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Driving sustainability: Green drivers and practices in the textile-fashion industry

Conduciendo la sostenibilidad: Impulsores y prácticas verdes en la industria de la moda textil

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ABSTRACT

This study aims to identify the main drivers that influence internal GSCM (Green Supply Chain Management) practices undertaken by companies in the textile-fashion sector in Spain. Additionally, it examines how these companies leverage these practices to enhance both economic and environmental performance. By using a survey-based methodology and applying the PLS-SEM technique, the analysis highlights that imposed regulatory requirements and company environmental awareness are not a direct precursor to product and process oriented internal GSCM practices. Instead, internal firm-level motivators are significant in internal GSCM practices. External stakeholder pressures are significant in internal GSCM practices and more influential in internal product GSCM practices (eco-design and green packaging). Furthermore, while process-oriented GSCM practices positively contribute towards environmental outcomes, they do not directly enhance economic performance. Conversely, product-oriented GSCM practices positively affect both environmental and economic performance. By distinguishing the effects of product versus process practices, this study provides nuanced insights on the literature regarding GSCM, particularly in resource-intensive sectors such as textile and fashion, where strategic decisions regarding green practices can lead to differentiated economic and environmental outcomes.

Keywords: GSCM, Drivers, Green supply chain management practices, Performance sustainability, Textile-fashion industry, PLS-SEM.

RESUMEN

Este estudio tiene como objetivo identificar los principales impulsores que influyen en las prácticas internas de GSCM (Gestión de la Cadena de Suministro Verde) llevadas a cabo por empresas del sector textil-moda en España. Además, examina cómo estas empresas aprovechan dichas prácticas para mejorar tanto el rendimiento económico como el ambiental. Mediante una metodología basada en encuestas y la aplicación de la técnica PLS-SEM, el análisis destaca que los requisitos regulatorios impuestos y la conciencia ambiental de la empresa no son un antecedente directo de las prácticas internas de GSCM orientadas al producto y al proceso. Sin embargo, los motivadores internos a nivel de empresa y las presiones externas de los grupos de interés son significativas en las prácticas internas de GSCM y tienen una mayor influencia en las prácticas de GSCM orientadas al producto (ecodiseño y embalaje verde). Asimismo, aunque las prácticas orientadas al proceso contribuyen positivamente a los resultados ambientales, no mejoran directamente el desempeño económico. Por el contrario, las prácticas orientadas al producto impactan positivamente tanto en los resultados ambientales como económicos. Al distinguir los efectos de las prácticas orientadas al producto frente a las orientadas al proceso, este estudio aporta una visión matizada a la literatura sobre GSCM, particularmente en sectores intensivos en recursos como el textil-moda, donde las decisiones estratégicas sobre prácticas verdes pueden generar resultados diferenciados en términos económicos y ambientales.

Palabras clave: GSCM, Impulsores, Prácticas de gestión de cadena de suministro verde, Rendimiento, Industria textil-moda, PLS-SEM.

1. INTRODUCTION

Climate change pressures and government regulations push companies towards environmentally friendly practices (Dou *et al.*, 2018). Strategic responses have evolved from controlling pollution to adopting preventive approaches focused on reducing pollution at the source (Daily *et al.*, 2012).

Green Supply Chain Management (GSCM) integrates environmental thinking throughout supply chain operations, encompassing the entire product life cycle, to reduce resource waste, minimize environmental pollution, and lower production costs (Abbas & Hussien, 2021; Fang & Zhang 2018; Wang *et al.*, 2022). GSCM emphasizes balancing economic and environmental performance to remain competitive (Gawusu *et al.*, 2022).

The textile-fashion industry embodies the urgent need for sustainable practices due to its substantial environmental footprint, characterized by intensive energy use, toxic chemicals, and natural resources consumption (Moazzem *et al.*, 2021; Sivaram *et al.*, 2019). It is responsible for 20% of water pollution worldwide (European Parliament, 2024) and ranks fourth in environmental impact in the EU (European Commission, 2022). Fast fashion has doubled fiber production from 58 million tons in 2000 to 124 million tons in 2023 (Textile Exchange, 2024).

Companies adopt green practices either proactively through top management, or reactively to external pressures (Srivastava, 2007; Tay *et al.*, 2015), with the European Commission recognizing green claims as competitive advantage (European Commission, 2023).

Despite extensive research on drivers of GSCM practices (Mojumder & Singh, 2021; Silva & Gomes, 2023), empirical studies that comprehensively identify the factors motivating firms to implement GSCM practices are limited (Fatima *et al.*, 2024), or tend to solely focus on specific functions, such as green purchasing or reverse logistics (Liu & Lu, 2023). Few studies have focused on GSCM practices within the textile-fashion industry, where its implementation presents difficulties (Bai *et al.*, 2017). To achieve sustainability goals, textile companies must incorporate sustainable supply chain practices (Kumar *et al.*, 2022).

Two types of green practices, namely intra- and inter-organizational practices have been identified (Fianko *et al.*, 2021). The adoption of internal GSCM practices often constitutes a logical and operational prerequisite towards the successful implementation of external practices. Effective implementation of GSCM, including customer and supplier collaboration, is facilitated by an initial adoption of green practices within the organization itself (Agyabeng-Mensah *et al.*, 2020). The development of internal resources and capabilities provides a solid foundation for extending environmental initiatives to external partners (Zhu *et al.*, 2013). For instance, before requiring suppliers to comply with specific environmental standards, a company must first internalize environmental management processes and demonstrated its own commitment to sustainability (Ahmed *et al.*, 2020).

According to Maditati *et al.* (2018), analyzing drivers and practice groups as an integrated system, rather than examining them in isolation, is crucial. A major challenge companies face is determining which GSCM practices to adopt and how to implement and coordinate them effectively. Many studies examine GSCM's internal and external factors without considering the interaction between GSCM pressures and drivers (El-Garaihy *et al.*, 2022).

Following recent recommendations in the GSCM literature highlighting the need for region- and industry-specific studies to better understand local dynamics, as well as the use of advanced methodological approaches, such as structural modeling (Rajkiran & Almeida, 2024), this study analyzes the drivers and performance outcomes of internal GSCM practices within the Spanish textile-fashion sector, addressing the following research questions:

RQ1: Which are the main drivers of internal GSCM practices in the fashion-textile sector?

RQ2: How are internal GSCM practices used to improve sustainability of economic and environmental performance?

