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Performance Outcomes of Supply Chain Management Practices: Evidence from Pakistan's Fan Manufacturing SMEs

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ABSTRACT

This study examines the impact of supply chain management practices on the organization's marketing and financial performance. We present the results of a survey conducted with 100 Pakistani fan manufacturing firms. Statistical analysis reveals that the industry struggles with information sharing and joint operations within the supply chain. PLS-SEM analysis of the survey data shows that supply chain performance is significantly correlated with organizational performance. Both customer and supplier relationship management have positive and significant effects on the performance of the supply chain and the organization. However, the impact of customer relationship management is stronger as its path coefficient is greater. Additionally, although internal supply chain management also impacts both supply chain and organization performance positively, the impact is slightly short of being statistically significant. This study contributes to the supply chain management literature by providing empirical evidence from an understudied manufacturing sector from a developing country.

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1. Introduction

Since the beginning of the 20th century, Supply Chain Management (SCM) practices have revolutionized the manufacturing industry. It is now well established that successful SCM is crucial not only to improve performance but also to survive in today's intensely competitive and dynamic market. Through the comprehensive approach of SCM principles, organizations can improve their coordination, integration, and optimization of all processes from sourcing of the raw materials to sale to the consumers. Numerous academic studies on supply chain management demonstrate a statistically meaningful link between the effective implementation of supply chain management practices and an organization's performance in both financial and marketing domains [1]-[4]. In this paper, we aim to study the impact of supply chain management practices on organization's performance on a specific set of family-owned small-sized enterprises from Pakistan.

Within the manufacturing sector of Pakistan's developing economy, fan industry stands out as one

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of the sectors facing crucial challenges in terms of supply chain management and having a remarkable untapped potential in the global markets. Pakistan's fan industry consists of about 450 small and medium-sized enterprises located mostly (about 90%) in Gujrat and Gujranwala districts of Punjab Province [5]. The industry consists mainly of family-owned small businesses except for 6 large companies. The industry report prepared by Lahore University of Management Sciences, indicates that fan manufacturers of Pakistan have seen a rapid growth in years leading up to 2010 but this growth is stunted due to lack of quality domestic raw materials which forces the industry to import raw materials at high prices; shortage of technology upgrades leading to low production capacity and wastage in the materials; electric power supply being inconsistent and expensive compared to global competition; lack of skilled labor [6].

These observations are also confirmed in a more recent report written by the collaboration of the Pakistan Business Council, Engineering Development Board, and the Pakistan Electric Fan Manufacturers Association [7]. Additionally, this latter report indicates that Pakistan's fan production has higher quality compared to fans manufactured by competitors such as China and India, which have a global market share of 77.6% and 0.9% respectively as of 2020. However, due to high production costs and dependence on imported raw materials, Pakistan fan manufacturers are not able to offer competitive selling prices in the global market and their market share has reached only 0.4%, which corresponds to $30.8 million in 2022 exports [8]. The Pakistan Business Council report [7] estimates that there is a $928 million exports potential for Pakistan fan manufacturers only in the European market. As such, improving the performance and competitiveness of Pakistan fan industry in the global market has become an important concern for Pakistan's economy.

This paper aims to illustrate the relationship between various SCM activities and the success of the organization. Additionally, the paper also demonstrates the current state of SCM practices among fan manufacturing SMEs in Pakistan. We present the results of a survey that explores the implementation of various SCM applications and their impact on organizational performance. The significance of this study lies in identifying which SCM applications are lacking in this sector and thus need improvement, as well as how SCM practices impact organizational success. In doing so, this paper contributes to both the existing body of knowledge in SCM literature and the specific context of the Pakistan fan manufacturing industry.

