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Synergizing Sustainability: Green HRM and Green SCM Impacting Business Performance (Reflections through Supply Chain Traceability and Eco-centricity)

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Abstract
Sustainable supply management has become important for improving business performance. Therefore, management needs to understand the factors that increase performance in this area. This article examines how two specific functions of sustainable sourcing (environment and procurement) affect the sustainable performance of corporate sector. Data was collected from 453 textile companies in Pakistan and analyzed using questionnaires. The findings of this study show that green supply chain management (GSCM) has a positive impact on business performance. Also, high levels of environmental and supply chain involvement strengthen the relationship between GSCM and performance. Surprisingly, high levels of outsourcing were found to harm GSCM relationships. The study used a cross-sectional survey-based design. Future research will utilize longitudinal studies to examine the long-term effects of GSCM practices on performance. This article supports the idea that GSCM practices increase performance diversity. It suggests that investigations in collaboration with a wide range of ecosystem partners (eccentricity) and improving the supply chain can lead to better environmental outcomes. Managers are encouraged to take a closer look at how they think about and monitor their supply chains. The article makes substantial contributions to this field of research. Firstly; it develops and validates a scale to measure Eco-centricity and provides a chain of control. Thereafter, it shows how these two variables specific to supply chain sustainability can have a positive impact on companies' performance.

Keywords: Green SCM Practices - Supply Chain Eco-centricity - Supply Chain Traceability

1. Introduction

Companies have taken significant steps to address environmental issues within their supply chains. Much of the existing literature indicates that green supply chain management (GSCM) positively impacts business performance (Geng et al., 2017; Sadia et al., 2019). However, some studies suggest managers need help to realize these benefits due to potential implementation barriers (Goyal & Kumar, 2017). This research aims to understand why business performance outcomes vary with different GSCM implementation methods, addressing the call for research on the broad impacts and results of GSCM implementation (Montabon et al., 2016; Pagell & Shevchenko, 2014; Touboulic & Walker, 2015).

Recent literature and meta-syntheses have explored the status of GSCM worldwide (Khan & Muktar, 2020; Nobari et al., 2018; Paulet et al., 2021; Pham et al., 2020; Yusliza et al., 2019), but the questions still exist. It is important to understand how GSCM is performance-based. Studies (Acquah et al., 2020; Yu et al., 2020; Yusoff et al., 2020) have shown that GSCM practices, such as energy conservation and waste reduction, can improve management performance (Pereira et al., 2020). However, implementing GSCM often requires significant financial investments that could lead to financial consequences (Carballo-Penela & Castroman-Diz, 2015).

The relationship between GSCM and business performance also depends on the type of industry, as stakeholder pressure varies depending on the environmental impact (Saifulina et al., 2021). Employees' perceptions of GHRM practices significantly impact their performance, which is determined by the country's culture (Jiang et al., 2014), indicating the importance of analyzing the moderating effects of culture on GSCM performance. Improving GHRM standards and understanding employees' perceptions are important to improve performance (Ren et al., 2020). Management methods, such as the measures obtained and the number of parameters used to evaluate the GSCM, contribute to defining its impact on the management process.

This study aims to understand how GSCM affects business performance by examining methods such as measurement standards and metrics and the roles of managers in eco-centricity and supply chain traceability. Combining these insights, this framework provides a comprehensive view of the impact of GSCM on business performance, enabling the identification of empirical analyses and providing reliable information on these relationships (Lim et al., 2012). , 2022; Imperial, 1999; Itani et al. , 2019).This study provides an empirical analysis of the impact of GSCM on business performance by examining the dimensions of sustainable supply chain

management (the level of the supply chain and the extent to which it can be monitored) that play an important role in GSCM applications (Pagell & Wu, 2009).

The supply chain examines a company's knowledge of its products and operations from the source to the end customer (Dabbene et al., 2014; Skilton & Robinson, 2009; Wowak et al., 2016). We have developed and validated metrics to measure the supply chain and address these issues. Environmental level and sustainability may influence the interaction between GSCM performance and business performance. Achieving performance guidelines often requires managing factors outside direct control across multiple supplier categories (Grimm et al., 2016). The contributions of investors like industry associations and NGOs, who possess the necessary knowledge and skills to overcome environmental challenges, should be noticed.

Tracking materials from origin to use strengthens a company's ability to identify and address environmental weaknesses in the supply chain. The consequences of supply chain deficiencies can be significant (Hajmohammad & Vachon, 2015; Hartmann & Moeller, 2014; Roehrich et al., 2014; Wright, 2016). An intriguing question is whether traceability and eco-centricity improve (or worsen) the relationship between GSCM and business performance. We conducted an empirical study using surveys from more than 400 Pakistani textile firms, contributing significantly to the literature. Firstly, we validate an objective scale to obtain quantitative and measurable results. Secondly, we examine the relationship between GSCM and business performance. Importantly, we explore how supply chain traceability and Eco-centricity moderate the relationship between GSCM and business performance. The remainder of our article is structured as follows: We review the literature to develop the basis for our model, focusing on hypotheses regarding GSCM practices, business performance, and the roles of eco-centricity and supply chain traceability. Our research methodology, data analysis, and results are then evaluated, followed by a discussion of our findings and concluding remarks with recommendations.

