation, therefore, is understood to contribute to the sustainable development of the environment (Mores et al., 2018; Silvestre, 2015), in addition to being considered important for the organization's sustainability. Therefore, understanding green product innovation because of the interaction between innovation and sustainability becomes a strategic priority for theory and practice (Dangelico & Pujari, 2010). Furthermore, companies miss great earning opportunities in dynamic environments because they have little guidance on how an environmental innovation strategy can be formulated to respond to increasing government regulation and stakeholder pressures (Yu et al., 2017).

In addition to environmental issues linked to innovation and performance, the global demand for renewable products has given rise to the development of innovative products in the chemical industry (Mores et al., 2018). Consequently, the use of renewable energy sources offers an alternative to fossil fuels, thus improving the environment (Hall et al., 2011; Mores et al., 2018). According to the authors, one of the examples is the petrochemical industry, which replaces the use of green plastic. Green plastic is the world's first renewable-source certified plastic, making the petrochemical industry one of the pioneers in this field.

On the topic related to plastic, some recent studies draw attention to the importance of the topic in emerging countries, such as Brazil. The country has a wide production chain in terms of the market, considering the refining stage, going through different stages until reaching the final consumer, in addition to the recycling stages. However, the industry had difficulties in growth in 2018 (0.8%), with a projection of more than 2.0% growth

in 2019, which has not been consolidated (Associação Brasileira da Indústria do Plástico [Abiplast], 2019). In addition, the effects of the pandemic directly influence the projections for 2020 and 2021, generating a retraction in the periods of COVID-19, following so many others. In 2022, the revenue of the plastic processed industry was R$ 117.5 billion, with US$3.8 billion generated by imports and US$1.4 billion from exports of processed plastics, thus influencing the increase of R$1.3 million in the Brazilian GDP (Gross Domestic Product) and R$3.35 million in the economy's total production.

In the case of Portugal, the pressure from entities to reduce waste stands out, in addition to the participation of companies, associations, universities, and the Government, all united by the Portuguese Pact for Plastics. According to the Portuguese Plastics Industry Association (Apip) and the Portuguese Plastics Pact (PPP, 2021), the initiative aims to reduce plastic pollution by transitioning to a circular economy, valuing plastic as a resource within the economy and decreasing it as a threat to the environment. This initiative highlights the importance of the actors involved in the industry and the need for companies to innovate in an environmentally strategic way.

Then, the gap was identified on environmental pressures from stakeholders, such as environmental regulations (Borsato & Bazani, 2021), the importance of top management support, strategic environmental innovation, innovation in green products, and environmental performance, verifying that the understanding of these relationships in the Brazilian and Portuguese context is relevant.

Based on this gap, the following research question is considered: What is the influence of stakeholders and top management support on environmental innovation strategy, green product innovation, and environmental performance in the context of the plastics industry of Brazil and Portugal?

Therefore, the objective of the article is to identify the influence of stakeholders and top management support on the environmental innovation strategy, green product innovation and environmental performance in the context of the plastics industry in Brazil and Portugal.

We believe that the results provide reflection on how external elements and the top management of an organization influence strategic decision-making for innovation in green products. This point is relevant, considering the importance for organizational and literature terms, that the "steps" of organizations are influenced by external and high-ranking elements. Therefore, understanding the impacts of stakeholders, which are often absorbed or understood as opportunities by the top management of organizations, has a direct impact on strategic decision-making for green product innovation in different locations, with different dimensions and cultures.

This paper is organized as follows: first, the theoretical assumptions. Second, the study design and methodological procedures are presented. Third, the study's conclusions are presented, and the managerial implications are discussed. Finally, considerations are presented with a summary, the main limitations, and suggestions for future research.

THEORETICAL REVIEWS

The role of stakeholders in the innovation process

Innovation presents a series of possibilities for improvement in the places where they are inserted/implanted. However, for innovative companies to succeed, they must bring together various stakeholders, such as investors, suppliers, and consumers (Kahupi et al., 2021). In this sense, companies must have results in their own businesses and persuade potential partners to participate in their value creation (Kahupi et al., 2021).