To the best of our knowledge, this is the first and only academic study investigating the extent of SCM practices in the Pakistan fan industry. Most academic research in Pakistan tends to prioritize larger industries like textile and agriculture. The scarcity of academic studies focused on fan industry can be explained through several interrelated factors. Firstly, the sector is dominated by family-owned small and medium-sized enterprises which limits their exposure to academic institutions and collaborative research opportunities. These firms typically lack the resources and incentives to engage in or support academic research initiatives, leading to a deficiency of reliable data and hindering academic studies. [9], [10]. As a matter of fact, during the course of our research, direct attempts to contact these firms and collect data in person proved largely unsuccessful. It was only after the intervention of the local chamber of commerce, which contacted the firms on our behalf, that we were able to obtain the necessary data. Furthermore, the overall size of the industry is relatively small, which limits the potential sample size and may further deter researchers from selecting this sector for empirical studies. Given these challenges, we believe this study makes a meaningful and original contribution to the literature on supply chain management.

The remainder of the paper is structured as follows: In Section 2 we provide a summary of selected literature relevant to our study. In Section 3 we outline the research methodology, and in Section 4 we present the results of the statistical and PLS-SEM analysis results. Finally in Section 5, we sum up the objective and findings of the paper.

2. Related Literature and Hypothesis Development

SCM employs a systematic approach to harmonize the objectives of all participants within a network. This collaborative effort entails synchronizing their activities to optimize profitability across the entire chain. From an individual firm's perspective, effective SCM hinges on managing three critical processes: Supplier Relationship Management (SRM), Customer Relationship Management (CRM), and Internal Supply Chain Management (ISCM) [11]. These processes are interdependent, and their successful coordination is crucial for achieving superior supply chain performance.

2.1 Supplier Relationship Management

Strategic supplier relationship, as defined by GEBN [12] is the long-term collaborative interaction between a firm and its suppliers aiming to utilize their strategic and operational strengths to obtain consistent and significant benefits for all involved parties. Monczka et al. [13] established the attributes of strategic supplier relationships as commitment, reliability and coordination, mutual reliance, communication, the extend and quality of shared information, collaborative planning, conflict resolution and supplier selection processes. Expanding on these notions, Li et al. [14] posited that strategic supplier relationship is one of the SCM practices that can improve competitive advantage and improve organizational performance. This assertion finds support in the survey conducted by Li et al. [1]. Furthermore, Khan and Pillania [15] indicated that strategic supplier relationships can improve the agility of the manufacturing firms and improve organizational performance. According to Seal et al. [16], strategic supply partnerships in manufacturing firms can lead to closer ties, information sharing and research and development collaboration, improving overall cost control. Highlighting the positive impact, Al Abdallah et al. [17] demonstrated that the development of supplier partnerships significantly influences company performance. Additionally, Nenavani and Jain [18] revealed that strategic supplier relationship management enhances supply chain responsiveness. Prajogo and Olhager [19] highlighted the essential importance of information exchange among companies in a supply chain. They find that such sharing significantly improves logistics integration, subsequently enhancing operational performance.

As demonstrated by the above literature, suppliers and the strategic interaction of the focal firm with its suppliers have a major impact on the success of the firm. Hence, selection of the suppliers to work with is equally important. In fact, there are several studies showing the impact of supplier selection on the performance of the firm. Vonderembse and Tracey [20] showed that selecting the suppliers based on delivery reliability, product quality and performance is significantly correlated with the performance of the manufacturer. This paper also shows that joint product design and continuous improvement efforts with the supplier also improve the performance of the focal firm. Another study by Kannan and Tan [21] revealed that supplier selection based on qualitative and usually-considered-unimportant criteria such as strategic commitment or willingness to share information of the suppliers impact the focal firm's performance significantly. Building on the aforementioned literature, we develop the following hypotheses:

- *H1a: SRM practices affect supply chain performance positively.*
- *H1b: SRM practices affect organizational performance positively.*

2.2 Internal Supply Chain Management

Internal Supply Chain Management is the management of all processes that govern the flow of materials, information, and other resources within a firm's own internal operations. The objective of ISCM is to achieve efficiency, cost-effectiveness, and timeliness in all internal processes to support the firm's core business functions. ISCM is necessary to meet the customer demand of which the information is collected through CRM.