2. Literature Review

2.1 Theoretical Background:

The Natural Resource-Based View (NRBV), introduced by Hart in 1995, builds upon the earlier Resource-Based View (RBV) of the firm, as developed by Barney (1991) and Penrose (1959). The RBV provides a theoretical framework that explains how firms can leverage their valuable, rare, and inimitable resources to gain a sustainable competitive advantage (Barney, 1986; Wernerfelt, 1984). The distinctiveness of a company's operational resources shields it from competition. However, Hart (1995) critiques the RBV for its heavy reliance on internal resources, arguing that it inadequately considers environmental factors. He asserts that companies must evaluate their resources in the context of the broader environment. Hart (1995) suggests that addressing this 'fit' between internal resources and the environment can address the limitations of the RBV. NRBV emphasizes that sustainable performance is a strategic asset that is difficult for competitors to imitate due to institutional and capacity constraints (Hart & Dowell, 2011). Therefore, NRBV encourages companies to focus on green activities. It shows that companies are affected not only by the domestic environment but also by the external environment and costs. NRBV defines three key environmental measures: 'pollution prevention' (reducing environmental impacts such as reducing emissions and packaging waste), 'product excellence' (reducing the life cycle costs of products through design and innovation), and 'sustainable development' (reducing the company's environmental impact through technological development) to minimize its impact on it (Hart & Ahuja, 1996). In the context of the RBV, these environmental strategies can be a source of sustainable competitive advantage. Implementing green management (GSCM) and improving business performance are essential for environmental strategies.

2.2 Sustainable Business Performance and GSCM Practices: Montaben, Pagell & Wu (2016) highlight green supply chain management (GSCM) as a conceptual framework and the importance of differentiating the specific GSCM practices to be implemented. GSCM's activities include key management strategies such as environmental management, green purchasing, consumer choice, and return on investment. Research has consistently demonstrated the relationship between GSCM and environmental sustainability (Geng et al., 2017; Rao & Holt, 2005; Russo & Fout, 1997; Sadia et al., 2019; Zhu et al., 2005). In this article, we intend presenting GSCM performance supported by statistical testing hypotheses highlighting the relationship between GSCM performance and performance (Kim et al., 2015). These hypotheses are based on the natural resource-based view (NRBV), which emphasizes gaining a competitive advantage by efficiently using environmental activities to achieve environmental goals (Bals & Tate, 2018). NRBV also shows that GSCM performance contributes to economic growth (Pullman et al., 2009; Zhu et al., 2005). Carter et al. (2008) suggest key benefit of GSCM is to help reduce costs associated with the environment (Hart, 1995). Here, it outlines: H_1: GSCM practices are positively associated with business performance.

2.3 Moderating Role of Supply Chain Eco-centricity: Pagell and Wu (2009) suggest that companies leveraging environmental opportunities will benefit from the expertise and skills of external partners, leading to stronger market connections. This sensitivity concept, rooted in environmental research (Gladwin et al., 1995), defines the attributes of firms striving for social good and results in benefits. Eco-centricity, a term discussed conceptually and theoretically in literature (Chavez et al., 2016; Gold et al., 2013), has gained notable attention (Pagell & Wu, 2009). The NRBV indicates that fundamental tools should be in place to support these efforts. Eco-centricity can be a crucial resource due to its uniqueness and difficulty in replication. It encompasses collaboration, relationships, and cultural traits within an organization, which are challenging for competitors to imitate, as highlighted by the NRBV. Environmental stakeholders, including regulators, governments, NGOs, and trade associations, often scrutinize companies. Firms that fail to meet environmental standards may view these external partners as adversaries (Pagell & Wu, 2009), feel pressured by regulators and governments (Zhu & Sarkis, 2007), and perceive non-compliance as a threat (Sarkis, 2010). These companies might comply with external pressures rather than continuously learn (Dacin et al., 2011). Consequently, their approach to improving environmental performance might diverge from existing GSCM concepts. Poorly executed green activities can be perceived as mere 'greenwashing' (Laufer, 2003). Overlooking the capabilities of external stakeholders, such as the updated Environmental Conduct and Compliance Guidelines (Tate et al., 2011), can lead to GSCM practices that harm rather than benefit the environment. In contrast, some businesses actively collaborate with external partners to enhance their environmental impact (Borwankar & Velamuri, 2009). This collaboration involves joint efforts where all parties work together to achieve shared goals (Van Huijstee & Glasbergen, 2010; Visseren-Hamakers et al., 2011). Partnering with stakeholders can provide insights into transportation or environmental packaging materials previously unknown to the company (Johnson et al., 2018). External stakeholders can help define and measure green purchasing and product selection criteria more accurately (Tate et al., 2011). Thus, companies with strong environmental performance will likely engage with environmental stakeholders to enhance GSCM practices (Simpson et al., 2007). Engaging with and learning from environmental stakeholders can increase the costs of GSCM efforts. Non-traditional supply chain members, such as NGOs, non-profits, and local governments, can offer valuable information through environmental technologies that boost economic performance (Tate et al., 2011). These capabilities streamline planning and implementation processes, enhancing efficiency. On the other hand, poorly performing companies might struggle (Matos & Hall, 2007). Access to the latest technology and environmental knowledge can reduce conflict and confusion among managers implementing GSCM, lowering costs by improving environmental performance (Sarkis et al., 2011). Collaborative and learning-focused processes with stakeholders can help companies mitigate legal risks, fines, and penalties associated with GSCM (Roehrich et al., 2014). Here, it outlines: H_{1a}: The relationship between GSCM practices and business performance is stronger when a firm has high levels of supply chain ecocentricity, rather than low.

