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Examining the Impact of Sustainable Supply Chain Management Practices and Supply Chain Ambidexterity on Sustainability Performance

Faria Ahmad
UE Business School, University of Education, Lahore, Pakistan
Email: Fariaahmad@ue.edu.pk (*Corresponding Author*)

Shahid Ghafoor Khokhar
UE Business School, University of Education, Lahore, Pakistan
Email: Shahid.khokhar@ue.edu.pk

ABSTRACT

In recent years, both businesses and academia have started to recognize sustainability as a crucial aspect of gaining a competitive advantage in the supply chain. This study aims to assess the effects of sustainable supply chain management (SSCM) practices on textile sectors' sustainability performance. It also assesses how supply chain ambidexterity mediates the connection between SSCM, from a triple bottom line (TBL) standpoint, and firm sustainability performance outcomes. Using the resource-based view and stakeholder theories, the study employed 240 survey responses from firms operating in textile industry in Pakistan and the validity and reliability of the data were confirmed, and the hypotheses were evaluated, using PLS-SEM. The findings show that SSCM practices have a major favorable influence on Sustainability Performance (SP) and Supply Chain Ambidexterity (SCA). Furthermore, in Pakistan's textile industry, SCA acts as a mediator in the relationship between SSCM and Sustainability Performance. Through an analysis of the fundamental factors and connections that lead to the development of the intricate connection between SSCM practices from a triple bottom line viewpoint and a company's sustainability performance, this research contributes to the current literature on SSCM and SCA, especially in the context of Pakistan's textile industry, by identifying the mediation effect of SCA on SSCM and SP.

Keywords: *economic performance, environmental performance, social performance, supply chain ambidexterity, sustainable supply chain management, triple bottom line*

1. INTRODUCTION

In today's rapidly evolving business landscape, balancing sustainability with competitiveness is a critical priority for organizations around the world. The 17 Sustainable Development Goals (SDGs), which are a component of the 2030 Agenda for Sustainability Development, were endorsed by world leaders at a historic UN meeting in September 2015. In order to build a sustainable and circular economy, all three of the sustainable development pillars (environmental, economic and social)—as well as the SDGs—must be created and taken into account (Lam *et al.*, 2020). To achieve this, the three pillars of sustainable development have all been made monetized in order to build networks and processes that meet sustainability requirements like sustainable profit and net present value (Arslan, 2020).

Considering the idea of sustainable development and improved awareness of environmental protection and social responsibility, individuals and organizations have come to embrace SSCM. Managers must take into account the public's attitudes and ideals about social responsibility and the environment. SSCM is a crucial component of dynamic business development's corporate innovation processes, which are essential to the survival and growth of corporate (Gosling *et al.*, 2016). Usually, supply chain companies are accountable for the negative consequences of each link in the chain (Kovács, 2008). Core businesses must take greater accountability for the social and environmental performance of the whole supply chain. As a result, businesses use the SSCM approach for managing every supply chain participant as well as for their own sustainable management. To prevent and reduce the negative effects of supply chain members' environmental and social responsibilities, supply chain core firms should enhance their environmental and social performance through effective SSCM.

Sustainable supply chain management (SSCM) derived from the recognition of the strategic importance of buying and supplying exercises, to achieve the firm's long-term performance and promote sustainability issues within business capabilities (Touboulic & Walker, 2015). This study observes the deployment SSCM practices, including Sustainable Product Design (PD), Supply-side Sustainability Collaboration (SSC), Demand-side Sustainability Collaboration (DSC) and Sustainable Process Design (RD) by Paulraj *et al*. (2017) on sustainability performance in the textile sector of Pakistan. These practices match supply chain operations with stakeholder requests and regulatory requirements by integrating environmental and social issues. The inclusion of these elements of SSCM has been inspired by the studies of (Kurczewski & Lewandowska, 2010; Mohrman & Worley, 2010; Siems *et al.*, 2021).

This paper also embraces the mediatory effect of Supply chain ambidexterity (SCA). SCA is the capacity of a company to balance efficiency and flexibility by concurrently investigating new supply chain technologies

and utilizing current supply chain capabilities. In order to attain long-term sustainability performance, trade-offs between these two skills must be managed. Supply chain exploitation practices and supply chain exploration practices are the two key indicators used to measure it (Kristal *et al.*, 2010). Organizations can maintain a flexible and effective source chain by leveraging the dynamic capabilities of market sensing (search), supply chain adaptableness, and supply chain agility (Aslam *et al.*, 2020). In order to achieve sustainability goals, supply chains must be ambidextrous, which is defined by the capacity to strike a balance between efficiency and flexibility (Tamayo-Torres *et al*., 2017).

The textile industry is associated with several environmental challenges, including water pollution, air pollution, and solid waste generation (Akhuand & Abbas, 2023). These challenges emphasize the urgent need for SSCM practices where they can play a key role in addressing these environmental challenges and improving the overall performance of the textile sector in Pakistan. Hence, choosing the textile sector for this study is very important (Hayat *et al.*, 2020). The textile sector is in the middle of industrial midpoint because of its substantial economic contribution, but despite this, it is still plagued by several issues that have prevented expansion from accelerating, such as a lack of technical expertise and a lack of support from upper management (Akhuand & Abbas, 2023). Non-governmental organizations, governmental norms and legislation, and customer awareness have put a lot of pressure on businesses to evaluate the sustainability performance of their suppliers. Organizations (manufacturers and producers) are compelled to include sustainability in their processes through balanced models as a result of globalization, customer awareness, and legislation (Dweiri *et al.*, 2021; Khan *et al.*, 2021; Khanam & Ghosh, 2022; Mangla *et al.*, 2020). Stakeholders such as customers, media outlets, and regulators demand evidence that sustainability considerations have been thoroughly incorporated throughout worldwide supply chains (Kleindorfer *et al.*, 2005).