Tarigan et al. [22] considered the effect of internal integration on supply chain agility, resilience, partnership and in turn on sustainable advantage. Their study shows that the effect is significant. Modgil and Sharma [23] studied the effect of total quality management on pharmaceutical manufacturing supply chain performance. They considered employee empowerment, training and development among their independent variables and they show the effect is significant. Li et al. [1] contemplated postponement to represent the internal supply chain management processes and measure its impact on the supply chain. Hence, we develop the following hypotheses:

- *H2a: ISCM practices affect supply chain performance positively.*
- *H2b: ISCM practices affect organizational performance positively.*

2.3 Customer Relationship Management

Customer relationship management is a strategic approach to managing all interactions of the supply chain with its customers to gain knowledge about the attitudes, preferences, expectations and behavior of the customers and to ultimately achieve higher customer satisfaction, customer retention and higher profits. This includes practices such as customer segmentation and marketing practices, sales, managing call centers, order management and after-sale services, and information sharing with customers. Mithas et. al. [24] demonstrated that through CRM firms can get to know about their customers at an

improved level and achieve higher customer satisfaction. This study also implies that customer related information exchange between partnering firms in a supply chain also improves the knowledge of the firm about their customers. Chen and Popovich [25] expressed that through CRM firms can attract new customers as well as maintain their current customer base, and as a result achieve continued sales and sustained profitability. Hence, we develop the following hypotheses:

- *H3a: CRM practices affect supply chain performance positively.*
- *H3b: CRM practices affect organizational performance positively.*

As mentioned earlier, the performance of these macro processes is conditional on the successful implementation of the other two. Naturally, without a successful SRM, the firm cannot obtain high quality, low cost and timely delivery of supplies and the production process cannot be performed as efficiently. That in turn affects the quality and price of the product and its delivery to the customers. Conversely, without strategic CRM implementation the firms cannot collect accurate demand information from customers and cannot plan inventories and production accurately which may lead to stock-outs or excess inventories, which in turn will impact the orders from the supplier.

2.4 Supply Chain Performance and Organizational Performance

Improvement in performance requires the measurement of the performance to start with. As supply chain performance has become substantially important for the success of the firms, so has the measurement of this performance. Gunasekaran et al. [26] listed various performance metrics and measures for supply chain performance. Later, Gunasekaran et al. [27] developed a scheme for the measurement of supply chain performance. This framework includes the planning, sourcing, making/assembling and delivering stages of the supply processes. Combining performance metrics from Gunasekaran et al. [26], Beamon [28], and several other highly influential sources from the literature. Shepherd and Günter [29] compiled an extensive list of performance metrics divided into five groups, namely planning, sourcing, making, delivering, and return or customer satisfaction. The authors also indicate whether each of these metrics is qualitative or quantitative and which supply chain performance aspect they measure. These performance aspects are cost, time, quality, flexibility and innovativeness.

Stewart [30] showed that improvement in delivery, flexibility and responsiveness, logistics costs, and asset management performance metrics lead to improved financial outcomes. Li et al. [1] studied the relationship between supply chain management practices, competitive advantage and organization's marketing and financial performance. They found that practices such as strategic supplier relationship management, customer relationship management, level and quality of information-sharing and postponement improve competitive advantage and organizational performance significantly. Ou et al. [2] considered a more complex model and investigate the effect of various supply chain activities on operational and financial performance of the firm. Their study reveals that factors such as customer focus, management leadership, human resource, quality data and reporting, supplier management, design management, process management support each other significantly and directly and indirectly improve organization's performance and customer satisfaction. In another study, a similar yet much simpler model is studied by Truong et al. [4] and reveals that top management support significantly enhances customer focus, supplier management and process control and improvement. These in turn improve the operational performance of the firm.