Spain was selected as a case study, as within the textile and clothing industry, it ranks fourth in Europe in terms of turnover and exports, after Italy, Germany, and France (EURATEX, 2024). Its company' profiles mirror those of other European countries: 99.7% micro companies and SMEs and only 0.3% larger companies, including Inditex, one of the world's largest retailers. Although this study only analyzes Spanish companies (based on a sample of 166), many operate within global value chains or impact other countries through their sales, representing a broader spectrum. Hence, the results of this research could be replicable in other countries with comparable institutional contexts.

Thus, this study seeks to identify the most decisive drivers in implementing internal GSCM practices within the textile-fashion sector, to investigate their influence on economic and environmental performance, and test a model of the sector's environmental performance using the Partial Least Squares (PLS) technique.

2. LITERATURE REVIEW

2.1. GSCM practices

GSCM has advanced progress in academic publications, as observed in the analysis of its implementation, whilst a widely accepted definition has not yet been described (Islam *et al.*, 2017). GSCM extends traditional supply chain management by incorporating environmental considerations across all stages of product lifecycles (Mohamed *et al.*, 2023). This integration encompasses eco-design, green sourcing, sustainable production, distribution, and end-of-life management practices, as highlighted by Al-Shammari and Al-Maathidi (2024).

GSCM practices comprise a range of strategies aimed at minimizing the environmental impact of the supply chain (Islam *et al.*, 2024). According to Gera *et al.* (2022:535), GSCM practices "are a management technique to make supply chain eco-friendly, without adversely affecting organizational objectives".

Numerous studies have distinguished between two sets of green practices (intra- and inter-organizational) (Zaid *et al.*, 2018, Zhu & Sarkis, 2004; Zhu *et al.* 2008). Internal GSCM comprises environmentally oriented actions that do not require direct supplier or customer involvement. These can be managed and implemented by an individual manufacturer and include green manufacturing processes, green logistics, internal environmental management, eco-design, and green packaging (Zhu *et al.*, 2012). In contrast, external GSCM practices require partial cooperation and transactions with suppliers and customers in terms of green procurement, reverse logistics, and environmental cooperation with customers and suppliers (Zhu *et al.*, 2013).

Internal GSCM practices are those that a company can design, manage, and execute independently, without relying on external players. These practices reflect the organization's internal resources, capabilities, and strategic orientation towards sustainability (Geng *et al.*, 2017). Furthermore, empirical research has shown that strong internal environmental practices are often a necessary condition for successfully engaging in external GSCM collaborations (Zhu & Sarkis, 2004). Without well-established internal systems, firms may lack the credibility, data, or operational readiness needed to support green partnerships with upstream or downstream partners (Gavronski *et al.*, 2011).

GSCM practices can be divided into two categories (Kim *et al.*, 2021): product practices focus on reducing pollution and waste through product design and material selection, while process practices encompass all operational processes, from manufacturing to logistics and life-cycle management to reduce environmental impact. We classify internal GSCM practices into internal process practices (green production, green logistics, and internal environmental management), and internal product practices (eco-design and green packaging). Therefore, the selected practices capture both critical areas of environmental impact, and strategic opportunities for companies operating in this sector Sivaram *et al.*, 2019). These five practices have been consistently employed in prior empirical studies as representative indicators of internal GSCM efforts (e.g., Wong *et al.*, 2021; Zhu *et al.* 2008; Zhu *et al.*, 2012) ensuring both conceptual validity and comparability across studies.

Green production involves the development and implementation of manufacturing processes that incorporate environmental considerations by adhering to the principles of reducing, reusing, and recycling resources. Its primary aim is to minimize raw material consumption, lower total production costs, and mitigate environmental impacts, thereby enhancing the competitiveness and sustainability of firms. (Çankaya & Sezen, 2019; Isfianadewi *et al.*, 2025).

Green logistics refers to the adoption of environmentally friendly logistics practices throughout the supply chain (Bozhanova *et al.*, 2022): route optimization, low-emission vehicles, and shipment consolidation (Rehman Khan & Yu, 2020).

Internal Environmental Management (IEM) is the structured integration of environmental sustainability principles within an organization's internal processes and policies. It involves the commitment of managers at all levels to environmental goals, the implementation of environmental auditing programs, the establishment of clear environmental objectives and responsibilities, and the continuous monitoring and evaluation of environmental impacts (Alkandi *et al.*, 2025).

Eco-design, also known as green design, refers to the proactive integration of environmental considerations into the early stages of product development. Its aim is to minimize material and energy consumption, facilitate product recycling and reuse, reduce the use of hazardous substances, and enhance waste reduction throughout a product's lifecycle (Al Karim *et al.*, 2024). It ensures products are designed to be easily disassembled and recycled when reaching its lifecycle(Tseng & Chiu, 2013).

Green packaging involves the use of packaging solutions that minimize environmental impact (Islam *et al.*, 2017). This practice not only ensures product protection and functional performance during logistics and storage but also contributes to broader sustainability goals by enhancing energy efficiency and reducing emissions associated with packaging activities (Mohamed *et al.*, 2023).

2.2. GSCM drivers

The primary internal and external drivers of GSCM implementation identified in the literature include organizational factors, regulatory requirements, customer demands, competitor dynamics, and societal pressures (Paluš *et al.*, 2024). Regulatory and market pressures can enhance a company's environmental performance when they adopt eco-design and green purchasing practices in response to these pressures (Maditati *et al.*, 2018). Testa and Iraldo (2010) suggested that GSCM practices should supplement other advanced management practices. Implementing a green supply chain starts with internal or external drivers (Sharma, 2013). Internal drivers stem from proactive efforts initiated within organizations, whereas external drivers are shaped by the influence and demands of various stakeholder groups. Drivers are critical factors in implementing GSCM practices (Dhull & Narwal, 2016) that lead entrepreneurs to embark on sustainable supply chain management. These factors strengthen GSCM practices and positively impact environmental performance (Sarkis *et al.*, 2010).

Maditati *et al.* (2018) distinguish different groups of drivers of CSCM practices based on two dimensions: the responsibility dimension (environmental awareness/responsibility or demands/requirements) and the motivation source dimension (internal or external, depending on the type of stakeholder involved). Environmental awareness is the first category of enablers (Singh & Misra, 2022): it represents the company's self-awareness, self-imposed issues such as corporate image, social and environmental responsibility, or promotional activities on the green image. As regards legal regulatory requirements, environmental awareness imposed through regulatory pressures, government interventions, and required quality certifications, drives many GSCM practices. Internal motivators refer to company-specific demands involving levels of strategies and objectives that stimulate GSCM practices: company performance, cost-saving strategies, product/process development strategy, management, and worker support. Finally, external pressures refer to applying direct or indirect requirements from supply chain stakeholders, such as societal environmental awareness, market pressures, and collaboration with suppliers and customers.