In the context of the textile sector in Pakistan, there is a growing need to bridge the gap between practical implementations and theoretical frameworks of SSCM practices (Leire & Mont, 2010). Additionally, businesses need to satisfy their social and environmental obligations while maintaining and improving their market position (Fratocchi & Di Stefano, 2019). The study aims to find out how supply chain ambidexterity, cooperation tactics, and sustainable product and process design might help address environmental issues and enhance sustainability performance in general. It also complements the larger conversation on SSCM practices and has important implications for Pakistan's textile industry. This study can also assist organizations looking to improve their sustainability performance which includes the indicators that are divided into three categories: environmental, social, and economic performance, while keeping competitiveness with practical insights by examining the relationship between SSCM strategies, environmental issues, and market demands. This makes it clear how sustainability is assessed using the triple bottom line.

There are seven sections in this paper: The introduction is covered in Section 1 and the study's literature review is covered in Section 2. The research methodology and data analysis methods employed in the study are described in Section 3. The study's findings are presented and discussed in Section 4. Section 5 contains the discussion, section 6 contains the implications, limitations and suggestions for additional research and in the last section conclusion of the paper is given.

2. REVIEW OF LITERATURE

The literature analysis begins with brief discussion of the theoretical foundations and constructs. The Resource-Based View (RBV) Theory and Shareholder Theory are the main ideas that describe SSCM (Islam *et al.*, 2021). The resource-based view (RBV) helps develop the theoretical framework (Barney *et al.*, 2021). The RBV helps the researcher identify the key resources that are important for SSCM practices and SP. According to the RBV, increasing a firm's capacity to take advantage of extrinsic opportunities and effectively utilize its current resources (Freeman *et al.*, 2021). Therefore, it is expected that the practices of managing the environment and accountability management, upon which the RBV theory bases this study, will have the greatest influence on the performance of sustainable supply chains. Conversely, the Stakeholder Theory accepts that a firm's tasks affect both external and internal parties (Abdolazimi *et al.*, 2021). Corporate social responsibility is the commitment made by a company to live up to the expectations of its shareholders (Freeman *et al.*, 2021). Businesses can ensure their long-term and permanent continuity and uphold their general right to work by incorporating a diverse network of participants into their strategy. This study considers that businesses do not focus primarily on their internal operations to improve performance only; but to sustain long-term ties with its participants, it ensures an appropriate connection between the vendors it uses and other shareholders (Younis & Sundarakani, 2020).

2.1 Sustainable Supply Chain Management Practices and Performance

Supply chain management and sustainability come together to form SSCM. According to Gualandris and Kalchschmidt (2014), SSCMPs combine SCM from the product design phase through the end cycles of management with environmental considerations and viewpoints. The term "closing the loop" refers to the range of sustainable supply chain processes, which include green purchasing from suppliers to manufacturers, developers, and customers (Eltayeb & Zailani, 2014). SSCM is the strategic, open integration and accomplishment of an organization's social context and economic goals require the systematic collaboration of key inter-organizational operations to improve the long-term financial health of each company and its supply chains (Joshi & Sharma, 2022). Businesses integrate eco-friendly practices into their supply chains to reduce the adverse effects of their operations and goods on the natural world (Cuc & Vidovic, 2014). SSCM refers to managing the financial, social, and environmental factors and promoting good governance and practices generally and over the course of the life cycle of products,

services, and goods (Garcia-Torres *et al.*, 2022). The study examines how SSCM practices affect sustainability performance in Pakistan's textile industry.

2.1.1 SSCM Practices and Environmental Performance

Environmental performance pertains to the results and metrics that a business attains in mitigating its ecological footprint by implementing sustainable practices throughout its supply chain (Acquaye *et al.*, 2018). It includes a wide variety of actions designed to reduce adverse environmental consequences while preserving operational effectiveness and competitiveness. To manage the supply chain as a whole and to increase the positive and decrease the negative effects on the environment, society, and economy is the goal of SSCM. The target of SSCM is to ensure that the overall supply chain works and operates in a manner that is sustainable and does not cause any major harm to the existing environment or society (Centobelli *et al.*, 2018). By incorporating sustainability considerations into supply chain operations, encouraging eco-friendly practices, and lowering the total environmental effect of corporate activities, SSCM practices play a critical role in enhancing a company's environmental performance. Resource-based view theory can facilitate the implementation and performance management of SSCM practices in emerging economies, while also serving as a sound business decision and environmental need (Esfahbodi *et al.*, 2016). On the basis of above discussion, following hypothesis can be made:

H1: *Environmental performance is positively influenced by SSCM practices.*

2.1.2 SSCM Practices and Economic Performance

According to Freeman et al. (2021), the shareholder theory primarily supports corporate strategy creation by fortifying the distribution of shareholders with whom a business should genuinely interact. The shareholder theory states that firms can improve their financial standing by attending to and meeting all of the major demands of their shareholders (Voronov & Weber, 2020). SSCM practices can improve a company's economic performance through cost-cutting, risk-taking, brand reputation building, innovation, and long-term value creation. The term "economic performance" describes the monetary gains and cost-efficiency that a company experiences as a result of implementing sustainable supply chain procedures (Jawaad & Zafar, 2020). How successfully a company can manage its financial objectives of development, profitability, and cost containment with its social and environmental duties is how this performance is measured. As managers increasingly recognize the importance of sustainability in driving long-term profitability and resilience, sustainable investments in production and energy infrastructure can provide economic benefits, societal and environmental value. The majority of industry managers prioritize economic performance when making financial investments in production and energy infrastructure (Bilan *et al.*, 2020).
In light of the above discussion, the following hypothesis is put forth.

H2: *Economic performance is positively influenced by SSCM practices.*

2.1.3 SSM Practices and Social Performance

How well a business incorporates and encourages social responsibility and ethical behavior across its supply chain is referred to as social performance (Yawar & Seuring, 2017). The influence that a corporation has on different stakeholders, such as customers, suppliers, workers, and the society at large, as well as its compliance with socially responsible policies, are commonly used to gauge social performance. The company's operations are closely linked to the local community, with workers from the surrounding area benefiting from employment. However, those near the facility are highly susceptible to radiation and pollutants, necessitating the design of sensors, monitoring, and measurement units. The process of generating surplus heat is widely applied to the heating of residences or public buildings (Glavič *et al.*, 2021). Research indicates that firms adopting SSCM practices show improved social performance metrics, including employee satisfaction and community relations, and can leverage these practices to achieve business objectives. SSCM practices adoption has a positive impact on performance of the firm, particularly in the economic and social aspects (Mann, 2018).
On the basis of the discussion above, following hypothesis is formulated:

H3: *Social performance is positively influenced by SSCM practices.*

2.2 Supply Chain Ambidexterity and Performance

Suppliers are under significant pressure to curtail expenses and enhance productivity, in current competitive worldwide marketplace. Moreover, they must be able to respond quickly to client needs, changing market demands, and technological advancements. By looking for cost-effectiveness and inventiveness due to the ambidextrous structure of their supply networks, businesses may be able to balance these conflicting demands. A manufacturer's efforts, particularly for major industrial organizations, to enhance or expand its current resources, develop new supply chain competencies, and generate performance improvements are referred to as supply chain ambidexterity (Garcia-Torres *et al.*, 2022). Businesses that pursue supply chain ambidexterity may obtain improved resilience and agility, a durable competitive edge in the market, , support equitable and inclusive development and growth (Al-Khawaldah *et al.*, 2022).

2.2.1 SSCM Practices and Supply Chain Ambidexterity

SSCM practices enhance supply chain ambidexterity by promoting innovation, resilience, and flexibility. Integrating sustainability into supply chain strategies allows organizations to navigate uncertainties and capitalize on emerging opportunities, aligning with principles of ambidexterity in management. When coupled with supply chain disruption and organizational ambidexterity, sustainable sourcing can improve dexterity performance (Li *et al.*, 2023). Further, Bui et al. (2021) emphasizes the significance of striking a balance between supply chain disruption and sustainability, with an emphasis on critical metrics including resilience, agility, coordination, financing, flexibility, and sustainability. Moreover, the

RBV lens provides a strategic framework for comprehending sustainable supply chain practices, emphasizing the potential for these methods to develop exclusive resources, improve productivity, and stimulate innovation in the supply chain. SCA facilitates an organization's more efficient use of sustainable supply chain management (SSCM) practices (Abdallah *et al.*, 2021). It functions as a mediator by making the supply chain more flexible and adaptable, which improves sustainability performance. Businesses may match their operations with both short-term operational objectives and long-term sustainability aspirations by striking a balance between exploration and exploitation (Hahn *et al.*, 2015). In order to include sustainability into their supply chain operations, businesses must constantly innovate and investigate new approaches. To guarantee that sustainability objectives are fulfilled, businesses must simultaneously maximize and use their current resources effectively (Keay, 2008). By encouraging agility and flexibility in decision-making, SCA serves as the link that allows SSCM practices to be fully realized and translated into enhanced sustainability performance. Based upon the above discussion, following relation can be hypothesized:

H4: *SSCM practices are positively related to Supply Chain ambidexterity*

2.2.2 Supply Chain Ambidexterity and Environmental Performance

Environmental performance assessment is becoming increasingly important, because of resource scarcity, stakeholder concerns, and environmental issues. Graham *et al.* (2018) and Rintala *et al.* (2022), both demonstrate how ambidexterity in logistics operations and environmental logistics practices can enhance financial and environmental performances, respectively. The impact of environmental dynamism on supply chain flexibility is mediated by organizational ambidexterity as explored by Seimon and Endagamage (2022) which is important for environmental performance. Additionally, Shukor *et al.* (2021) emphasized how organizational ambidexterity improves supply chain integration, which benefits organizational flexibility and supply chain agility—two factors that are critical to environmental performance. This goes in line with the RBV viewpoint, that supply chain ambidexterity can promote improved environmental performance through resource combination and integration, the development of dynamic capabilities, and competitive advantage. Following hypothesis can be put forth, based on the above debate:

H5: Supply Chain ambidexterity is positively related to Environmental Performance

2.2.3 Supply Chain Ambidexterity and Economic Performance

There are many variables that might affect the complex relationship between supply chain ambidexterity and economic performance and supply chain ambidexterity can positively affect economic performance. Supply chain performance and combinative competitive skills go hand in hand with an ambidextrous approach (Kristal *et al.*, 2010). This is further supported by Scott (2016) where he suggested that enhanced supply chain responsiveness and integration can result in higher performance through the use of ambidextrous supply chain technology whereas the RBV suggests that competitive advantage of a firm and economic performance are derived from its unique, valuable, rare, inimitable, and non-substitutable resources, capabilities, and competencies. Following hypothesis can be driven based upon above discussion:

H6: *Supply Chain ambidexterity is positively related to Economic Performance*

2.2.4 Supply Chain Ambidexterity and Social Performance

The correlation observed between ambidextrous supply chain strategy and business sustainability performance is positive, highlighting the significance of incorporating efficiency and innovation into supply chain management to effectively tackle modern environmental and social issues (Cao *et al.*, 2023). This is further supported where the balance and combined dimensions of ambidexterity enhance corporate social performance by promoting efficiency, risk management, stakeholder engagement, innovation, and continuous improvement in CSR strategies (Hahn *et al.*, 2016). From an RBV perspective, by utilizing special and valued resources and talents to strike a balance between responsiveness and efficiency, supply chain ambidexterity can have a beneficial impact on social performance and contribute to increased social value creation and sustainable competitive advantage. Following hypothesis can be driven based upon above discussion:

H7: *Supply Chain ambidexterity is positively related to Social Performance*

2.3 Supply Chain Ambidexterity, SSCM Practices and Sustainable Performance

Structured ambidexterity is described by empirical research models that explain the interplay between exploitation and exploration research models. Whereas, exploitation is primarily concerned enhancing, expanding upon, and putting successful techniques into practice, exploration seeks out innovative practices and uses seeking, innovating, and taking risks (Sirilertsuwan, 2020). To make the most of opportunity, maximize the use of available resources, and obtain a competitive edge, businesses are putting ambidextrous policies into place more swiftly. In supply chains, ambidexterity has been strengthened more recently (Suhi *et al.*, 2019). In contrary to general belief, which advocates for trade-offs between exploration and exploitation, ambidextrous supply chain strategies have been found to be associated with competitiveness abilities and improved supply chain performance (Kalkanci & Plambeck, 2020). According to their investigation, Supply chain managers aim for ideal performance while continuously exploring novel paths to leverage the benefits of these actions and this is consistent with the interdependent perspective. The effects of an ambidextrous supply chain on its efficiency have also been highlighted by other studies and research (Couzineau-Zegwaard & Meier, 2020). Based on above debate following hypotheses can be put forth:

H8a: *Supply Chain ambidexterity acts as mediator between SSCM practices and Environmental Performance.*

H8b: *Supply Chain ambidexterity mediates the relationship between SSCM practices and Economic Performance.*

H8c: *Supply Chain ambidexterity mediates the relationship between SSCM practices and Social Performance.*

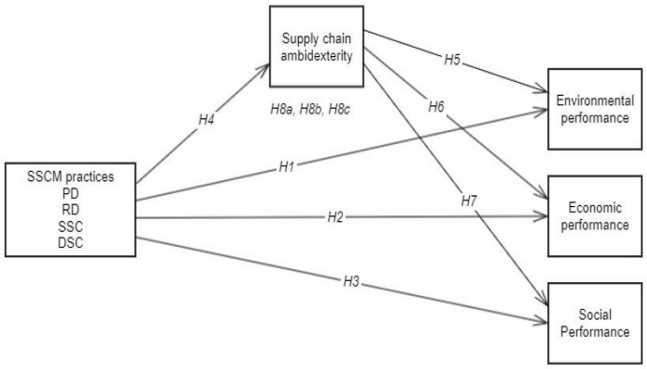

Figure 1 Proposed conceptual framework

3. METHODOLOGY AND METHODS

3.1 Methodological Research Choice

To clarify the causal relationships between concepts and variables (SSCM practices, SCA and SP) deductive reasoning was used. This approach functions mostly well when researchers start with an established theory or body of knowledge and attempt to produce hypotheses that are then validated by empirical observations or data collection (Saunders *et al.*, 2007). By employing quantitative data, the deductive technique improves the study's external validity in an effort to try and extrapolate study findings to a wider population. It is possible to develop specific, testable hypotheses that may be fully examined through empirical research by using this method. The choice of a quantitative, mono-method research design for the study affirms the connection between positivism and quantitative research. Quantitative procedures that employ highly structured and predetermined data collection methods are well-suited to positivism because of its strong emphasis on systematic measurement and empirical observation (Patten, 2016). The data was collected and analyzed using a cross-sectional research method.

3.1.1 Population and Sample

The data was collected by simple random sampling. This sampling method works well in populations that are well-known (Park-Poaps & Rees, 2010). In the current study, we know our population registered under Pakistan's Pakistan Textile Exporters Association (PTEA) and All Pakistan Textile Mills Association (APTMA). This type of sampling strategy employs numerous advantages; for instance, it increases the sample's representativeness, includes precision, and is cost-effective (Crowther & Lancaster, 2012).