Hashim et al. [31] investigated the effect of supply chain management practices on the organizational performance with moderating effect of innovation culture in Pakistan textile industry. Parallel to earlier literature, the study finds that supply chain management practices significantly support organizational performance. Additionally, innovation culture has significant positive moderating effect. Another study from another developing economy, India, investigates the impact of supplier relationship management, customer relationship management, goal consistency and information sharing on supply chain performance and firm's financial performance [32]. The authors model supply chain performance as mediating variable and find support for complete mediation. Also, the study shows all supply chain activities included in the study significantly improve both supply chain and firm performance. Additionally, supply chain performance is also found to positively influence the firm's financial performance. Hence, we develop the following hypothesis:

- H4: Supply chain performance affects organizational performance positively.

Based on the brief literature we have listed above; we propose the structural model depicted in Figure 1.

3. Research Methodology

As explained earlier, Pakistan fan manufacturing industry is far from realizing its business potential. To analyze the current practices in various supply chain management fields and their performance impacts on fan manufacturers of Pakistan, we conducted a survey study with the ethics committee approval. The survey is adapted from Li et al. [1] and Al Madi [33]. Note that Al Madi [33] also adapted their survey partly from Li et al. [1]. The relevant questions were adopted directly from the original sources without any modifications. Since this study is exploratory in nature and aims to understand the current state of SCM practices in Pakistan's fan manufacturing industry, using pre-validated and widely accepted survey instruments without modification ensures both reliability and comparability.

The survey consists of 67 five-point Likert scale questions with 1 being "strongly disagree" and 5 being "strongly agree". The sources of the survey questions are written in the leftmost columns of Tables 1-5. The survey was administered using a paper-based questionnaire distributed among fan manufacturers located in the Gujrat and Gujranwala regions of Pakistan. Initially, we personally visited the firms to request their participation and assistance in filling out the surveys. However, this approach proved to be both time-consuming and challenging, as many firms were reluctant to participate, and we lacked prior personal connections within the industry. To address these difficulties, we sought assistance from the Pakistan Electric Fan Manufacturers Association and the Chambers of Commerce of Gujrat and Gujranwala. Officials from these organizations contacted the firms on our behalf, encouraged their participation, and facilitated the distribution of the surveys. We provided printed copies of the questionnaire to the officials, who then distributed them to the firms, collected the completed surveys, and returned them to us.

A total of 120 surveys were randomly distributed among fan manufacturing firms. Of these, 100 completed surveys were collected, resulting in an effective response rate of approximately 83%. All collected responses are included in the subsequent analyses. The data is initially analyzed for descriptive statistics and correlation in SPSS version 25. Here we compute the mean and standard deviation of responses to each question in order to understand the central tendency and the dispersion in each of the supply chain management activities. Then we measure the correlation of question with the performance outcomes to assess individual effect of each activity. In this analysis, the responses to the performance outcomes are averaged and the correlation with this average is computed.

To assess the combined effect of all supply chain management activities on firm performance a reflective structural model is used. This model is analyzed with Partial Least Squares Structural Equation Modeling (PLS-SEM) technique using SmartPLS version 4.1.0.6. PLS-SEM is a variance-based technique widely applied in exploratory research, particularly when dealing with complex relationships among latent constructs, smaller sample sizes, and non-normally distributed data [34]. Given the nature of the research model and the sample size of 100 responses, PLS-SEM is an appropriate and robust analytical method for this study.