Moreover, stakeholders have different roles in influencing company innovations. In a broad sense, stakeholders are any identifiable group/individual that influences (or is influenced) in achieving an organization's objectives. In a narrow sense, it would be any group or individual on which the organization depends for its continued survival (Freeman & Reed, 1983). One of the main stakeholders is the government, which acts as regulators, causing pressure on companies. Literature points out that the environmental regulations imposed by governments are an important pressure on companies to promote green innovation (Borsatto & Amui, 2019; Borsatto & Bazani, 2021). These regulations act as an incentive for companies to adopt more sustainable practices and technologies, aiming to reduce their environmental impact (Borsatto & Amui, 2019; Borsatto & Bazani, 2021). Therefore, government regulations and stakeholder pressure leave companies to respond to environmental changes dynamically (Yu et al., 2017).

Therefore, in the case of pressure from environmental regulations or policies, these stakeholders play an important role in boosting environmental management practices. Environmental regulations can represent restrictions or regulatory compliance, but they can also provide opportunities for risk minimization, preservation of revenues and reputation, or the creation of new businesses (Hao et al., 2023; Kong & Qin, 2021; Yang, Zhang & Zhang, 2021). Studies show that environmental regulations, especially those based on market incentives and government subsidies, have a positive impact on improving production efficiency and reducing emissions (Borsatto & Amui, 2019; Borsatto & Bazani, 2021; Chan et al., 2016). They can significantly improve the utilization rate of industrial capacity and promote the updating of the industrial structure towards more sustainable models, while enhancing its competitiveness (Borsatto & Amui, 2019; Borsatto & Bazani, 2021).

Finally, it is understood that the pressures of the interested parties (stakeholders) allow the company to leave their comfort zone, generating greater space for innovations and exchanges with those involved, suggesting that this is seen as a constituent element of strategies for environmental innovation.

Stakeholders and Environmental Innovation Strategy

Literature has given greater attention to issues focused on environmental innovation strategies (EIS) and the sustainable competitive advantage of organizations (Lopes et al., 2022; Wang, Zhang & Wang, 2022). Furthermore, generating an environment where companies can create environmental benefits and promote savings allows them to emphasize innovation, especially

environmental innovation strategies (Siedschlag, Meneto & Koecklin, 2022; Xu et al., 2021). Therefore, those actions are characterized by preventing pollution and adopting an environmental management system and practices to reduce resource sources (Eiadat et al., 2008; Yu et al., 2017).

Nevertheless, stakeholder pressures manifest in various forms, shaping the environmental innovation landscape (Adomako & Tran, 2022). Regulatory pressures, such as stricter environmental standards, compel companies to adopt eco-friendly practices, fostering EIS (Borsatto & Bazani, 2021; Cui et al., 2022; Li, Huang & Su, 2023). Market pressures driven by consumer demand for sustainable products and services push companies to innovate environmentally to remain competitive (Aibar-Guzmán & Somohano-Rodríguez, 2021; Lestari et al., 2021; Lopes et al., 2022). Additionally, financial pressures from investors prioritizing companies with strong environmental credentials incentivize EIS adoption for financial gains (Deng, Li, & Wang, 2022; Zhou et al., 2023). Moreover, community pressures from residents demanding environmentally responsible operations can influence companies to embrace EIS (Wu et al., 2022).

A growing body of research corroborates the positive influence of stakeholder pressure on EIS. Mady et al. (2022) found that companies facing stronger stakeholder pressures were more likely to invest in eco-innovation. Similarly, Feng, Wang and Zhou (2021) demonstrated that firms under intense environmental regulations exhibited higher levels of EIS adoption. These findings underscore the compelling role of stakeholder pressures in driving companies towards environmentally innovative strategies.

While stakeholder pressure generally drives EIS adoption, it is important to recognize that the nature and intensity of these pressures can vary across industries and contexts (Adomako & Tran, 2022). Additionally, companies' environmental commitment (Hu et al., 2023) and risk tolerance (Meng, Wang & Yu, 2022) can influence their response to stakeholder pressures. These factors can moderate the strength of the relationship between stakeholder pressure and EIS adoption.

In this sense, considering the influence of external pressures exerted by stakeholders, such as regulations, consumer preferences, and investor demands, and how these pressures encourage companies to improve environmental performance (Sarkis et al., 2011; Yu & Ramanathan, 2016; Yu et al., 2017), we suggest the hypothesis:

> *H1: Stakeholder pressure positively influences environmental innovation strategies.*

Stakeholders pressure and green product innovation

Green product innovation, which considers environmental impact throughout the product lifecycle (Hao et al., 2023; Kong & Qin, 2021; Yang, Zhang & Zhang, 2021), is increasingly influenced by stakeholder pressures. The goal of product innovation is to improve product performance in exchange for new customers and new markets. In contrast, process innovation increases productivity, cost efficiency, and flexibility (Wong, 2012) and implements the differentiation strategy to develop a market niche (Kahupi et al., 2021).