The focus of this study was the textile sector. The data collection for this study focused on top export-oriented textile companies. As per the Pakistan Textile Exporters Association, 204 registered exporters in Pakistan and 222 companies registered in the All-Pakistan Textile Mills Association were the study's target population. The companies ' suitable personnel (department heads/general managers/ managers/ executives) provided the data. Based on the items-to-response ratio, a minimum sample of 240 (5 responses per item) were selected (Williams, 2007).

3.2 Measures

To collect quantitative data, the study employed a five-point Likert measuring scale, with 5 denoting Strongly agree, 4 Agree, 3 Neutral, 2 Disagree, and 1 signifying Strongly disagree. Prior to starting the data collection, face validity approaches based on previous studies were used to modify all of the measures. Four dimensions totaling 23 items are used to measure SSCM practices (Paulraj *et al.*, 2017). Seven items are used to measure ENVP, and six items are used for each of ECOP and SOCP (Wang & Dai, 2018). Finally, SCA was measured with four items per dimension across two dimensions as supply chain exploitation and supply chain exploration practices (Kristal *et al.*, 2010).

3.2.1 Time Horizon

A cross-sectional study methodology was employed in the collection and analysis of the data. Additionally, the study's objectives were addressed through the use of quantitative research. This kind of design is helpful for getting a momentary view of the traits, attitudes, and behaviors of a population.

Cross-sectional study designs are useful in SSCM research because they can be used to analyze the sustainability practices of businesses in a certain industry, spot patterns in sustainable supply chain practices, or gauge how successful the SSC program is (Crowther & Lancaster, 2012). However, because cross-sectional research only offers a picture of a population at one point in time, it has limitations, such as the inability to establish cause-and-effect links.

4. DATA ANALYSIS

4.1 Data Analysis Techniques

Researchers utilize a variety of statistical approaches to analyses the data. SPSS is utilized in the current study to screen data, identify data missing values and to remove impurities including univariate and multivariate outliers from the data. The data was carefully examined, and the hypothesis testing was carried out using Smart PLS 4.1.0.0 following the removal of contaminants.

4.2 Descriptive Analysis and Interpretation

Descriptive analysis is performed on a sample of 240 respondents to obtain a demographic summary that includes title, age of the firm, revenue, years of experience, and size of the firm in **Table 1.**

4.3 Analysis

After the data were first screened, Smart PLS 4.1.0 was used for processing. The data were first verified for external measurement, and then a hypothesis test was conducted.

Table 1 Descriptive statistics

Demographics	Frequency	%
Title		
C-Level (CEO/ CFO/ COO)	25	10.4
Director Level	46	19.2
Sr. Manager level	18	7.5
Manager Level	144	60
VP Level	7	2.9
Age of the Firm (operating years)		
1--5	20	8.3
6--10	14	5.8
11--15	21	8.8
16-20	27	11.3
21-30	37	15.4
Above 30	120	50
Revenue (in million rupees)		
<50	32	13.3
51-500	55	22.9
501-10000	75	31.3
>10000	78	32.5
Years of Experience		
0--5	50	20.8
6--10	63	26.3
11--15	59	24.6
16-20	35	14.6
21-30	23	9.6
Above 30	10	4.2
Size of the Firm (Number of employees)		
100-199	24	10
200-499	14	5.8
500-999	50	20.8
1000-4999	47	19.6
Above 5000	105	43.8

Note: *n*=240

4.3.1 The Outer Model Measurement

Convergent, discriminant, and reliability validity calculations are related to the outer model's validity. Internal consistency between the construct's items is quantified by reliability, which is often determined by the composite reliability of the variables. Convergent average variance extracted (AVE) and discriminant validity are measured as part of the validity using the Fornel and Larckar criteria and the heterotrait–monotrait (HTMT) criterion (Hair *et al.*, 2011; Henseler *et al.*, 2015).

4.3.2 Reliability Testing

Cronbach's alpha gauges a scale's dependability or internal consistency. All constructs have reasonably high Cronbach's alpha values, ranging from 0.880 to 0.958, indicating good internal consistency.

Values range from 0 to 1, with higher values indicating greater internal consistency. While there are several ways to quantify reliability, composite reliability is the method that is prioritized. (Hair *et al.*, 2014). **Table 2** displays the composite reliability value for each latent variable wherein the values are greater than 0.7 for composite reliability (Hair *et al.*, 2011).

4.3.3 Convergent Validity

A collection of items that together compute a same idea is known as convergent validity (Hair *et al.*, 2013). Convergent validity is investigated by the application of AVE and cross-loading criteria. First, the majority of the construct's factor loadings for the items need to be significant and higher than 0.7 (Henseler *et al.*, 2016). Second, the value criterion for the AVE, which measures convergent validity, is more than 0.5 (Hair *et al.*, 2011). All of the results in **Tables 2** are higher than the limits, confirming the acceptance of convergent validity.

4.3.4 Discriminant Validity

The degree of divergence between two constructs is estimated via discriminant validity (Hair Jr *et al.*, 2014). Discriminant validity notes the variables in the given model when a set of items separates a variable from another. To establish that the results cannot be disputed, and that the outcome is the same, discriminant validity must be established. To quantify discriminant validity, the Heterotrait–Monotrait ratio, cross loading within the items and the Fornel and Lacker criterion are used (Hair Jr *et al.*, 2014; Henseler *et al.*, 2015).