Table 1 summarizes the main categories of drivers analyzed in the literature classified according to motivation source and responsibility dimensions.

Table 1
Main categories of drivers in a green supply chain

SOURCE OF MOTIVATION	External	*Regulatory requirements imposed* Legal regulatory pressures	*External pressure* Environmental awareness in society Market pressure Environmental collaboration with suppliers Environmental collaboration with customers
	Internal	*Environmental awareness* Corporate environmental awareness	*Internal motivators at the company level* Top management commitment Internal pressures Internal costs
		Consciousness/ Responsibility	Demands/Requirements
		RESPONSIBILITY	

Source: Own elaboration based on Maditati *et al.* (2018).

Corporate environmental awareness refers to the integration of ecological values into an organization's belief system, often requiring internal cultural and strategic transformation (Huang and Huang, 2021). Social values and ethics play a crucial role in successful collaboration, purchasing, and ethical sourcing, which makes them internal enablers of sustainability initiatives (Dubey *et al.*, 2017).

Regulatory requirements are one of the main driving forces to which companies have responded (Agan *et al.*, 2013; Eltalhi *et al.*, 2025) to adopt environmentally sustainable practices within their operations, enforcing compliance with environmental standards. In the European Union's textile and fashion industry, the regulatory framework was comparatively lenient until 2022, following which the EU Strategy for Sustainable and Circular Textiles was introduced, marking a significant legislative shift towards stricter environmental standards (European Commission, 2022).

Internal motivators encompass the organizational forces that originate within the company and drive the adoption of GSCM practices. Among these, top management commitment has been consistently recognized as a pivotal factor, as leadership support often catalyzes the implementation of GSCM strategies across all organizational levels (Chacón Vargas *et al.*, 2018). Internal motivators may include reducing operational costs through energy efficiency and waste minimization (Wang *et al.*, 2018), and employee involvement (Dubey *et al.*, 2017).

External pressure arises from the expectations and demands placed on organizations by stakeholders beyond the company's boundaries, including governments, non-governmental organizations, customers, suppliers, competitors, and the broader community. These stakeholders can significantly influence the adoption of GSCM practices (Marrucci *et al.*, 2021; Tay *et al.*, 2015; Zhu *et al.*, 2010).

2.3. *GSCM performance*

Research in GSCM has primarily focused on examining how environmental sustainability practices impact environmental and economic performance (Maditati *et al.*, 2018). Economic performance is linked to a company's ability to reduce costs associated with material purchases, energy consumption, waste treatment, waste disposal, and fines for environmental incidents (Zhu *et al.*, 2008); or financial and marketing improvements (profitability, return on investment, growth in sales revenue) from implementing GSCM practices (Younis *et al.*, 2016), serving as a critical benchmark for evaluating organizational competitiveness and sustainability (Alkandi *et al.*, 2025).

Environmental performance is the extent to which an organization minimizes its negative impact on the natural environment through its operations and practices (Al Lawati *et al.*, 2024): reduction of effluents, solid waste, hazardous and toxic materials (Zhu *et al.*, 2008), and environmental accidents (Fang & Zhang, 2018). It is a critical indicator for evaluating the effectiveness of environmental practices (Zhu *et al.*, 2012).

3. RESEARCH FRAMEWORK AND HYPOTHESIS DEVELOPMENT

3.1. *GSCM drivers and internal GSCM practices*

The relationship between drivers and the adoption of GSCM practices has been discussed in the literature (Hebaz & Oulfarsi, 2021; Huang & Huang, 2021). Internal environmental awareness has been identified as crucial for companies implementing environmental practices (Kalpande & Toke, 2020). Social and environmental responsibility pressures companies into implementing GSCM practices (Xu *et al.*, 2022). Companies increasingly undertake strategic environmental initiatives to maintain corporate reputation through new product development and green practices (Habib *et al.*, 2020). Mojumder and Singh (2021) consider corporate social responsibility the main driver of GSCM practices within the Indian construction sector. Green production practices have been linked to environmental awareness fostered through green entrepreneurial behavior (de Guimarães *et al.*, 2018). Despite prior research focused on manufacturing sectors, the European Commission (2022) reports that the textile sector is one of the most polluting. These factors underscore the sector's vulnerability to environmental pressures and its alignment with the challenges addressed in GSCM research. Supply chain structures and stakeholder configurations support the applicability of findings from other industries to textile-fashion contexts (Mousa *et al.*, 2025). Based on this reasoning, we formulate the following hypotheses:

H1a. Environmental awareness positively influences the adoption of internal process GSCM practices.

H2a. Environmental awareness positively influences the adoption of internal product GSCM practices.

Legislative pressure through policies and regulations is a critical factor driving GSCM practices (Sabat, 2022). Ososanmi *et al.* (2022), based on research with Nigerian companies, conclude that government environmental regulations are the main driver of GSCM. Zhu *et al.* (2013), studying Chinese manufacturers, show that environmental regulations encourage manufacturers to imitate successful competitors in adopting GSCM practices of eco-design and internal environmental management. In a study by Zhu and Sarkis (2006) with Chinese companies in automotive, thermal power, and electronics industries, legal regulations are the most important pressure for GSCM implementation. Luthra *et al.* (2016) reached similar conclusions, considering regulatory pressure the most critical factor in implementing process practices (green production, green logistics, and internal environmental management) and eco-design. Eltalhi *et al.* (2025) provide empirical evidence that government regulations significantly enhance GSCM practices, especially in developing economies. Likewise, Xu *et al.* (2022) demonstrate how carbon taxes and recycling subsidies reshape operational decisions in closed-loop supply chains, pushing manufacturers to modify internal processes to reduce emissions and comply with environmental regulations. Based on this, we propose:

H1b. Regulatory requirements positively influence the adoption of internal process GSCM practices.

H2b. Regulatory requirements positively influence the adoption of internal product GSCM practices.