2.4 Moderating Role of Supply Chain Traceability: The literature has extensively studied supply chain management (Faucheux & Nicolaï, 2011; Jenkin et al., 2011) and among various risk management tools, auditing plays a crucial role in reducing information asymmetry (Tachizawa et al., 2015). One common monitoring method is the phenomenon of indicators (Wowak et al., 2016). Traceability, defined as the ability to identify and control components and events within the supply chain (Skilton & Robinson, 2009), involves tracking the origin and characteristics of specific products, thereby documenting their market introduction history (Bechini et al., 2008). Monitoring entails identifying the sources of raw materials, chemicals, or ingredients in purchased products, overseeing the environmental performance and production activities, and tracking the origins of purchased products in production areas (Thalib & Mohammad, 2024). The NRBV emphasizes the necessity of monitoring due to its rarity and complexity, making it difficult to replicate (Hart, 1995). Effective monitoring involves not just one company but a network of firms utilizing internal technology and supply chain knowledge (Wowak et al., 2012; Skilton & Robinson, 2009). Tracking and monitoring products and activities help reduce information asymmetry between supply chain members, allowing suppliers to identify opportunities (Wowak et al., 2016). It demonstrates the positive impact of GSCM on environmental performance (Plambeck et al., 2016). Improved traceability enhances suppliers' initial and ongoing environmental investments (Klassen & Vachon, 2003; Lee & Klassen, 2008), amplifying the environmental benefits of GSCM practices. With proper market monitoring, companies' efforts to improve performance may be improved, or they might be misled (Wowak et al., 2016). Tracking and tracing products and the supply chain involves crucial management decisions to improve organizational performance and ensure effective risk management (Rábade & Alfaro, 2006). Alfaro and Rábade (2009) found that organizations reap benefits from enhanced definitions, such as increased efficiency. They concluded that traceability boosts system efficiency by reducing damaged inventory levels, minimizing product sizes, and shortening delivery times (Regattieri et al., 2007). It hypothesizes: *H_{1b}: The relationship between GSCM practices and business performance is stronger when a firm has high levels of supply chain traceability, rather than low.*

3. Research Methodology

3.1 Theoretical Framework: The theoretical framework to identify the impact of GSCM practices on sustainable business performance is as given below. It aims at identifying the moderating role of supply chain eco-centricity and traceability between GSCM practices and sustainable business performance.