In 1981, one technique proposed by Fornell and Larcker to assess discriminant validity. The diagonal value, which is the square root of AVE, must be less than the inter-construct correlation values (Hair *et al.*, 2011). In addition to demonstrating that all diagonal values are bigger in the pertinent rows and columns, **Table 3** provides an illustration of the correlation matrix supporting discriminant validity.

Table 2 The convergent validity analysis

	Cronbach's Alpha	CR	AVE
ENVP	0.898	0.899	0.620
ECOP	0.886	0.887	0.637
SOCP	0.893	0.897	0.651
SCA	0.880	0.892	0.626
SSCMP	0.958	0.960	0.523

Table 3 Correlation of discriminant validity

	ENVP	ECOP	SCA	SOCP	SSCMP
ENVP	0.787				
ECOP	0.684	0.798			
SCA	0.526	0.442	0.791		
SOCP	0.773	0.776	0.489	0.807	
SSCMP	0.786	0.674	0.528	0.765	0.723

Table 6 displays the HTMT results of different constructs ENVP, ECOP, SCA, SOCP, and SSCMP. The HTMT value between two constructs is represented by each cell in the matrix. The values are in the range of 0 to 1, where 1 denotes no discriminant validity (i.e., the constructs are indistinguishable) and 0 represents perfect discriminant validity (i.e., the constructs are fully separate). When two constructs' HTMT values are near zero or fall below a specific threshold (often 0.85), it indicates that the constructs have strong discriminant validity, indicating that they measure different concepts. Poor discriminant validity is indicated by an HTMT result that is near to 1 or above the threshold, indicating that the constructs may be assessing comparable underlying concepts.

Table 4 Heterotrait-Monotrait Ratio (HTMT) results

	ENVP	ECOP	SCA	SOCP	SSCMP
ENVP					
ECOP	0.761				
SCA	0.580	0.479			
SOCP	0.622	0.752	0.530		
SSCMP	0.844	0.729	0.553	0.821	

In this study HTMT ratio in **Table 4** is shown for each pair of constructs which all have values less than 1. (Sarstedt *et al.*, 2016). ECOP and SCA have an HTMT value of 0.479, indicating strong discriminant validity between these two constructs. Similarly, there may be some overlap or similarity between ENVP and SSCMP, as indicated by the HTMT value of 0.844 between the two constructs. Lastly, the item loadings can also be used to establish the discriminant validity. There should be a difference of more than 0.1 between the loading of the outside construct variable and the loading of the items that are part of the construct variable (Gefen & Straub, 2005). Discriminant validity is thus validated.

4.3.5 Inner Model Measurement and Hypothesis Testing

Following examination of the outer model assessment, data analysis was done for inner model measurement (Hair *et al.*, 2011; Henseler *et al.*, 2009). In general, the PLS SEM technique is used by the researchers to handle complex models more effectively than alternative covariance-supported methods (Henseler *et al.*, 2015). Smart PLS 4.1.0 was used for hypothesis testing.

4.3.6 Predictive Relevance of the Model.

In statistical models, predictive relevance denotes the model's capacity to precisely forecast outcomes in novel, unknown data. It entails evaluating how well the model performs in terms of discrimination, calibration, and outside validation. In order to evaluate a model's generalizability through testing it on different datasets, external validation is essential (Collins *et al.*, 2014). R square and Q square are used to assess the factors' predictive power (Hair Jr *et al.*, 2014). The cross-validated redundancy, represented by Q^2, and the coefficient determination, represented by R^2, are explored using a primary criterion in order to assess the inner model (Hair *et al.*, 2011; Henseler *et al.*, 2009). The Q-square results in **Table 5**, which are greater than 0, demonstrate the model's good definition.

Table 5 The predictive power of the construct

	R^2	Q^2
ENVP	0.638	0.391
ECOP	0.464	0.291
SOCP	0.596	0.380
SCA	0.278	0.472

According to (Hair Jr *et al.*, 2014) Cross-validate redundancy calculates the inner model's relevance. The blindfolding approach has been used to estimate the Q^2 since it shows the accuracy of the model. Model predictive authenticity is gauged by R^2, which represents the overall influence of exogenous (independent) factors on endogenous (dependent) variables (Hair Jr *et al.*, 2014).

4.4 Hypotheses Testing

The SEM is used in this paper to investigate 8 hypotheses. In this study, the considerable effect of SSCM practices on SCA and SCA on ENVP, ECOP and SOCP sheds light on mediating effects. The non-parametric bootstrapping method is used in this work (Hair *et al.*, 2017; Preacher & Hayes, 2008) at significant levels of 1%,

as well as variance account for (VAF) to calculate the magnitude of the mediating impact (Hair *et al.*, 2014), respectively (see **Table 8** and Fig. 2). H1, H2 and H3 state that SSCMP are positively related to ENVP, ECOP and SOCP respectively, the regression coefficient and corresponding significance levels support the findings (β = 0.708, p<.001), (β = 0.617, p<.001) and (β = 0.702, p<.001) as shown in **table 6**. Similarly, H4 states that SSCMP is positively related to SCA, this result is also supported as shown by the corresponding significance level and regression coefficient (β = 0.532, p<.001). Likewise, H5, H6 and H7 are supported stating that SCA is positively related with ENVP, ECOP and SOCP respectively, indicated by the regression coefficient and associated significance levels (β = 0.154, p<.001), (β = 0.120, p<.05) and (β = 0.119, p<.005).