Previous studies have identified top management commitment as a decisive factor in successful GSCM adoption. Mauricio and Lopes de Sousa Jabbour (2017) concluded that top management commitment is the most critical factor in adopting GSCM practices, while workers' participation is least influential. Internal motivators (organizational environmental commitment, green culture, and proactive leadership) have been identified as key predecessors for implementing internal environmental management and cleaner production processes. Ali (2022) emphasizes that green production must be embedded in organizational culture and actively promoted by top management for effective implementation. According to Panpatil and Kant (2022), internal enablers (especially strategic managerial commitment and green policy formulation) are among the highest-ranked factors promoting GSCM practices. Eltalhi *et al.* (2025) demonstrate that employee environmental commitment significantly enhances internal green supply chain initiatives. Cost is an internal motivator that significantly influences green practices implementation (Abbasi & Nilsson, 2012). Wang *et al.* (2018) found that cost drives internal GSCM practices: there are great opportunities for cost savings when green practices are incorporated early in procurement. Based on this reasoning, we can formulate the following hypotheses:

H1c. Internal motivators positively influence the adoption of internal process GSCM practices.

H2c. Internal motivators positively influence the adoption of internal product GSCM practices.

External pressures have a positive influence on the adoption of internal GSCM practices (Ahmed *et al.* 2020): stakeholders help promote internal environmental management and eco-design practices (Huang *et al.*, 2021) and cooperation in the textile-fashion sector (Habib *et al.*, 2022). Engaging suppliers and customers in GSCM initiatives further strengthens the effective adoption of green practices (Liu *et al.*, 2020). These findings justify extending the analysis of external pressures to the textile-fashion sector, where growing environmental scrutiny and regulatory pressures make stakeholder engagement even more crucial (Paluš *et al.*, 2024). Based on the above arguments, we propose the following hypotheses:

H1d. External pressure positively influences the adoption of internal process GSCM practices.

H2d. External pressure positively influences the adoption of internal product GSCM practices.

3.2. Internal GSCM practices and GSCM performance

The positive relationship between internal GSCM practices and economic performance has been widely supported by existing literature (Baumers *et al.*, 2016) although implementation costs can be a critical factor reducing financial returns in early adoption stages. The positive association suggests that adopting GSCM practices can generate net profit gains (Zhu & Sarkis, 2004). Environmentally friendly production, logistics, and product design increase company competitiveness (Das, 2022). Sun *et al.* (2017) directly link economic performance to GSCM practices, arguing that waste reduction protects the environment while lowering costs, improving economic outcomes. However, some GSCM practices may increase company costs, especially at the beginning (Fang & Zhang, 2018). Bon *et al.* (2018), Habib *et al.* (2020), and Zaid *et al.* (2018) have verified how GSCM practices have significant relationship with economic performance. According to the above, we might propose the following hypotheses:

H3a. The adoption of internal process GSCM practices positively influences economic performance.

H4a. The adoption of internal product GSCM practices positively influences economic performance.

Evidence supports the positive link between internal practices and environmental performance (Habib *et al.*, 2021). Companies adopting internal green practices are likely to reduce potential environmental pollution through non-toxic materials, component recycling, and the appropriate management of outdated machinery. Al Karim *et al.* (2024) assess the effects of GSCM practices on environmental performance, indicating that green design and collaboration improve environmental outcomes. (Khan *et al.*, 2024) obtain similar results in Pakistan's construction sector, for green production and logistics, enhancing environmental outcomes. El-Garaihy *et al.* (2022) similarly demonstrate that GSCM practices of product and process significantly impact environmental performance. Based on the above arguments, we can postulate the following hypotheses.

H3b. The adoption of internal process GSCM practices positively influences environmental performance.

H4b. The adoption of internal product GSCM practices positively influences environmental performance.

Figure 1 presents the proposed research framework, which illustrates the direct effects of GSCM drivers on GSCM practices and establishes the influence of these practices on GSCM performance.

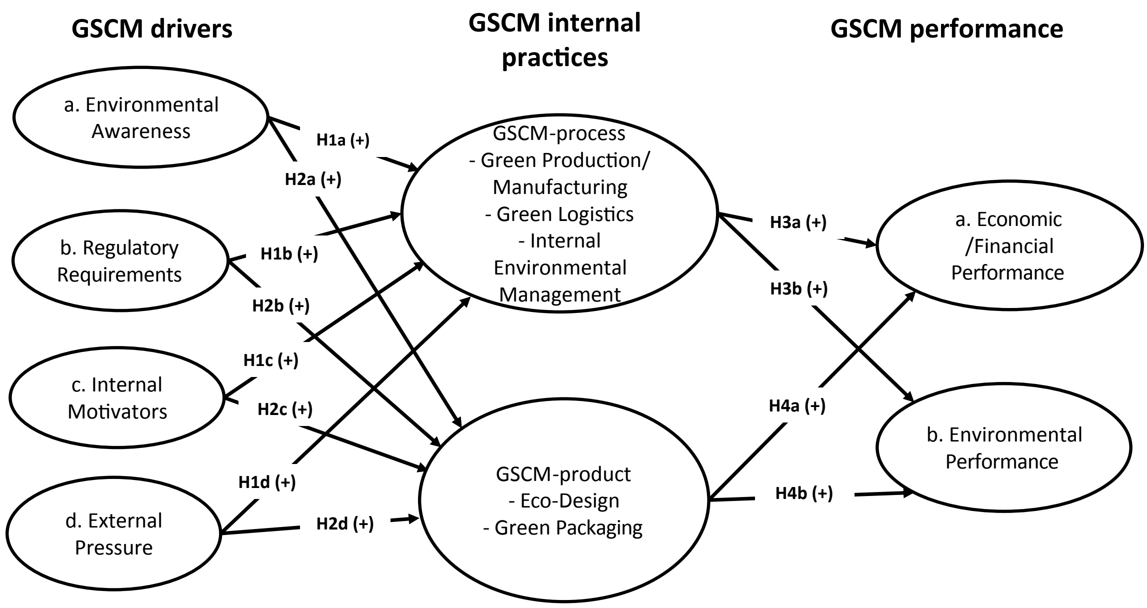


Figure 1
Research model
Source: Authors.