However, green products' innovation performance and processes positively correlate with competitive advantage (Tu & Wu, 2021). More spe-

cifically, green product innovation impacts the competitive advantage of companies and their image (Qiu et al., 2020).

However, the intention to introduce innovation will require a high corporate level of environmental responsibility and a sustained level of implementation of the company's environmental policies to put green product ideas into practice and overcome challenges and risks (Petruzzelli et al., 2011; Kong & Qin, 2021; Yang, Zhang & Zhang, 2021). Thus, authors emphasize that environmental responsibility in developing new products often originates from an internal environmental orientation of the company combined with the potential for success in the market.

Furthermore, green innovations are characterized by high internal and external complexity (Meidute-Kavaliauskiene et al., 2021; Petruzzelli et al., 2011). Combining external and internal knowledge sources (necessary for sustainable innovations) requires new skills and capacities to compose knowledge (Meidute-Kavaliauskiene et al., 2021).

Moreover, Rennings (2000) emphasizes that eco-innovation involves not only technological changes but also social and institutional innovations. The author identifies three peculiarities of eco-innovation: the double externality problem, the regulatory push/pull effect, and the increasing importance of social and institutional innovation. He argues that these peculiarities are often ignored in innovation economics and that a broader understanding of innovation is necessary to overcome market failure and avoid a "technology bias." Therefore, Rennings (2000) concludes that ecological economics can contribute to eco-innovation research by integrating ecological, social, and economic aspects of sustainable development and by adopting methodological pluralism.

Motivated by government policies, environmental pressures on innovation strategies and their possible gaps (Khan et al., 2021; Xu et al., 2021; Yu et al., 2017), and the perception of market opportunity by decision-makers, companies have invested in green product innovation (Meidute-Kavaliauskiene et al., 2021), considering that green product innovation is a crucial way to achieve long-term strategic development (Barforoush et al., 2021). Nevertheless, these pressures can come from various stakeholders, such as stricter government regulations mandating eco-friendly products, consumer demand for sustainable options, and investor interest in companies with strong environmental credentials. Studies show a positive correlation between stakeholder pressure and green product innovation (Zhou, Sawyer & Safi, 2021). Thus, the following hypothesis is suggested:

> *H2: Stakeholder pressures positively influence green product innovation.*

Top management support and environmental innovation strategies

Managing corporate environmental sustainability is a complex task and can be considered a great challenge an organization faces (Koch & Sauer, 2024). Top management support, guidance, and leadership are key factors in the organizational adoption and implementation of innovations, technologies, programs, and initiatives in corporate planning (Griffin et al., 2004; Hamel &

Prahalad, 1989). Adopting a management system focused on environmental sustainability is also believed to provide a competitive advantage for companies (Lopes et al., 2022).

Top management with clear policies and effective strategic planning that provides the necessary resources and adequate employee training can increase sustainable procurement (Tarigan et al., 2020). This supports research showing positive links between top management commitment, corporate environmental practices (Lee & Ball, 2003), and environmental sustainability (Colwell & Joshi, 2013). Singh et al. (2013) identified top management commitment as one of 11 performance measures for environmentally conscious manufacturing. Management commitment and support are necessary for innovation, especially environmental concerns, through employee empowerment and involvement (Tarigan et al., 2020).

Li, Wang and Fang (2024) applied machine learning techniques to investigate the relationship between top management characteristics, environmental actions, and industry factors in driving green innovation within firms. The study underscores the significance of the CEO characteristics, such as pay, education level, and research and development experience, in driving green innovation within firms. Additionally, proactive environmental actions, like reducing energy consumption and carbon footprint, are highlighted as essential for developing and utilizing innovative, environmentally friendly technologies to gain a competitive edge in sustainability. Furthermore, the study emphasizes the positive impact of environmental disclosures, industry characteristics, and factors like environmental, social, and governance ratings and corporate social responsibility performance on enhancing corporate green innovation.