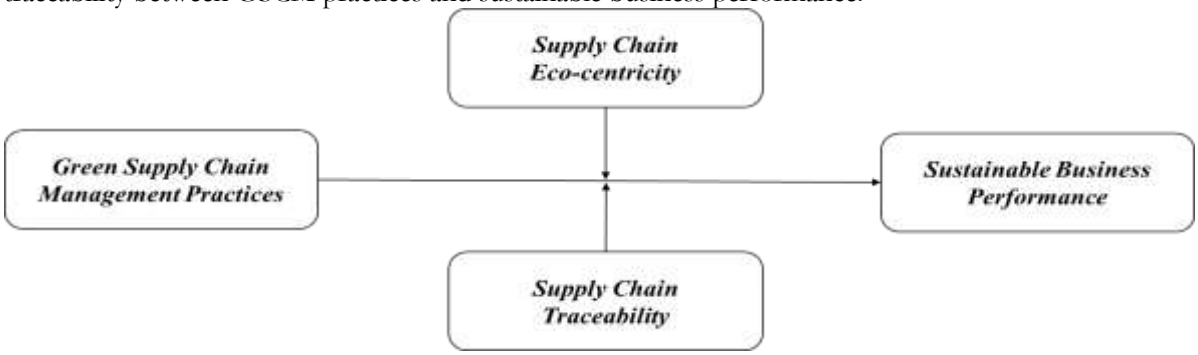

Figure-1: Research Framework
Source: Author Estimation

32. Survey Administration and Data Collection: In this research work, we have adopted a post-positivist philosophy, which guided our use of a deductive approach. It employs quantitative research design for data analysis and has utilized PLS-SEM software to analyze measurement and structural equation models. Data was collected using an adapted questionnaire and the survey technique. The primary data was gathered from participants, with a sample of more than 500 textile companies selected from the 'APTMA', Pakistan Textile Directory. Given the unknown total population for the study, a minimum sample size of 453 was considered sufficient to represent the population, allowing for the generalization of the results. Each respondent was selected based on their managerial positions, plant size (minimum 50 employees), and industry. Initially, the survey was sent to the entire sample, followed by two reminder emails to those who had yet to respond. We ultimately received 482 responses, but 29 were invalid due to missing data, resulting in a final response rate of 27.4 percent (453 out of 1650). Participants were asked to complete a survey regarding all the variables included in the questionnaire about their sector. The study was conducted in two phases. First, a draft survey was sent to experts in the field for feedback on content, clarity, and validity, leading to several revisions. Subsequently, a referral link was sent to nine other experts, who were asked to complete the online survey focusing on content, design, and usability. Minor design adjustments were made at this stage. We conducted tests for nonresponse bias by comparing initial respondents (those who responded within the first two weeks) with later respondents (those who responded in the third week or later) using a difference t-test for fixed variables (GSCM and Business Performance). The results showed no significant difference between the pre-test and post-test groups, indicating that nonresponse bias was not a concern.

3.3 Operationalization of variables: The survey scales used in this study were either standardized or developed and validated in existing literature. We followed a developmental model proposed by DeVellis (2003) for the environmental supply chain and its distribution. This model included extensive primary qualitative interviews with purchasing managers, a comprehensive review of current academic literature, self-reports, and Q-tests with knowledgeable participants. All constructs were descriptive and measured using a five-point Likert scale. For GSCM performance, we used a five-item scale developed by Gonzalez-Benito and Gonzalez-Benito (2006). Participants were asked to rate various logistics activities, packaging materials, waste management equipment, purchasing strategies, and consumer selection criteria based on environmental considerations. A new measure was created for this study to measure the supply chain, drawing on the supply chain strategy outlined by Pagell and Wu (2009) and insights from Seuring (2004), Gold et al. (2013), and Gladwin et al. (1995). Respondents provided input on the role of external partners in developing sustainable environmental networks, the extent of collaboration with non-governmental organizations or non-profits, and input from regulators. For purchasing transparency, we developed a new measure based on the literature on purchasing and transparency (Dabbene et al., 2014; Skilton & Robinson, 2009; Wowak et al., 2016). This measure assessed the extent to which the company tracks the source of its purchases, identifies the origins of raw materials, and monitors the chemicals and ingredients in purchased products and the processes related to product production.

4. Discussion

4.1 Demographic Analysis: The study collected questionnaire responses from January 2024 to July 2024, yielding 453 completed surveys. The demographic details and positions of the participants are summarized in Table 1. The age distribution among the employees is as follows: 19% are under 30, 24% are between 31-40, 22% are between

41-50, 28% are between 51-60, and only 28 employees are over 60. The participants demonstrated good awareness and skills in Green Supply Chain Management (GSCM) practices, ensuring the quality of the data collected. Regarding gender, 69% of the respondents were male, and 31% were female. Geographically, the companies' head offices were distributed as follows: 43% in Karachi, 25% in Lahore, 10% in Islamabad, 16% in Peshawar, and 6% in Quetta. The respondents' positions within their companies were diverse: 14% were in top management, 41% were middle managers, 32% were at the supervisory level, 8% were in non-managerial roles, and 5% held other positions. Of the total surveyed companies, 66% have obtained Environmental Management System Certification (EMSC), such as ISO 14001, indicating a significant commitment to environmental standards. The remaining companies do not possess any EMSC certification. About 37% of these companies have been operating in the market for 11-15 years, while 60 companies have over 15 years of experience. Only 6% of companies with less than one year of experience are relatively new, and 32 companies fall into the 6-10-year experience range.

Demographic	Category Variable	Frequency	Percentage (%)
Age	<30	88	19%
	31-40	110	24%
	41-50	101	22%
	51-60	126	28%
	>60	28	6%
Gender	Male	314	69%
	Female	139	31%
Head Office	Karachi	195	43%
	Lahore	113	25%
	Islamabad	45	10%
	Peshawar	71	16%
	Quetta	29	6%
Designation	Top Management	62	14%
	Middle Manager	186	41%
	Supervisory Level	146	32%
	Non-Managerial Level	35	8%
	Others	24	5%
Business Age	<1	26	6%
	1—5	53	12%
	6—10	145	32%
	10—15	169	37%
	>15	60	13%
Number of Employees	Less than 50	39	9%
	51-100	146	32%
	101-500	164	36%
	501-1000	159	35%
	More than 1000	45	10%
EMSC	Yes	298	66%
	No	155	34%

Table-1: Demographic Analysis
Source: Author Estimation

In terms of company size, 39 companies have fewer than 50 employees, 146 companies employ between 51 and 100 staff, 164 companies have 101 to 500 employees, 159 companies range from 501 to 1000 employees, and 45 companies have more than 1000 employees. According to Table 2, 66% of the surveyed staff members confirm that their companies integrate environmental management into their business operations, aligning with their EMSC certifications. It indicates a strong adherence to environmental practices among the surveyed firms.