4. METHODOLOGY

4.1. Sample and data collection

To conduct this study, data were collected using a survey-based research methodology, as described in (see Table S1 in the Supplementary Material). The Iberian Balance Sheet Analysis System (SABI), a financial analysis database of leading Spanish fashion and textile companies, was used to define the target population. As a result, a total of 2,805 companies with at least ten employees were identified. The survey was administered using a computer-assisted telephone interview (CATI) system operated by a specialized company, under the supervision of one of the authors, from September to October 2021. A stratified random sampling technique was applied within each stratum to select firms for participation. The population was stratified by two key variables, company size and industry classification code (CNAE), to ensure that the final sample reflected the diversity of firms operating in the Spanish textile-fashion sector. From the firms contacted, we obtained 166 complete responses, representing a response rate of approximately 5.9%. To reinforce the robustness of the analysis, we verified that our sample size meets Green's (1991) guideline for multiple regression, which is frequently referenced in structural equation modeling. Given that our structural model includes up to four predictors for some endogenous constructs, the minimum recommended sample size for detecting a medium effect size would be 84. Our final sample of 166 firms comfortably exceeds this threshold, ensuring the statistical adequacy of results. Regarding the sampling unit, since the analysis level in this study is the organization, only top managers within the areas of sustainability, quality, supply chain, and operations, and the managers of the sampled companies have participated in data collection. This decision was based on the assumption that only these individuals would have a comprehensive view of business processes and, consequently, would be able to assess the overall impact of GSCM practices.

4.2. Measurements

A two-part questionnaire was used for collecting data: one section contained questions regarding participants' demographic information, and the other measured items adapted from previously validated scales in the literature. Special attention was given to translating the original versions of the scales to accurately capture their linguistic nuances. All measures used in this study are included in the Supplementary Material (Appendices S1, S2, and S3).

Since the analysis uses pre-validated scales, efforts in this section focused on adapting the measures to the context and language in which the researchers were working. Respondents were requested to indicate the degree of agreement with statements related to key constructs of the study: GSCM drivers, internal GSCM practices, and GSCM performance (economic/financial and environmental). All variables in this study were measured using Likert-type scales (1 = strongly disagree to 7 = strongly agree) based on scales from previous studies in the literature. GSCM drivers consist of 20 items, classified into four categories (Govindan *et al.*, 2016): environmental awareness (2 items), regulatory requirements (4 items), internal motivators (6 items) and external pressure (8 items). GSCM drivers refer to variables that initiate and enhance the effectiveness of GSCM by motivating or compelling organizations to adopt and implement green practices.

Internal GSCM practices were measured using 21 items: green production practices (4 items), green logistics (4 items) (Wong *et al.*, 2021) and internal environmental management (7 items) (Zhu *et al.*, 2007b). These process practices reflect the organization's internal efforts to manage and optimize GSCM performance across key operational processes. In contrast, product practices emphasize environmental considerations during the product development stage. This includes eco-design (3 items) (Zhu *et al.*, 2007b) and green packaging (3 items) (Wong *et al.*, 2021).

GSCM performance measures were adopted from Çankaya and Sezen (2019), and comprise two key dimensions: economic/financial performance (7 items) and environmental performance (5 items). Economic/financial performance refers to a company's capacity to minimize various operational costs, including those related to raw material acquisition, energy usage, waste management, and environmental compliance penalties. It also encompasses broader financial outcomes such as increased profitability and sales growth. Environmental performance reflects the extent to which a company can reduce its ecological footprint by lowering emissions and waste, minimizing the use of toxic materials, and decreasing the frequency of environmentally harmful incidents.

To ensure the quality of the questionnaire, the authors validated its content through a pilot test with three experts in its different sections to find any problems with the questionnaire's wording, design, format, and suitability for the textile-fashion sector (Rashid Hashmi & Tawfiq Mohd, 2020). Their suggestions and contributions were incorporated into a revised version of the questionnaire.

4.3. Data analysis

In this study, we propose a research model and, because all measurements are operationalized as composites (Henseler, 2017; Rigdon, 2016), we have decided to use Partial Least Squares Structural Equation Modeling (PLS-SEM) in order to test the proposed hypotheses as well as the research model. There are two main reasons for this choice. Firstly, the study uses estimated Mode A and Mode B composites (Hair *et al.*, 2019; Rigdon *et al.*, 2017) and additionally, and secondly, the study adopts an explanatory approach (Henseler, 2018).

Accordingly, Mode A estimates were made for Environmental Awareness (EA), Regulatory Requirements (RR), External Pressure (EP), Economic Performance (ECP), and Environmental Performance (ENP); and Mode B estimates have been made for the rest, i.e., Internal Motivation (IM), Process GSCM practices, and Product GSCM practices.

This decision was based on the study's explanatory nature and the intrinsic characteristics of PLS-SEM when applied to component-based models (Henseler & Schuberth, 2020). Unlike reflective models, where indicators are considered, manifestations of an underlying latent construct, and formative models, where indicators define the construct, composites are understood as weighted combinations of their indicators. This conceptualization is appropriate in contexts where the main objective is prediction and the explanation of the variance of the dependent variables, which aligns with the objectives of our study. Furthermore, PLS-SEM is inherently a component-based method, where even constructs that could theoretically be latent are analyzed as composites formed by their indicators (Sabol *et al.*, 2023). This approach offers flexibility and is suitable when the normality assumptions required by covariance-based methods such as CB-SEM are not strictly met (Cepeda *et al.*, 2024).

Composites are estimated in Mode A when the indicators that constitute the latent variable are correlated. According to Hair *et al.* (2019), to evaluate explanatory modeling with PLS-SEM, a two-step process was developed: in the first step, the measurement model is evaluated, and, in the second step, the structural model is evaluated.

Mode B in PLS-SEM is used when the objective is to maximize the correlation of the construct with other constructs in the structural model (Schuberth *et al.*, 2023). In contrast to Mode A, which seeks to maximize the variance of the construct itself through its indicators, Mode B is more appropriate when the construct is conceived as a specific combination of its components, and its meaning and relationship with other variables in the model emanate from the unique contribution of each component.

To assess the significance of the parameters, we have used a bootstrap procedure (Chin, 1998). This resampling technique allows us to determine the significance of the coefficients, weights, and loadings of the indicators for each composite construct. In this study, the SmartPLS 3.2.6 software package was used for data analysis (Ringle *et al.*, 2015).

4.4. Common method bias analysis

To mitigate potential common method bias (CMB), procedural remedies were used during the research design phase following Podsakoff *et al.* (2012). Additionally, a statistical test based on variance inflation factors (VIFs) was conducted, as recommended by Kock and Lynn (2012). VIF values below the threshold of 3.3 indicate the absence of pathological collinearity and CMB (Kock, 2015). In this study, the maximum VIF was 1.975, suggesting that CMB is not a concern (see Table S2 in the Supplementary Material).