Therefore, top management commitment is considered one of the main capabilities of an organization that assists in developing and implementing corporate environmental practices (Yusliza et al., 2019) to achieve positive environmental performance (Lopes et al., 2022; Yang Spencer et al., 2013). Strongly emphasized in the existing literature (Gosling et al., 2017; Hoejmose et al., 2012), the vital role of top management commitment is critical to eliminating organizational barriers and, therefore, in successfully implementing green initiatives. Without top management commitment, building the proper strategic direction and developing green operations would not be realistic. Indeed, the failure of many green initiatives has largely been attributed to weak support from top management (Fawcett et al., 2015).

In other words, it is understood that the successful adoption of green initiatives by organizations depends on the commitment of the organization's top management (Lopes et al., 2022; Spencer et al., 2013; Yusliza et al., 2019). Thus, management support, leadership, and commitment to sustainability (Chen & Kitsis, 2017) are the crucial ingredients for the success of sustainable innovation practices (Kiron et al., 2013), suggesting the hypothesis:

H3: Top management support positively influences the environmental innovation strategy.

Top management support and green product innovation

Top managers act as important drivers in implementing various management practices that influence organizational performance (Chu et al., 2017), which is vital to support sustainable initiatives (Kitsis & Chen, 2021). Management attention appears in commitment, emotions, beliefs, intentions, or a strong stance to pursue the goal (Williams et al., 2014). Studies also highlight that the values and commitment of top management influence a company's culture, corporate decisions, and employee behavior (Robertson & Barling, 2013), facilitating the approval of human and financial resources and improving operations and performance.

Top management's attention in terms of a strong commitment to the organization's strategic statement modulates the impact of the mission on company performance through communication, company-wide involvement, and goal setting (Williams et al., 2014). This aligns with the suggestion of Colwell and Joshi (2013), who state that when the commitment of an organization's top management is high, it is more likely that the adoption of environmentally friendly innovation practices will be carried out.

In this sense, top management support has a positive effect on the company's resource management, facilitating the planning and process of environmental proposals (Tarigan et al., 2020), and top management's views on environmental sustainability can largely affect which green initiatives they select (Yusliza et al., 2019). Companies in different industrial environments can allocate resources to green innovation differently, using different strategies, which reflect differently on performance (Javeed et al., 2022).

Thus, while green product planning involves efficient use of materials, energy, resources, eco-friendly material selection, and design for easy disassembly, the green process is concerned with economic concerns and the environmental compatibility of the product and manufacturing processes (Narasimhan & Schoenherr, 2012).

Considering the important relationships of top management support for adopting a "sustainable path" for product innovation, the following hypothesis is suggested:

> *H4: Top management support positively influences green product innovation.*

The environmental innovation strategy and environmental performance

Corporations are assuming an increasingly significant role in pursuing sustainability to minimize the social and environmental impacts caused by production (Mores et al., 2018). Innovation is now understood as contributing to sustainable development (Boons et al., 2013; Silvestre, 2015), strongly emphasizing environmental innovation strategy (Amores-Salvadó et al., 2015; De Marchi, 2012).

Environmental innovation strategy is defined as manufacturing practices that include source reduction, pollution prevention, and adopting an environmental management system (Yu et al., 2017). It is seen as the var-

ious environmental management practices that a company implements to respond to increasing environmental pressures, which include setting annual targets for energy conservation, recycling, or waste reduction, while formulating clear environmental mission statements (Yu et al., 2017).

Companies exposed to environmental regulation and receptive to environmental demands from stakeholders are more likely to adopt an environmental innovation strategy because they understand that such a strategy will lead to better environmental and financial performance (Lai et al., 2012).

However, the influence of environmental innovation strategy on company performance may not be direct. For example, a company that can better use its scarce resources to achieve desired results will likely achieve higher performance (Eisenhardt & Martin, 2000; Yu et al., 2017).

However, considering the possible relationship between environmental innovation strategies and environmental performance, the following hypothesis is suggested:

> *H5: The environmental innovation strategy positively influences environmental performance.*

Green product innovation and environmental performance

Green innovation is distinguished from conventional innovation in that while the latter is developed not specifically to address environmental challenges, the former is initiated to meet the green requirements of a regulatory body or concerns of target customers (Porter & van der Linde, 1995).