4.2 Measurement Model: Validity and reliability are important criteria in evaluating measurement quality in research. Reliability refers to the extent to which a measurement tool evaluates the concept it aims to measure. On the other hand, validity examines how well an instrument measures the specific concept it aims to measure (Sekaran, 2003). This study followed the guidelines suggested by Hair et al. (2011) and Gotz et al. (2010) and assessed validity, including convergence and discrimination. Finally, a reliability analysis was performed to determine the parameters used in the study.

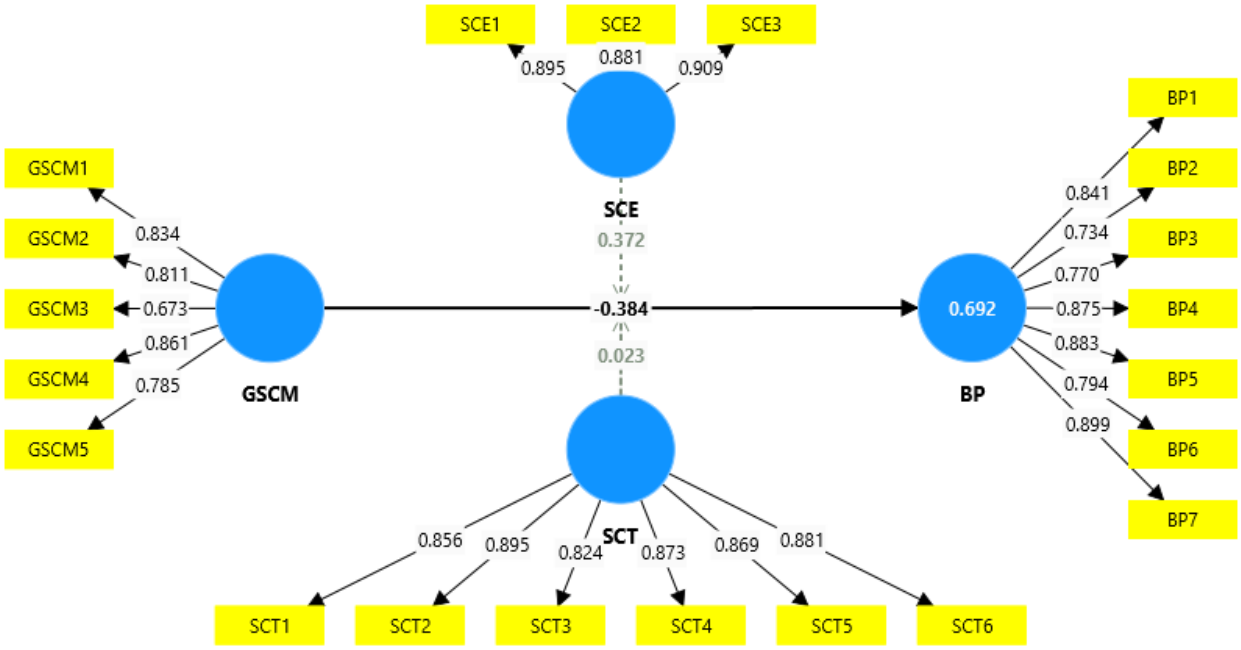

Figure-2: Measurement Model
Source: Author Estimation

4.3 Construct Validity: According to Sekaran and Bougie (2009), construct validity ensures that the results of a measurement tool are consistent with the assumptions intended to be evaluated. This involves verifying that the device accurately captures target structures (Ramayah et al., 2011). One way to achieve this is to evaluate weighted factors and perform cross-validation to determine validity and discrimination. Similarly, Valérie (2012) states that a correlation coefficient (or loading) ratio of 0.70 is frequently used in studies, meaning that the shared difference between the structure and its measurements is greater than the measurement error. This approach helps verify the validity and reliability of the measurement model by identifying the research constructs being studied.

	BP	GSCM	SCE	SCT	SCE*GSCM	SCT*GSCM
BP1	0.841					
BP2	0.734					
BP3	0.77					
BP4	0.875					
BP5	0.883					
BP6	0.794					
BP7	0.899					
GSCM1		0.834				
GSCM2		0.811				
GSCM3		0.673				
GSCM4		0.861				
GSCM5		0.785				
SCE1			0.895			
SCE2			0.881			
SCE3			0.909			
SCT1				0.856		
SCT2				0.895		
SCT3				0.824		
SCT4				0.873		
SCT5				0.869		
SCT6				0.881		
SCT*GSCM					1	
SCE*GSCM						1

Table-2: Outer Loading
Source: Author Estimation

Table 2 summarizes the external loadings obtained from the comparative analysis. It is important to evaluate how each factor contributes to measuring latent constructs in the study. Across the entire sample, all parameters established to measure business performance (BP) showed significant loadings between 0.734 and 0.899, confirming that they highly represent business activities. Similarly, Green Supply Chain Management (GSCM) showed strong loadings overall. There was little variation between elements, highlighting their effectiveness in driving the concept in the research. Supply Chain Ecocentricity (SCE) and Supply Chain Traceability (SCT) also showed significant loadings; this demonstrates reliability in measuring relevant constructs. Interaction effects such as SCE*GSCM and SCT*GSCM showed absolute loadings of 1,000, clearly indicating measurements of these interaction terms. Overall, the analysis confirms the validity and reliability of the applied structural model, confirming its suitability for investigating the relationship between green management practices and business performance in the Pakistani textile industry.