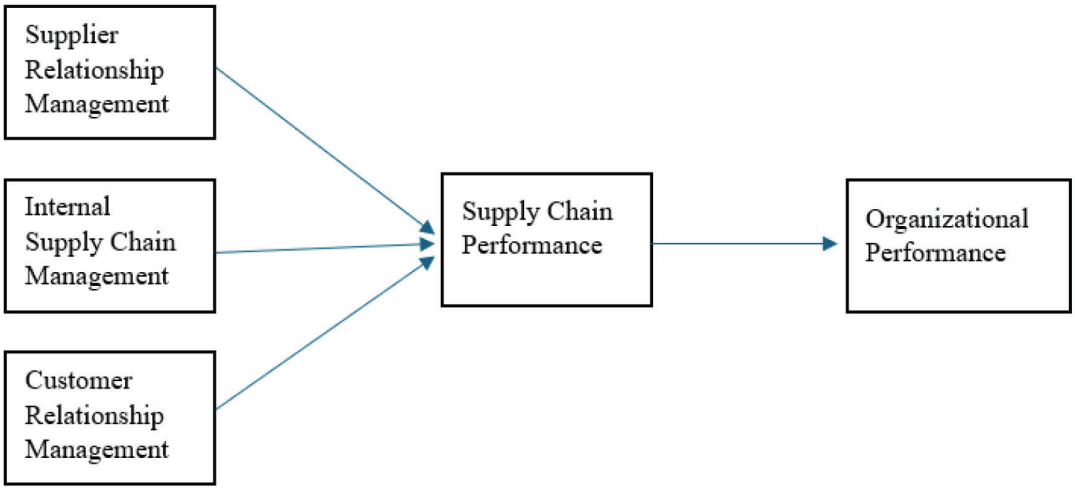

Figure 1. Theoretical model framework. *Source: Authors' own work*

4. Results

4.1 Statistical Analysis

Table 1 displays the mean and standard deviation values for SRM questions. These values indicate that there is strong emphasis on quality, long-term relationships, and joint problem solving in supplier relationships. Also, the extent and the quality of information sharing with the suppliers, along with the involvement of suppliers in the design and planning processes are rather weak compared to other aspects of supplier relationships. Despite most of the firms indicating long-term relationships with their suppliers, the weakness of information sharing, and joint design and planning efforts signals a need for improvement in these aspects. Table 1 also presents the correlations of individual questions with the average performance outcomes. Except for supplier selection criteria price and quality, all indicators have positive and significant correlations with supply chain performance, marketing performance and financial performance.

Table 2 displays the descriptive statistics for internal supply chain management questions. The mean values suggest that practices related to internal relations, information sharing, and employee training are fairly well-adopted, while postponement practices, particularly late-stage postponement, are less common. The standard deviations show variability in the adoption of these practices, particularly for employee training and postponement, indicating different levels of emphasis among these SMEs. All indicators except for postponement have positive and significant correlations with the performance metrics. Especially, internal relations and information sharing practices have strong positive correlations with performance outcomes. Employee quality through training also shows significant positive correlations, indicating that investment in employee training is beneficial for performance. Postponement variables do not correlate well with the performance outcomes. This observation along with the low mean values for these indi-

Table 1. Descriptive statistics for SRM questions

					Correlation with Performance Outcomes		
Source	Code	Item	Mean	Std. Dev.	SCP	MP	FP
Al Madi [33]	SSC1	Supplier selection criteria: quality	4.43	0.62	.370**	.253*	0.187
	SSC2	Supplier selection criteria: lead time	3.83	0.73	.305**	.287**	.337**
	SSC3	Supplier selection criteria: price	3.96	0.94	.077	.056	.079
Li et al. [1]	SSR1	Strategic supplier relationship: solving problems jointly	4.24	0.79	.482**	.500**	.451**
	SSR2	Strategic supplier relationship: helping suppliers improve quality	4.17	0.71	.484**	.403**	.338**
	SSR3	Strategic supplier relationship: Including suppliers into continuous improvement programs	3.75	0.98	.433**	.298**	.208*
	SSR4	Strategic supplier relationship: Including suppliers in planning and goal setting	3.56	1.01	.451**	.401**	.368**
	SSR5	Strategic supplier relationship: Including suppliers in new product development	3.62	1.03	.416**	.502**	.437**
	SSR6	Strategic supplier relationship: Formal supplier development program	3.24	1.06	.416**	.270**	.335**
	SSR7	Strategic supplier relationship: Long-term supplier relationship	4.29	0.70	.309**	.339**	.332**
	ISS1	Information sharing with suppliers: Suppliers' sharing full information about relevant issues	3.95	0.86	.597**	.539**	.509**
	ISS2	Information sharing with suppliers: Information exchange regarding business planning	3.80	0.80	.553**	.453**	.416**
	ISS3	Information sharing with suppliers: Informing each other about relevant events and changes	3.77	0.84	.529**	.399**	.366**
Al Madi [33]	IQS	Quality of information sharing with supplier: Adequacy and reliability	3.64	0.77	.543**	.403**	.365**