These innovations typically involve process, product, and marketing attributes to create product differentiation (Zhu et al., 2008), creating value by addressing the green concerns of the market, industry, company, and/or individual customers that a product or process (Linder et al., 2003).

Green innovation because "going green" helps companies to develop new market opportunities and increase their competitive advantage (Chen et al., 2006), as it helps companies achieve greater efficiency, establish, and strengthen their core competencies, improve their green image, resulting in the company's profitability (Chen, 2008).

A company innovating in green products undoubtedly faces the same challenge, but with the additional and more onerous task of innovating and operating under increasing green awareness, tightening environmental regulations (Groot & Borén, 2010), increasing competition in the narrower market and profit margins (Wong, 2012) and environmental performance (Seman et al., 2019; Yu et al., 2017).

In addition, interactions between customers, suppliers, and partners and joint research and development will promote environmental performance (Zhu et al., 2008).

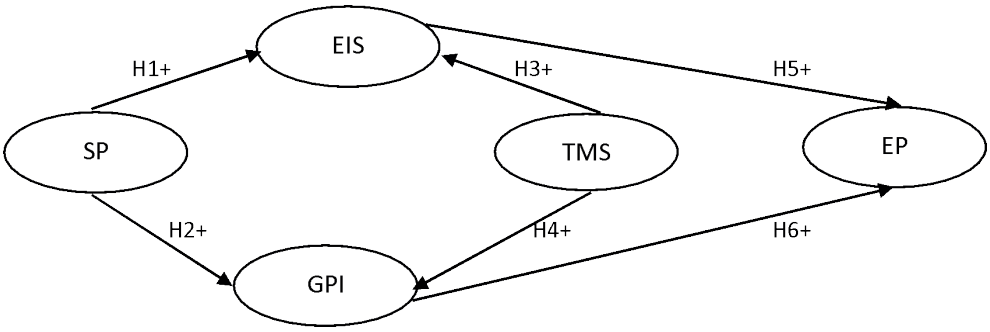
Considering the possible relationship between green product innovation and environmental performance, the following hypothesis is suggested:

> *H6: Green product innovation positively influences environmental performance.*

Schematically, the theoretical framework supports the conceptual model presented in Figure 1.

Figure 1.

Conceptual Model



METHODOLOGICAL PROCEDURES

The method used in this paper is the deductive method and the confirmatory methodological approach. Thus, a quantitative study of a conclusive-causal nature was developed to investigate the impact of stakeholder pressures and top management support on the environmental innovation strategy and, consequently, on the innovation of green products and their effect on environmental performance.

For this purpose, a structural equation model was proposed using the partial least squares (PLS) method with SMARTPLS v.3.3.2 software. This estimation method is suitable for theoretical development, small samples, and a few observations (Ringle et al., 2020).

The data was collected online, assuming the study's transversal characteristics. The sample comprises workers responsible for the environmental area in industrial companies in the plastics industry of Brazil and Portugal, and the sample is characterized as non-probabilistic and convenient.

Questionnaire vs measures

We developed a data collection instrument, which is a method that guarantees the standardization and comparison of data, increasing the accuracy of records and data processing (Malhotra, 2010). The instrument included three groups of closed questions: (1) about the respondents, (2) about the company where they work, and (3) about the variables of the study. For these, 5-point Likert scales of already tested agreement/disagreement were adopted.

The original scales were translated using the reverse translation methodology. Thus, the scales by Yu et al. (2017) were adapted to measure the Stakeholder Pressure and Environmental Innovation Strategies constructs; the scale of Chang (2016) to measure Green Product Innovation; the scale of Huang et al. (2016) to measure Top Management Support; and the scales of Huang et al. (2016) and Yu et al. (2017) to measure Environmental Performance.

For a better understanding of the variables (constructs), as well as the authors who served as the basis for this understanding, Figure 2 presents the concepts of variables assumed by the authors for the development of this article.

Figure 2.