4.4 Convergent Validity: This section discusses convergent factor analysis, which examines the correlation between items measuring the same concept (Ramayah et al., 2011). Variable validity relies on multivariate testing to ensure that items measuring constructs are closely related. These tests include weighted factors, correlation reliability (CR), and average inference (AVE) (Hair et al., 2010). It is recommended that the weight factor be greater than 0.70 (Hair et al., 2011; Valérie, 2012). According to Table 3, all reliability values in this study range between 0.710 and 0.999, which indicates a high value. Cronbach's alpha evaluates the internal consistency of the scale when used reliably. For high reliability, both Cronbach's alpha and reliability must be greater than 0.70 (Hair et al., 2011; Valérie, 2012).

Description	Cronbach's Alpha	Composite Reliability (rho-a)	Composite Reliability (rho-c)	Average Variance Extracted (AVE)
BP	0.924	0.936	0.939	0.689
GSCM	0.854	0.873	0.895	0.633
SCE	0.876	0.884	0.924	0.801
SCT	0.937	0.999	0.948	0.751

Table 3: Reliability and Validity
Source: Author Estimation

Table 3 summarizes the reliability and validity assessments conducted on the key activities in the research equity model. Constructs examined include business performance, green management (GSCM), supply chain management eco-centricity (SCE), and supply chain management traceability (SCT).

Business performance demonstrates internal consistency with a Cronbach's Alpha coefficient of 0.924, indicating high reliability. It also shows rho-a 0.936, and the average extracted value (AVE) is 0.939, confirming that it is reliable and valid. The GSCM shows good reliability with a Cronbach's Alpha of 0.854 and a strong correlation with a composite reliability of 0.873 and an AVE of 0. 895. SCE was found to measure well, with a Cronbach's alpha of 0.876, reliability of 0.884, and a high AVE of 0.924, indicating a high value. The SCT shows excellent reliability with a Cronbach's Alpha of 0.937, excellent reliability of 0.999, and an AVE of 0.948, indicating measurement quality.

4.5 Discriminant Validity: The study assessed discriminant validity using Table 4 HTMT (Heterotrait-Monotrait Correlations) and Table 5 Fornell-Larcker. According to HTMT, the cross index representing the square root of the Average Variance Extracted (AVE) of each building was higher than its correlation with other buildings. Results show the clear difference between Business Process (BP), Green Management (GSCM), Supply Chain Eco-centricity (SCE), Supply Chain Traceability (SCT), and their interactions (SCE*GSCM and SCT*GSCM).

	BP	GSCM	SCE	SCT	SCE*GSCM	SCT*GSCM
BP						
GSCM	0.689					
SCE	0.746	0.576				
SCT	0.23	0.251	0.237			
SCT*GSCM	0.281	0.059	0.1	0.153		
SCE*GSCM	0.093	0.06	0.166	0.08	0.104	

Table-4: Discriminant Validity (HTMT)
Source: Author Estimation

Similarly, the Fornell-Larcker test confirmed discriminant validity. The analysis confirms that BP, GSCM, SCE, and SCT effectively measure different concepts without significant overlap. In conclusion, both HTMT and Fornell-Larcker scales support this study's findings and show that the discrimination in their structures is valid.

	BP	**GSCM**	**SCE**	**SCT**
BP	0.83			
GSCM	-0.631	0.796		
SCE	-0.687	0.509	0.895	
SCT	-0.24	0.249	0.226	0.867

Table-5: Discriminant Validity (Fornell-Larcker)
Source: Author Estimation

4.6 **Structural Equation Model**: Following the analysis of the measurement model, the researcher proceeded to evaluate the structural or inner models using criteria established by Chin (2010), Hair et al. (2013), Hair et al. (2011), and Valérie (2012). Key considerations included R^2 values and effect size (f^2). Route coefficient levels, significance testing, and bootstrapping were employed to assess the study's hypotheses. As depicted in Figure 3 and based on the outcomes of the two-stage process, the next step involved evaluating the structural model depicted in Figure 3, or the inner model. The R2 value for Business Performance was 0.692, indicating that GSCM accounts for 69.2 percent of the variance in Business Performance, which is considered satisfactory. According to Hair et al. (2013) and Henseler and Fassott (2010), the main effects were adjusted to simple/single effects when examining the moderator model. The findings regarding effect size (f^2) indicated that Green Supply Chain Management (GSCM) had a moderate effect size ($f^2 = 0.345$) on Business Performance. Supply Chain Eco-centricity (SCE) showed a substantial effect size ($f^2 = 0.629$) on Business Performance, while Supply Chain Traceability (SCT) had a negligible effect size ($f^2 = 0.002$) on Business Performance. Moreover, the interaction effect of SCE*GSCM demonstrated a notable impact on Business Performance ($f^2 = 0.365$), whereas SCT*GSCM had a negligible impact on Business Performance ($f^2 = 0.001$).