5. RESULTS

5.1. Measurement model assessment

Based on the results, one may conclude that the measurement model meets all necessary criteria for composites estimated in Mode A (see Table S3 in the Supplementary Material). First, individual items demonstrate reliability because all standardized loadings exceed 0.7. Second, all measures of internal consistency (i.e., Cronbach's alpha, composite reliability (ρ_c), and ρ_A) exceed 0.8, indicating that the model fulfills the requirement for construct reliability. Third, convergent validity is confirmed, since the average variance extracted (AVE) values exceed 0.5. Finally, all variables estimated in Mode A reach discriminant validity because the heterotrait-monotrait ratio (HTMT) values are below the strict 0.85 threshold (Table 2).

Table 2
Values of the Heterotrait-Monotrait Ratio (HTMT)

Constructs	EA	RR	EP	ECP	ENP
EA					
RR	0.447				
EP	0.807	0.706			
ECP	0.278	0.546	0.373		
ENP	0.662	0.449	0.471	0.516	

Notes: EA: Environmental Awareness; RR: Regulatory Requirements; EP: External Pressure; ECP: Economic Performance; ENP: Environmental Performance.

Source: Authors.

Regarding constructs estimated in mode B, all items and dimensions have variance inflation factor (VIF) values below 3.3, indicating no issues with potential multicollinearity (see Table S4 in the Supplementary Material). The weights and loadings are shown in Table S4. The most critical indicator for the internal motivators construct is im2, while internal environmental management and eco-design are the most significant dimensions of Process and Product GSCM practices, respectively.

5.2. Structural model assessment

As Henseler *et al.* (2009) discussed, using bootstrapping (5,000 resamples) generate standard errors and t-statistics to assess the statistical significance of the path coefficients. The percentile bootstraps at the 95% confidence interval are presented in Table 3, where the significance level of the proposed hypotheses is shown. As shown in Table 3, seven of the twelve proposed hypotheses are supported, while five are not. Regarding the VIF statistics for collinearity of the antecedent variables of the model, all values are less than three (Hair *et al.*, 2019).

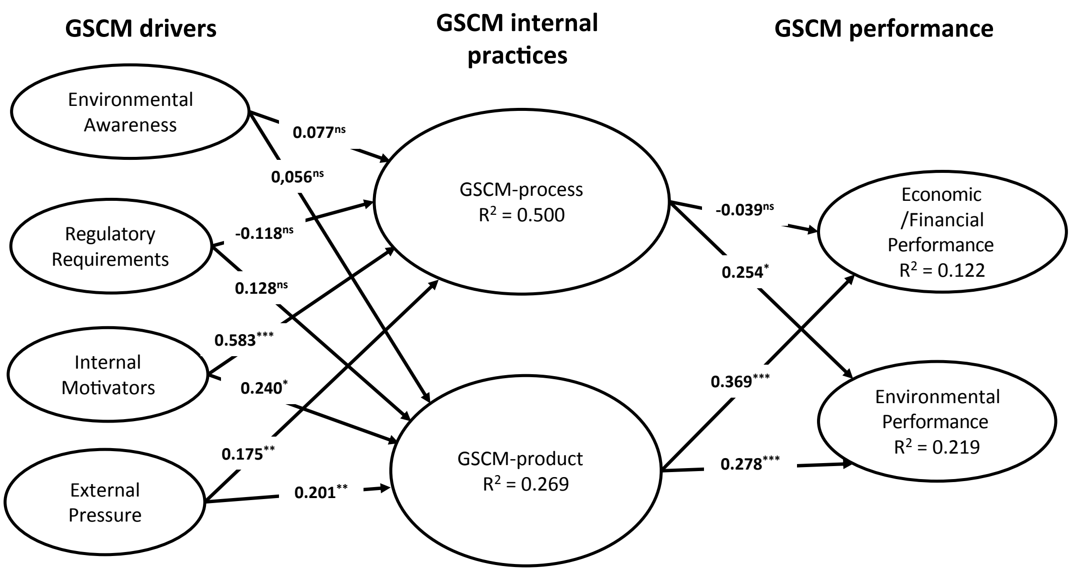
The results show that environmental awareness and regulatory requirements are not antecedents of internal GSCM practices, both process and product. Therefore, the proposed hypotheses H1a, H2a, H1b, and H2b are not supported. Figure 2 provides a graphical representation of the research model with the significance of the hypothesized relationships.

However, the hypothesized relationships between internal motivators and external pressure with the process GSCM practices and the product GSCM practices are significant (H1c, H2c, H1d, and H2d). These results indicate that internal motivator and external pressure are antecedents of process GSCM practices and product GSCM practices.

Regarding the relationship between process GSCM practices and product GSCM practices with economic performance and environmental performance, the results indicate that all GSCM practices are antecedents of both types of GSCM performance, except for process GSCM practices with economic performance (H3a). Table 3 shows the results supporting hypotheses H3b, H4a, and H4b, while hypothesis H3a is not fulfilled.

In PLS-SEM, R^2 measures the proportion of variance explained in the dependent variables, while f^2 assesses the effect size by measuring the impact of removing exogenous variables on the explained variance in the structural model. Both statistics are essential for evaluating the model's goodness-of-fit and predictive relevance. According to (Hair *et al.*, 2019), dependent variables with an R^2 greater than 0.75 indicate substantial explained variance, around 0.50 indicate moderate, and around 0.25 indicate weak explained variance.

Regarding effect size, (Cohen, 2013) suggests that f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effect sizes, respectively.



Notes: *** p < 0.001, ** p < 0.01, * p < 0.05, ns: non-significant (based on t(4999), one-tailed test)

Figure 2
Structural model
Source: Authors.