Construct characteristics

Construct	Concept	Authors
Stakeholder pressure	Pressure from influential actors, shaping the environmental innovation landscape.	Yu et al. (2017); Adomako & Tran (2022.
Top management support	It is considered one of the main capabilities of an organization that assists in developing and implementing corporate environmental practices to achieve positive environmental performance.	Yang Spencer et al. (2013); Huang et al. (2016); Yusliza et al. (2019).
Environmental innovation strategies	It is defined as manufacturing practices that include source reduction, pollution prevention, and adopting an environmental management system.	Yu et al. (2017)
Green product innovation	Green innovation is distinguished from conventional innovation in that while the latter is developed not specifically to address environmental challenges, the former is initiated to meet the green requirements of a regulatory body or concerns of target customers.	Porter & van der Linde (1995); Dangelico & Pujari (2010).
Environmental performance	Internal and external results identified by organizations, which are related to environmental strategies and innovations.	Yu et al. (2017)

Before sending the questionnaire, a pre-test was performed with ten administrators of companies in the plastics industry, being 5 Brazilians and 5 Portuguese, to avoid errors or difficulties in interpretation. The questionnaire was distributed online (by email) using the LimeSurvey tool, and the data collection occurred during September 2020.

Sample

The sample comprises 94 respondents; 52 are from Brazil, and 42 are from Portugal. Most respondents are men (63%), between 41 and 50 years old (60.6%) and with a long employment relationship with the company, since 60.7% have worked there for more than 11 years.

They mainly occupy management/administration functions (61.7%), and around 82% have an academic degree in higher education.

These respondents work in mostly small companies: 17% employ less than ten employees, 51.1% employ between 10 and 49 workers, and 17% employ between 50 and 99 workers. Most companies have been in the market for over ten years (83.2%) and belong to some business association (75.5%). The most used production techniques are injection (39.4%) and extrusion (10.6%). They mainly produce plastic packaging (29.8%), technical plastic parts mainly for the automotive industry (12.7%), plastic sheets, tubes, and profiles (11.7%), and plastic items for civil construction (9.6%).

All of them export, although some of these exports represent very little in terms of the total volume of business. Only 50 companies state that the foreign market represents 26.6% of the total volume of business.

Pre-analysis of the data

The data were collected based on the subjective perceptions and self-representations of the respondents before the model estimation: an exploratory factor analysis of principal components, to realize the factor test and verify that the data do not present any measurement error that compromises the credibility of the results of the data analysis. For this purpose, the Harman single-factor test, a widely used method, was performed to verify that the data were not subjected to Common Method Bias (Podsakoff et al., 2003).

The results did not show the presence of a single factor that explains most of the variance in the data; the first factor extracted explains 27% of the variance extracted. The Bartlett and Kaiser-Meyer-Olkin (KMO) sphericity tests revealed that the factor analysis performed is adequate to the data under study, with a statistical significance level of the Bartlett sphericity test < 0.001.

Furthermore, it is important to analyze multicollinearity by analyzing the Variance Inflation Factor coefficient (VIF) value. The VIF value verifies if a certain item is correlated with other items that perform the model, thus avoiding biases caused by multicollinearity. Following the recommendation of Marôco (2014), all items that presented VIF values above five were excluded from the study. Next, we estimated structural equations using the partial least squares method (PLS).

RESULTS

Analysis of the measurement model

The individual reliability of indicators can be analyzed by examining the contributions (loadings) or simple correlations of these indicators with the concept to which they are associated. Considering the data, we only considered values that had standardized coefficients (λ) greater than 0.5, which happened in all items under study (Marôco, 2014) (Table 1).

Table 1.

Reliability of measures and convergent validity of the constructs

Constructs	Items	λ**	α (> 0,7)	CR (> 0,7)	AVE > 0,5
Environmental Innovations Strategies (EIA)	EIS7	.772	.767	.866	.683
	EIS8	.876			
	EIS9	.829			
Green Products Innovation (GPI)	GPI1	.850	.839	0,892	0,674
	GPI2	0,900			
	GPI3	0,746			
	GPI5	0,780			
Environmental Performance (EP)	EP2	0,854	0,894	920	0,658
	EP3	0,884			
	EP4	0,713			
	EP5	0,857			
	EP6	0,836			
	EP8	0,703			
Stakeholders Pressure (SP)	SP5	0,903	0,794	0,879	0,709
	SP6	0,794			
	SP7	0,826			
Top Management Support (TMS)	TMS2	0,820	0,820	0,891	0,732
	TMS4	0,877			
	TMS6	0,870			

Nota. λ - Standardized Loadings | * * p < 0,001; α = Cronbach's Alpha; CR = Composite Reliability; AVE = Average Variance Extracted.