4.7 **Regression Analysis**: This regression analysis provides an in-depth look at how environmental management practices impact business performance. First, both supply chain management (GSCM) and supply chain eco-centricity (SCE) have a negative relationship with BP. Results show that the decline in these activities is associated with the decline in business activities, supported by high t-statistics and high p-value, indicating strong predictive value. In contrast, Supply Chain Traceability (SCT) alone has no statistically significant impact on BP; a non-significant p-value (0.36) indicates that it is not a good predictor of changes in business performance. Moreover, investigating interactive effects reveals an interesting dynamic. The interaction between SCE and GSCM (SCE *GSCM) positively affects BP. This means that SCE and GSCM when implemented together, increase the efficiency of business operations. In contrast, the interaction between SCT and GSCM (SCT*GSCM) has no significant effect on BP.

	Original sample (O)	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**
GSCM -> BP	-0.384	-0.386	0.031	12.212	0
SCE -> BP	-0.526	-0.526	0.031	16.754	0
SCT -> BP	0.026	0.025	0.028	0.916	0.36
SCE x GSCM -> BP	0.372	0.372	0.027	13.923	0
SCT x GSCM -> BP	0.023	0.022	0.025	0.906	0.365

Table-6: Path Coefficients
Source: Author Estimation

Results show that the total effect of SCT and GSCM does not significantly improve firm performance. The results highlight the complex relationship between supply chain environmental management strategies and various impacts on business performance. They emphasize the importance of integrating multiple sustainable practices to improve business performance while promoting environmental sustainability.

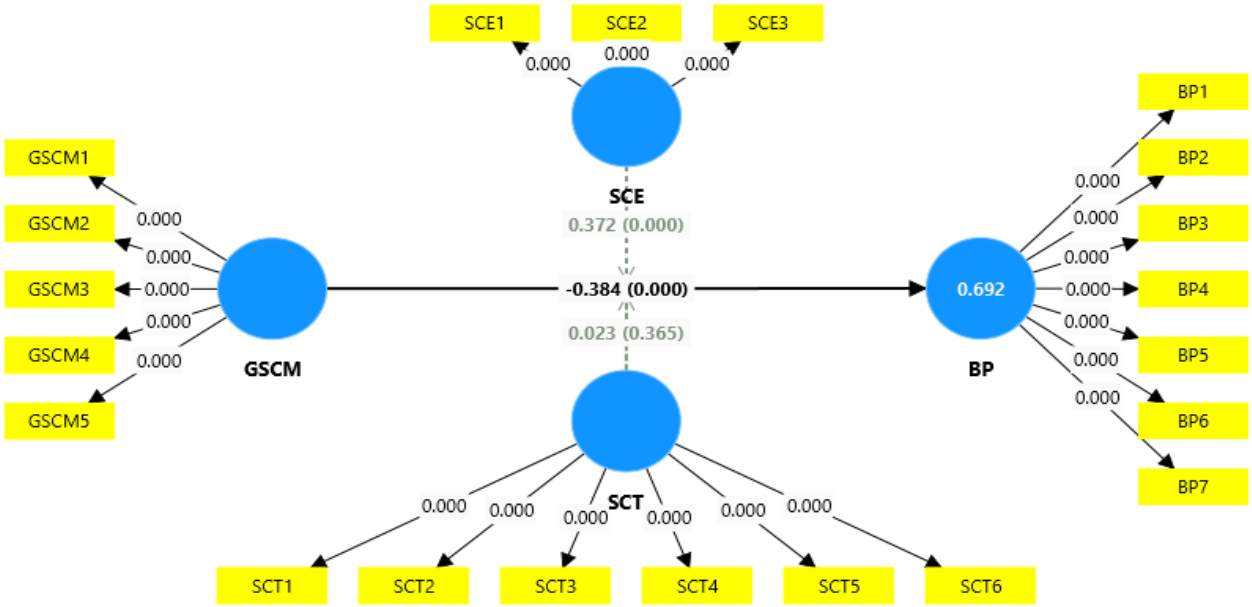

Figure-3: Structural Equation Model (Author's Estimation)
Source: Author Estimation

The study used the PLS algorithm and bootstrapping to evaluate the predicted relationships better, focusing mainly on path coefficients as part of the PLS analysis. Hair et al. (2011) showed that paths were considered significant if they showed parameters consistent with the expected direction. The most important way to validate the vision is to provide support for practical aspects. This study evaluated the importance of each path coefficient and weights of the parameters using bootstrapping. Figure 3 shows this analysis's factor loadings, path coefficients, and R^2 values . During the bootstrap process, a minimum of 5000 bootstrap samples were generated, corresponding to the expected number in the original sample (453). This method helped calculate the standard error, t-statistics, and confidence interval, which confirmed its power to assess the statistical significance of relationships. Figure 3 and Table 6 show the path coefficients obtained from the bootstrap results and how each relationship hypothesis was tested and confirmed. Table 6 details the results of testing the hypotheses and details the research findings regarding the relationship between green supply chain management and business performance.