Table 6 Hypotheses testing results (direct effects)

No	Hypotheses	Estimation	SD	*t*-statistics	*p*-values
H1	SSCMP -> ENVP	0.708	0.038	18.751	0.000
H2	SSCMP -> ECOP	0.612	0.054	11.383	0.000
H3	SSCMP -> SOCP	0.702	0.042	16.911	0.000
H4	SSCMP -> SCA	0.532	0.043	12.315	0.000
H5	SCA -> ENVP	0.154	0.039	3.919	0.000
H6	SCA -> ECOP	0.120	0.056	2.108	0.035
H7	SCA -> SOCP	0.119	0.045	2.625	0.009

The findings demonstrated an indirect effect of SSCM practices on ENVP, ECOP and SOCP via SCA. For SSCMP-ENVP (β = 0.082, p < 0.01), supporting H8a. For SSCMP-ECOP (β = 0.064, p < 0.05), supporting H8b and for SSCMP-SOCP (β = 0.064, p < 0.05), supporting H8c (**Table 7**). Notably, modelling validates the application of resources-based view and stakeholders' theories to explain ENVP, ECOP and SOCP through SCA and SSCMP. Specific indirect effects

Table 7 Hypotheses testing results (specific indirect effects)

No	Hypotheses	Estimation	SD	*t*-statistics	*p*-values
H8a	SSCMP -> SCA -> ENVP	0.082	0.023	3.538	0.000
H8b	SSCMP -> SCA -> ECOP	0.064	0.031	2.037	0.042
H8c	SSCMP -> SCA -> SOCP	0.064	0.025	2.493	0.013

5. DISCUSSION

Manufacturing businesses that prioritize international sales and aim to maximize revenue from exports must put SSCM practices into effect. This study aims to examine the impacts of SSCM practices and supply chain ambidexterity on sustainability performance and whether SSCM practices enhance the performances in the textile sector in the case of developing country like Pakistan. The results of the study reveals that application of SSCM practices leads to the enhancement of environmental, economic and social performances in the textile sector of Pakistan. The results of the study align with the prior research where environmental and social performance of a corporation is positively impacted by its internal SSCM measures (Das, 2018). Additionally, Alsayegh et al. (2020) also highlights the positive correlation between economic , environmental and social performances.

SSCM practices have a substantial positive effect on all three dimensions of performances (Kitsis & Chen, 2020). Businesses are meeting the expectations of diverse stakeholders, including customers, investors, regulators, and local communities, as evidenced by the positive benefits of SSCM practices on all performance parameters by striking a balance between economic, environmental and social responsibilities. Environmental, economic, and social SSCM practices have a favorable correlation with sustainable performance (Raza *et al.*, 2021).

Moreover, Paulraj et al. (2017) divided SSCM practices into four groups such as PD, RD, SSC DSC, where all practices have positive impact on sustainability performance. Businesses may improve their standing, long-term success and have a less impact on the society and environment by implementing these practices. According to Gopal and Thakkar (2016) SSCM practices are interrelated and help in enhancing the effectiveness of the supply chain. Businesses who use SSCM methods simultaneously see benefits in a number of performance areas, according to the findings. A larger market share and brand loyalty are all possible consequences of this edge by gaining access to new markets. This integrated approach shows that sustainability measures have a favorable impact on economic performance in addition to environmental and social considerations.

In this study, the impact of SSCM practices has been examined on sustainability performance (including environmental, economic, and social performances) along with the mediatory effect of supply chain ambidexterity in the textile sector of Pakistan. SSCM practices can exert a positive impact on all dimensions of sustainability performance (TBL) as well as on supply chain ambidexterity. For example, Businesses that are skilled at handling a variety of supply chain tactics may be in a better position to adjust and develop in order to meet sustainability goals (Agrawal & Jain, 2022).

The results of the current study shows that SSCM practices have significant positive impact on environmental, economic and social performances. It is in accordance with the previous study of Kitsis and Chen (2020) where they also show the impact of supply chain ambidexterity in the significant positive way. Therefore, the results predicts that SSCM practices are a major predictor of sustainability performance. Manufacturing companies utilize sustainable product and process designs to lower their carbon footprint and pollution levels, benefitting the environment through the use of safe materials and appropriate machine and technology management. Manufacturing companies can lessen their negative environmental impact by utilizing external SSMC methods. Similarly, supply-side sustainability collaboration and demand-side sustainability collaboration along with sustainable product and sustainable process designs utilizes by the companies to improve social performance of the company. Environmental and social performance have a positive relationship with economic performance which is the ultimate goal of every company (Gopal & Thakkar, 2016).

Several enablers and barriers impact Pakistan's textile industry's adoption of SSCM practices. Cooperative management techniques, combined sustainability missions, and connection with business strategy are some of the enablers for SSCM. Along the supply chain, these enablers create a sense of urgency for addressing social and environmental challenges and cultivate a collective principles for sustainability (Oelze, 2017). The textile sector also has several hindrances in order to implement SSCM practices. These include comprehension of sustainability and a deficiency of competitive pressures, intrinsic motivation and a lack of informal communication across departments handling supply chain-related procedures (Oelze, 2017).