We continued with the study of the convergent validity of the constructs, and, in this sense, given that the values of the composite reliability of the concepts are greater than 0.7 (CR > 0.7), the average extracted variance is greater than 0.5 (AVE > 0.5) and Cronbach's α values are greater than 0.7 (α > 0.7) (Hair et al., 2018), it is concluded that the constructs have convergent validity (Table 1).

Afterwards, the discriminant validity was analyzed using the criterion of Fornell and Larcker (1981), whose results are shown in Table 2. The AVE values present on the main diagonal are, in all cases, superior to the square of the correlations between the constructs present in the model, so it is concluded that there is discriminant validity, showing that the constructs are distinct from each other.

Table 2

Discriminant Validity - Fornell and Larcker (1981)

	(EIS)	(EP)	(GPI)	(SP)	(TMS)
Environmental Innovations Strategies (EIS)	**0,827**				
Environmental Performance (EP)	0,686	**0,811**			
Green Products Innovation (GPI)	0,652	0,722	**0,821**		
Stakeholders Pressure (SP)	0,650	0,608	0,463	**0,842**	
Top Management Support (TMS)	0,774	0,517	0,518	0,467	**0,856**

Analysis of the structural model

The SmartPLS software allows testing complex *path models* without estimation problems, making it possible to identify relationships between latent variables. With the structural model analysis, are also identified the dimension and the direction of the relationships between the variables to confirm or reject the research hypotheses formulated in this study.

The main criteria for evaluating the structural model are the R^2 values and the significance level of the *path coefficient* (Hair et al., 2018). The relationships between variables with coefficients greater than 0.2 can be considered strong. Regarding the R^2 values, these should be greater than 0.1 since, being lower, they provide little information (Falk & Miller, 1992). In this study, R^2 values of the dependent variables are considered moderate to strong: Environmental Innovation Strategies (R^2 = 0.705), Green Product Innovation (R^2 = 0.331), and Performance (R^2 = 0.602).

The second step in the PLS analysis evaluates and tests the structural model to validate the hypotheses under study. We used the *bootstrap* technique with 5000 subsamples to stabilize the results obtained. The analysis obtained the results that tested our hypotheses by analyzing standardized path coefficients (Std β) and the statistical significance *t* of *Student*. The hypotheses with t values above 1.96 were considered validated for a reliability of 95% (Table 3).

Table 3

Results of the Hypothesis Test

Hypotheses	Relationships	Std β	t-Value	p-value	Status
H1	PS - EIA	0,369	4,260	0,000	Confirmed
H2	PS - IPV	0,283	2,357	0,018	Confirmed
H3	AGT - EIA	0,601	7.899	0,000	Confirmed
H4	AGT - IPV	0,386	3.383	0,001	Confirmed
H5	EIA - PA	0,374	4,486	0,000	Confirmed
H6	IPV - PA	0,478	5,448	0,000	Confirmed

DISCUSSION OF RESULTS

The plastics industry faces increasing pressure to adopt more sustainable practices and reduce its environmental impact. In this context, the influence of stakeholders and top management support are critical factors shaping environmental innovation strategies in plastics companies. In our results, stakeholder pressure and top management support explain 70.5% of the environmental innovation strategies in plastics companies. It is noted that environmental innovation strategies are reactive strategies because external pressures are felt significantly ($\beta = 0.369$, $p < 0.000$, t-value = 4.260). However, adopting environmental innovation strategies in the plastic industry depends on the support of the top management ($\beta = 0.601$, $p < 0.000$, t-value = 7.899). Strong top management support is essential for environmental innovation strategies across companies of all sizes and crucial for overcoming internal barriers and driving sustainable change. In the case of this study, most participating companies are characterized as small. This requires an important strategic understanding so that actions can be delimited.

Green purchasing can be increased with top management with clear policies and effective strategic planning that provides the required resources, and adequate training for employees can increase green purchasing can be increased (Tarigan et al., 2020). In larger companies, obtaining support from top management may require navigating complex organizational structures and securing buy-in from multiple decision-makers. In SMEs, top management support may be more direct and accessible, but resource constraints could pose challenges to implementing sustainable initiatives.

Green product innovation developed in plastics companies is also influenced by stakeholder pressures ($\beta = 0.283$, $p < 0.018$, t-value = 2.357) and by top management support ($\beta = 0.386$, $p < 0.001$, t-value = 3,383). Altogether, they explain that 33.1%.