Table 3
Results of the structural model

Effects on endogenous variables	Path coeff.	Confidence intervals (95%)		Hypothesis support (p-value)	R^2 dependent construct	f^2 effect size	t-value
		5%CIlo	95%CIhi				
EA→ GSCM process (H1a)	0.077	–0.056	0.303	No (0.239)	0.500	0.005	0.692
RR→ GSCM process (H1b)	–0.118	–0.205	0.093	No (0.096)	0.500	0.019	0.102
IM→ GSCM process (H1c)	0.583	0.227	0.760	Yes (0.000)	0.500	0.250	3.502
EP→ GSCM process (H1d)	0.175	0.038	0.307	Yes (0.018)	0.500	0.033	2.081
EA→ GSCM product (H2a)	0.056	–0.160	0.256	No (0.330)	0.269	0.002	0.442
RR→ GSCM product (H2b)	0.128	–0.014	0.244	No (0.051)	0.269	0.015	1.624
IM→ GSCM product (H2c)	0.240	0.060	0.505	Yes (0.039)	0.269	0.029	1.744
EP→ GSCM product (H2d)	0.201	0.053	0.342	Yes (0.011)	0.269	0.030	2.284
GSCM process→ ECP (H3a)	–0.039	–0.171	0.141	No (0.341)	0.122	0.001	0.415
GSCM product→ ECP (H4a)	0.369	0.238	0.486	Yes (0.000)	0.122	0.108	4.907
GSCM process→ ENP (H3b)	0.254	0.080	0.465	Yes (0.015)	0.219	0.058	2.108
GSCM product→ ENP (H4b)	0.278	0.084	0.444	Yes (0.005)	0.219	0.069	2.497

Notes: EA: Environmental Awareness; RR: Regulatory Requirements; EP: External Pressure; IM: Internal; Motivators; ECP: Economic Performance; ENP: Environmental Performance.

Source: Authors.

5.3. Evaluation of the predictive power of the model

To evaluate the model's predictive power, the PLS predict procedure was applied following Shmueli *et al.* (2019), using GSCM performance as the target construct. The analysis, based on 5-fold cross-validation and repeated runs, showed Q^2predict > 0 for all indicators (see Table S5 in the Supplementary Material). Most indicators (regenerate, optimize, cycle, and virtualize) showed lower prediction errors in PLS-SEM than in linear models, indicating good predictive performance. However, exchange and share had slightly higher errors. Overall, the model demonstrates medium predictive power and potential generalizability.

6. DISCUSSION AND IMPLICATIONS

This study has examined the role of key drivers in the implementation of GSCM practices in the Spanish textile-fashion industry. The results indicate that the imposed regulatory requirements and environmental awareness do not influence the implementation of GSCM practices. In contrast, internal motivators have a significant impact on internal GSCM practices, being more influential in internal GSCM process practices. External pressures significantly influence internal GSCM practices, being more influential in internal GSCM product practices. Furthermore, this research demonstrates how GSCM process practices do not have a significant effect on economic performance but do positively influence environmental performance. GSCM product practices positively influence both economic and environmental performance. Therefore, both types of internal GSCM practices contribute equally to enhancing environmental performance.

6.1. Theoretical implications

A first contribution of this study suggests that legal and regulatory requirements such as government support and encouragement, regulations on the treatment of waste in dumping areas, and the environmental awareness of companies are not a direct predecessor of internal GSCM practices. This finding contrasts with prior assumptions highlighted in the literature. For instance, Zhu *et al.* (2005) argued that legal and regulatory requirements such as government support and encouragement, regulations on waste treatment in dumping areas, and the support and initiatives of institutions promoting environmental awareness in businesses are not direct precursors of internal GSCM practices. However, Zhu *et al.* (2007a) investigated the impact of regulatory pressures and internal awareness on GSCM practices and found no strong evidence of their role as drivers. In the Spanish context, regulatory requirements do not currently act as facilitators because there are still few binding regulations addressing the environmental impact of this sector. Although the European Commission published the EU Strategy on Sustainable and Circular Textile Products (European Commission, 2022) national regulations have not been implemented. This may influence this factor's weight when transposed in Spain. The strategy sets mandatory eco-design minimums, including recycled fibers use and extended producer responsibility. Although innovative companies have adopted these practices voluntarily, many firms are unlikely to change operations until new regulations require them.

The effects of environmental awareness have been measured through the protection from environmental, health, and safety risks, and corporate social responsibility commitment. Results suggest no clear association between environmental awareness and the implementation of internal GSCM practices. This may depend on resource availability, as companies prioritize environmental initiatives when economically stable. As Habib *et al.* (2021) note, the company's size affects the implementation of GSCM practices and their sustainability, as large companies can easily obtain resources to apply these practices. Similarly, Mojumder and Singh (2021) found that effort to implement GSCM practices gradually decreases as we move from large to smaller companies. In our sample, we considered 83.7% small companies with less than 50 workers. Most environmental harm occurs upstream, while finished product companies have less direct impact. The type of company and/or type of products manufactured influences the adoption of GSCM practices. Our sample shows that 66% are manufacturers with fewer wet operations (e.g., clothing and apparel, luggage and bags, other textile products), whereas only 29% are involved in more resource-intensive activities (e.g. spinning fibers, manufacturing textiles, finishing, and leather tanning).

The second contribution to our study is to identify and explain that internal motivators and external pressure are key drivers of internal GSCM practices. This finding underscores that internal motivators related to economic benefits and cost savings, pressures related to the scarcity of resources, and the commitment of internal stakeholders such as senior management and employees, are significant in internal GSCM practices (Chakraborty *et al.*, 2023). For process-oriented GSCM practices, internal motivators have a direct effect. These practices involve operational improvements, and efficiency gains that organizations can internally control. Companies are naturally driven to optimize their processes towards reducing operational costs, energy consumption, and waste, all of which are objectives that closely align with internal economic and strategic incentives. In the case of product-oriented GSCM practices, internal motivators also play a significant role, although their influence may be slightly less direct. Companies motivated by cost-saving and innovative incentives may proactively design products that minimize resource use or are easier to recycle, anticipating future market demands and regulatory trends. Top management commitment and employee engagement often support innovation processes that lead to greener products and packaging solutions. The stronger influence of internal motivators on process practices compared to product practices may be better explained by the fact that measuring of internal motivators is more directly related to process-oriented activities such as auditing, controlling, and monitoring than to product-focused activities like eco-design and packaging. These elements are inherently connected to operational processes, whereas product-related practices, such as eco-design and green packaging, involve different capabilities and strategic priorities. The recently approved Eco-design Regulation (European Union, 2024) has set new rules affecting product design, which require all companies to adopt more GSCM product practices. On the other hand, external pressures (such as awareness of environmental issues and cooperation among supply chain partners, the competitive strategy followed by companies in the industry, and the ease of obtaining financing and making investments) are significant in internal GSCM practices and most influential in internal GSCM product practices. Prior research has emphasized the importance of stakeholder collaboration to apply GSCM practices effectively. Additionally, early engagement with buyers during the design and implementation of the GSCM internal product can prove highly beneficial in reducing the environmental impact on the lifecycle (Rehman Khan & Yu, 2020). Successful implementation of GSCM practices requires cooperation and coordination among supply chain stakeholders, including suppliers, manufacturers, and buyers (Zhu *et al.*, 2008).