6. IMPLICATIONS, LIMITATIONS AND FUTURE RESEARCH RECOMMENDATIONS

SSCM is very important to Pakistan's textile industry. It can enhance reputation and supply chain performance, lower costs, meet consumer demand, preserve the environment, and boost competitiveness and profitability. It is possible to evaluate how sustainability affects sustainability performance using the suggested conceptual framework. Environmental, social, and economic performance are significantly improved by SSCM practices, which are heavily influenced by internal and external environmental orientation (Collins *et al.*, 2014). The result of current study shows that supply chain ambidexterity is a critical component of achieving sustainability performance through SSCM practices. It can be seen from the findings that the relationship is fully mediated by supply chain ambidexterity between SSCM practices and sustainability performance with all three pillars of TBL in the textile sector of Pakistan. It is also observed through another study of Shan et al. (2020) where Supply chain ambidexterity has a favorable impact on green supply chain management. This study can help managers determine the suitable balance between exploitation and exploration strategies needed to manage the supply chain in sustainable way. Moreover, the findings offer substantial backing indicating that SSCMP has a favorable impact on ECOP and SOCP via the mediating role of SCA within the model, which will help managers to identify the right mix for the exploitation and exploration strategies to enhance the sustainability performance in the textile sector of Pakistan.

This study adds to the theoretical knowledge of SSCM, by presenting empirical data on the ways in which supply chain ambidexterity functions as a mediator and how SSCM techniques affect sustainability performance. This research advances our knowledge of the complex interactions between supply chain management strategies and sustainability outcomes by coalescing theoretical concepts with empirical data. The measurement of sustainability performance, including environmental, economic and social performances of textile sector of Pakistan is the main objective of this study. To be more specific in offering strategic implications, future research in this field may focus on a specific industry sector or individual case, such as pharmaceutical, leather, automotive, chemical etc. To monitor the systematic effect on each functional aspect, such as marketing performance, cost performance, innovation performance, operations performance etc., more performance measuring variables could be introduced. Moreover, the mediation effect of a single variable is applied in the current research, more mediating or moderating variables should be included to check the multiple or parallel effects over the sustainability performance. In this study only four essential SSCM practices- PD, DSC), SSC and RD—were taken into account, it is crucial to consider alternate structures that have more sustainable behaviors in order to properly comprehend SSCM. To achieve rigor in the results, more research in the context of developing nations is needed. This could help environmentalists understand the situation on the ground and formulate plans based on the local circumstances.

7. CONCLUSIONS

The study's conclusions highlight the major advantages of SSCM techniques for the social, economic, and environmental outcomes of Pakistan's textile industry. By implementing sustainable product and process designs, participating in supply-side and demand-side sustainability collaborations, and applying ecologically and socially responsible activities, manufacturing companies in the textile industry can improve their sustainability performance. These results are consistent with other studies and demonstrate the value of SSCM approaches in achieving favorable results in a variety of sustainability-related domains. For instance, enhancing sustainability performance within supply chains can be achieved through implementing sustainable product and process designs, participating in cooperative sustainability projects, and embracing socially and ecologically responsible practices (Pagell & Shevchenko, 2014; Sarkis, 2012).

It has been determined that supply chain ambidexterity plays a critical mediating role in enabling the link between sustainability performance and SSCM techniques. SSCM practices can be leveraged to create sustainable outcomes through supply chain ambidexterity, which is defined as the capacity to simultaneously explore new opportunities and

harness current resources and capabilities. This idea highlights the significance of supply networks' capacity to concurrently seek new opportunities and capitalize on existing skills (Furlan *et al.*, 2023). This emphasizes how vital it is to have a fluid and adaptable supply chain ecosystem so that businesses can successfully adjust to balance conflicting agendas and changing market conditions.

Also, this study advances the theoretical understanding of SSCM by presenting empirical data on the ways in which SSCM practices affect sustainability performance and the mediating function of supply chain ambidexterity. Through the integration of theoretical knowledge with empirical research, this study contributes to growing understanding of the intricate relationship between sustainability results and supply chain management strategies. The study's conclusion emphasizes how important SSCM is in order to boost business sustainability performance in Pakistan's textile industry. By adopting sustainable practices and fostering a flexible and adaptable supply chain ecosystem, businesses can achieve sustainable results and position themselves for long-term success in a highly competitive global marketplace.

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Faria Ahmad is a PhD scholar at the UE Business School, University of Education, Lahore. She holds both a Bachelor's and a Master's degree from COMSATS University Islamabad, Lahore Campus. In addition to her academic pursuits, she is currently serving as an Administrative Officer in the Examination Department at the University of Education, Lahore. Her research interests include supply chain management, sustainability, and digital innovation.

Dr. Shahid Ghafoor Khokhar completed his PhD from Dalian University of Technology, China, with a focus on Operations Management and Logistics & Supply Chain. He has extensive academic experience, having served as a Senior Assistant Professor at Bahria University, Lahore Campus, and as an Assistant Professor at the Institute of Administrative Sciences, University of the Punjab. Dr. Khokhar is currently an Assistant Professor at the University of Education, Lower Mall Campus, Lahore.