4.8 Findings: This research investigated the effect of Green Supply Chain Management (GSCM) with Business Performance. Data were collected through questionnaires distributed to participants. Diagnostic and specification tests were conducted to ensure the data did not violate basic statistical assumptions and to understand their statistical properties. Descriptive statistics were used to determine the statistical distribution of the data, helping to assess the contribution of each independent variable in predicting the dependent variables. Following the recommendations of Hair et al. (2016), a multi-collinearity test was performed using the variance inflation factor (VIF) to confirm the absence of multi-collinearity among the independent variables. Variables indicate that all VIF values are below five and tolerance values exceed 0.20, suggesting that multi-collinearity is not an issue among the exogenous latent constructs in this study (Hair et al., 2011, 2014). Data were collected from managers and department heads in the textile sector in Pakistan, with 453 questionnaires distributed. An official letter from DHA Suffa University introduced the researcher and outlined the study's objectives, helping to gain cooperation from respondents. The questionnaires were initially delivered online. Despite efforts to increase response rates through follow-up phone calls, emails, and personal visits (Sekaran & Bougie, 2009), the response rate remained low. Consequently, the questionnaires were self-administered. In total, 453 out of 1650 questionnaires were returned, resulting in a response rate of 27.4%.

5. Conclusions

Addressing sustainability issues in the supply chain poses significant challenges for many companies. Our research significantly contributes to this field by examining how green business management (GSCM) affects the environment and business performance in general. We carefully examined two key moderators supply chain eco-centricity and supply chain traceability. We identified them as central constructs in this relationship. These findings are consistent with existing literature showing that GSCM practices can improve costs, profits, and the environment. Companies will benefit most from this process if they continue to control their networks and connect

to diverse, non-traditional suppliers. Our study highlights the important role of management activities in supply chain monitoring and collaboration to increase financial benefits from sustainable operations.

5.1 **Theoretical implications**: Our research aimed to determine how reporting and monitoring the environment impacts green supply chain management (GSCM) and its impact on environmental performance and cost efficiency. Based on the concept of sustainable supply chain management, as shown in previous studies (Meinlschmidt et al., 2018; Albertini, 2013; Carter et al., 2000; Golicic & Smith, 2013), we found empirical evidence of a positive relationship between GSCM and BP. In particular, the implementation of GSCM has had a significant impact on environmental improvement and firm performance. Our research also focuses on the role of the environment and supply chain in shaping GSCM performance and outcomes. We emphasized that the environment can be a strategic asset, especially through partnerships with non-governmental organizations and outsourcing. However, our findings revealed the effect. Although the environment did not influence environmental performance, it positively impacted performance, especially when companies emphasized sustainability in their operations and monitoring. Additionally, our supply chain research revealed mixed results. Contrary to expectations, we found that large and complex levels negatively affected the relationship between GSCM performance and operational performance. Companies with multiple supply chains need help in implementing environmental standards across their supply chains. It demonstrates the need for greater transparency and control to impose environmental impacts effectively. The findings contribute to a deeper understanding of how GSCM strategies interact with environmental and economic objectives. Future research should further investigate additional important factors in improving sustainability strategies and business performance in supply chain management.

5.2 **Managerial implications**: From a management perspective, our research provides important insights into implementing and developing Green Supply Chain Management (GSCM) in organizations. First, our findings confirm the relationship between GSCM adoption and good business performance. They suggest that managers who support GSCM activities can demonstrate their ability to improve financial performance. This is consistent with recent research showing that strong GSCM measures are associated with financial and market performance (Schmidt et al., 2017). Second, our research provides managers with practical guidance on using GSCM practices to improve environmental and supply chain efficiency. For example, focusing on products at the product level as part of a long-term strategy can positively impact the environment. Additionally, working with independent partners to create a large, profitable system supported by a good control system can strengthen the market and compete effectively (Bititci et al., 2012; Hervani et al., 2005). Such a system provides operational resources, reduces credit risk, and increases pollution prevention measures. The findings highlight the importance of developing deep collaboration and control mechanisms with non-traditional partners to achieve cost effectiveness by improving GSCM performance. This practical approach improves performance and strengthens sustainability goals in the supply chain.

5.3 **Limitations and Future Research**: Our study used a cross-sectional design. It would be useful for future research to examine longitudinal data to understand better how GSCM programs impact performance over time, depending on the various factors involved. Examining this in different contexts outside the Pakistani industry, for example, the role of green procurement in promoting corporate social responsibility (Amann et al., 2014), could extend insights. Our data collection consisted of the cognitive techniques scale corresponding to internal and external management evaluations (Dess & Robinson, 1984; Venkatraman & Ramanujam, 1986). Future studies could improve this approach by adding additional information about relevant variables, such as the operational and social perfromance, that would enrich the analysis. Although our study is based on established literature (Chavez et al., 2016; Gladwin et al., 1995; Gold et al., 2013; Pagell & Wu, 2009; Seuring, 2004), we agree with Pagell and Wu (2009) that some constructs such as environmental engineering remain unexplored, providing opportunities for further research and development of standards.

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