Our third contribution highlights that GSCM process practices do not influence economic performance but environmental impact performance, while GSCM product practices positively influence economic and environmental performance. Previous studies have reported inconclusive results, showing no significant impact of internal environmental practices on economic results has been found (Laari *et al.*, 2016). Habib *et al.* (2021) confirmed the existence of a relationship between GSCM practices and economic and environmental performance occurs but noted that many companies lack well-defined economic and environmental performance measures, which limits their ability to evaluate outcomes and design future initiatives. Process practices significantly reduce the use of natural resources and mitigate the negative environmental impact of company operations by focusing on production control, CO_2 emissions reduction, transport optimization, and overall environmental management. However, the high cost of infrastructure required to implement these practices, to allow an efficient use of resources, could be the reason behind it not influencing economic performance. Internal process practices refer to internal processes for logistics, manufacturing, and environmental management. In the textile sector, significant investment in technology and machinery is required to change manufacturing processes (spinning, wet operations) and environmental management certifications also entail an economic cost. As a result, good process practices do not necessarily improve financial performance immediately and may even increase costs. Nevertheless, in the long term, they are expected to enhance financial competitiveness (Ahmed *et al.*, 2020). This situation might lessen if there were cooperation between different companies to invest in the necessary infrastructures so that both the investment and the economic benefits derived from the economies of scale were shared. By contrast, product practices focus on product design and packaging for reuse, recycling, and subsequent recovery. Product-oriented GSCM practices are more visible to consumers, investors, and other stakeholders. This visibility enhances environmental outcomes by reducing material consumption, promoting recyclability, and minimizing environmental impacts across the product life cycle. Simultaneously, it strengthens economic outcomes by improving brand reputation, increasing customer loyalty, opening access to green markets, and achieving cost savings through more efficient use of resources and packaging materials. Our study contributes to the literature by demonstrating, within the specific context of Spain's textile-fashion industry, that integrating environmental considerations into product design and packaging yields tangible benefits for both environmental and economic and financial performance. Thus, our findings extend previous research by providing empirical evidence that product-oriented GSCM practices can generate a dual positive impact, even in a sector where sustainability transitions are still developing.

6.2. Practical implications

Based on our results, managers within the textile-fashion industry should focus on strengthening internal motivators and external pressure as primary drivers for implementing GSCM practices linked to economic and environmental performance.

Regarding internal motivators, companies should create an ecosystem of understanding and shared values among senior management, employees, and trade unions, before adopting environmentally sustainable practices. Investment in cleaner technologies and Environmental Management Systems (EMS) like ISO 14001 facilitates systematic process improvements while optimizing resource use and reducing costs. Developing key performance indicators (KPIs) focused on cost-saving environmental metrics enables continuous operational improvement and performance-based employee rewards. Furthermore, supplier selection should comply with sustainability standards (Winkelmann *et al.*, 2024).

The stronger influence of external pressure on production practices requires proactive stakeholder engagement and market responsiveness. Mandatory reporting requirements (European Commission, 2025), although only currently applicable to large companies, may increase transparency in communication with customers, local communities, and stakeholders. This collaborative approach should extend to creating networks of committed eco-design suppliers, representing a key aspect in achieving economic savings and improving the environmental impact. Companies should prioritize eco-design training for designers and agents involved in upstream and downstream supply chain operations. This presents opportunities for governments, universities, and training centers to offer updated training programs. Furthermore, seeking alternatives for green packaging represents a necessary improvement trend offering direct economic and environmental benefits. Textile and fashion companies must establish alliances with packaging companies to develop products that optimize materials and resources.

In scenarios where sustainability awareness is steadily growing, companies increasingly focus on the tactical role of eco-design as a means towards meet sustainability criteria and cultivating enduring competencies, ensuring organizational environmental sustainability (Hsu *et al.*, 2023). Embracing green product design practices offers vast benefits to businesses, including market differentiation, resource efficiency, longer product lifespans, circular economy opportunities, stronger stakeholder relationships, and compliance with evolving regulations (Chau *et al.*, 2023).

6.3. Limitations and future lines of research

This research presents certain limitations suggesting various future research avenues. Our study does not demonstrate specific relationships between the four driver categories and GSCM practices, nor individually analyze each GSCM practice's impact on performance measures. Future research could focus on discovering these relationships.

A second limitation concerns the positive relationship between practices and GSCM performance, as some practices may increase costs despite their environmental benefits. Future research could analyze whether this compensation relationship occurs and determine whether practices positively influence economic and environmental performance.

The third limitation relating to cooperative relationships between companies and their supply chains, was not analyzed. Future studies could examine how collaboration with suppliers and customers contributes to enhancing overall sustainability performance, building on internal practices. This would clarify how companies can align internal efforts with external partnerships to achieve comprehensive sustainability outcomes across supply chains.

Another limitation concerns company size, of which 97.5% are SMEs, this being consistent with the European average (European Commission, 2020). Additionally, sustainability performance was addressed in only two dimensions -economic and environmental- while future research could tackle the social dimension, according to the Triple Bottom Line (Elkington, 1998).

The geographical focus on Spain presents another limitation. Whilst many firms have international operations, findings primarily reflect Spanish regulatory, cultural, and economic conditions. Caution should be exercised when generalizing results to other contexts with different regulatory frameworks, market dynamics, or environmental pressures. Future studies could conduct cross-national comparative analyses examining whether observed relationships hold true in countries with more stringent environmental regulations or different industry structures. Researchers could explore how cultural factors, institutional capacity, and sustainability policy maturity influence the applicability of findings within diverse contexts.

The final limitation relates to temporal scope, capturing a snapshot of Spanish textile SMEs prior to the comprehensive European regulatory framework implementation on sustainability and circularity. Findings reveal significant gaps between current company practices and new regulation objectives (e.g., Eco-design, Waste, Due Diligence, Strategy for Circular Textiles, Corporate Reporting Directive). The situation appears similar across Europe, with the new Omnibus I simplification package proposal (European Commission, 2025), delaying the application of recently approved regulations and lowering the scope and requirements for all sectors, including textiles, having the EU considered these regulations to hinder European competitiveness. Longitudinal studies considering future implementation measures would be valuable, along with research focusing on larger firms operating downstream in supply chains.

7. AUTHORSHIP

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9. SUPPLEMENTARY FILE

A supplementary file containing additional methodological details and extended results is available at the following URL: https://ojs.ehu.eus/index.php/CG/libraryFiles/downloadPublic/207

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