It is confirmed that stakeholders, customers, suppliers, distributors, and competitors, etc., provide challenges to plastics companies regarding environmental sustainability, reflected in the adoption of environmental innovation strategies and consequently in the innovation of green products (Mores et al., 2018; Yu et al., 2017).

The influence of stakeholder pressure and top management support on green product innovation can vary depending on the size of the company. Larger companies with extensive resources may be better equipped to invest in research and development, implement advanced technologies, and engage in collaborative partnerships to drive environmental innovation.

On the other hand, SMEs may focus on more practical and cost-effective solutions, such as process optimization, waste reduction, and product redesign, to enhance their environmental performance.

Companies invest in green product innovation because they consider it a strategic issue, as it allows them to be more competitive and explore market opportunities, in addition to influencing their image (Chen et al., 2006; Wong, 2012).

Because of this, the plastics industry has identified technologies that can be applied to different stages of the plastics chain, highlighting the direct relationship between strategy and green innovation, considering innovation as a process that has stages developed over time (Chan et al., 2016).

In this sense, such actors and their activities and actions are influential for innovation strategies, as they will participate in pre-production, distribution, and product demand (in the case of consumers) that are more aligned with the green proposal and companies, which, in turn, should align the development of such products based on their future proposals in terms of competitiveness and sustainability (Chan et al., 2016; Huang et al., 2016).

Performance is strongly influenced by the environmental innovation strategy ($\beta = 0.374$, $p < 0.000$, t-value = 4.486) and by the innovation of green products ($\beta = 0.478$, $p < 0.000$, t-value = 5.448). In total, they explain 60.2% of the variation in environmental performance. The results suggest a positive and direct relationship between the constructs, reinforcing the result that the relationship between green innovation and environmental performance has remained inconclusive (Seman et al., 2019). In practice, the implementation of green innovation has the potential to improve environmental performance significantly and enhance the performance of other businesses in terms of competitive advantage and green image through this implementation (Chen et al., 2006; Chen, 2008; Seman et al., 2019; Kitsis & Chen, 2021).

FINAL REMARKS

This paper aimed to identify the influence of stakeholders and top management on environmental innovation strategy and green product innovation, as well as the relationship of both innovations in environmental performance in the context of the plastics industry in Brazil and Portugal.

Stakeholder pressures and top management influence environmental innovation strategy and positively impact green product innovation. In addition, it is observed that the environmental innovation strategy and the innovation of green products positively influence environmental performance.

The results are relevant in terms of their applications and reflect in practice and strengthen the results found in research so far, as they consider the influential role that stakeholders and top management have in innovation strategies. Thus, it is understood that strategic alignment involves understanding the pressures of stakeholders and is understood by top management. They can impact opportunities, as they also influence other companies and create barriers that can condition the market in which they operate.

In addition, a good relationship with stakeholders can influence a possible competitive advantage for the company, as collaboration with (and of) stakeholders, such as NGOs, government, or companies in the supply chain, among others, enables cost reduction and better use of resources (Dijkstra et al., 2020).

The influence of stakeholders and top management on innovation has a positive relationship with green product innovation, enabling companies to innovate their green products financially sustainably and increase their share.

In addition, the innovation strategy and innovation in green products positively influence environmental performance, enabling the understanding that strategies linked to innovation enable effects linked to the results of organizations. Another important point is the possibility of improving the

quality of products and the relationship with the market, enabling greater satisfaction and loyalty of consumers, which suggests long-term relationships with users.

The limitations of the present study indicate that more research is needed to improve knowledge of the determinants and consequences of environmental innovation strategies. The first limitations are the sample size and convenience sampling, which, among other factors, limit the generalizability of the results.

Furthermore, the data were collected at a single time point and from the same source, which may imply variance risks from the common method (Podsakoff et al., 2003). Certain preventive procedures were performed, as suggested by Podsakoff et al. (2003), for example, Harman's single factor test (Podsakoff & Organ, 1986), which demonstrated that this risk does not constitute a serious problem and, therefore, is not a threat to the validity of the results found.

However, future studies may collect data at different time points or through the dual source method. For example, environmental practices can be reported by customers and consumers in addition to managers or administrators. Furthermore, it can also apply to companies other than plastics.

In future studies, other variables can be studied, and the measurement scales in this study can be improved. The scales showed some multicollinearity problems between the items, which led to the abandonment of some items, weakening their reliability and validity.

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