*Note. * significant at 5%, ** significant at 1%*

Table 2. Descriptive statistics for ISCM questions

Source	Code	Item	Mean	Std. Dev.	Correlation with Performance Outcomes SCP	MP	FP
Al Madi [33]	IR1	Internal relations: joint determination of objectives	4.08	0.73	.364**	0.123	.221*
	IR2	Internal relations: joint decisions to improve work	4.06	0.89	.501**	.371**	.331**
	IR3	Internal relations: continuous improvement program including all departments	3.97	0.86	.419**	.398**	.296**
	IIS1	Internal information sharing: all departments exchanging information relevant to business planning	4.10	0.90	.412**	.277**	.208*
	IIS2	Internal information sharing: all departments sharing information about relevant events or changes	3.91	0.85	.379**	.266**	.350**
	IIQ1	Quality of internal information sharing: timeliness, accuracy, and completeness	3.77	0.68	.400**	.334**	.375**
	IIQ2	Quality of internal information sharing: adequacy and reliability	3.8	0.72	.329**	.345**	.384**
	EQ1	Employee quality: employee training program for all	3.66	1.04	.533**	.375**	.293**
	EQ2	Employee quality: each employee taking relevant training	3.63	1.05	.562**	.410**	.296**
	P1	Postponement: modular assembly	3.86	0.68	.467**	.312**	.234*
	P2	Postponement: product finalization postponed until customer order	3.02	1.14	-.124	-.158	-.145
	P3	Postponement: product assembly postponed to the last possible link in the supply chain	2.88	1.06	-.031	-.079	-.112

*Note. * significant at 5%, ** significant at 1%*

cators may imply that postponement is not prevalent or suitable for the current business model of these firms.

The descriptive statistics for Customer Relationship Management questions are listed in Table 3. The mean values suggest that practices related to customer interaction and information sharing are well-adopted, while others like inclusion in new product development and sharing private information are less common and have greater variability. All indicators have significant correlation with the supply chain performance. Practices such as those involving interaction, problem-solving, and inclusion in planning show strong positive correlations with SCP, indicating their importance for supply chain performance.

The descriptive statistics of the supply chain performance metrics are presented in Table 4. These mean values indicate that there is room for improvement in the cycle times and lead times of various stages of supply chain operations. Other than short product development cycle time, short process cycle time and short manufacturing lead time questions, all the SCP indicators have significant correlation with the organizational performance metrics. High-capacity utilization and delivery reliability are particularly influential, with very strong positive correlations to both MP and FP, highlighting their importance in overall performance. Reliable supplier delivery and a wide range of products and services also show strong positive correlations with both MP and FP, indicating their importance in maintaining strong operational performance. Short product development cycle time and short process cycle time do not show significant correlations with either MP or FP, suggesting these areas may not be as critical for performance outcomes as the other metrics.

The descriptive statistics for organizational performance metric are presented in Table 5. The mean values for both marketing and financial performance indicators suggest that organizations perceive themselves as performing moderately well. There are positive trends in market share, sales growth, and competitive positioning, but the improvements are not substantial. The relatively modest means, especially in financial performance metrics like ROI growth and profit margins, suggest that while there is progress, there is still room for significant improvement. Organizations may need to refine their strategies to enhance these financial outcomes.

Table 3. Descriptive statistics for CRM questions

Source	Code	Item	Mean	Std. Dev.	Correlation with Performance Outcomes		
					SCP	MP	FP
Li et al. [1]	ISP1	Information sharing with trading partners: informing partners in advance about changing needs	4.29	0.7	.272**	0.065	0.19
	ISP2	Information sharing with trading partners: partners sharing private information	3.66	1.00	.428**	.433**	.313**
	ISP3	Information sharing with trading partners: partners sharing full information about relevant issues	3.92	0.76	.543**	.414**	.344**
	ISP4	Information sharing with trading partners: partners sharing business knowledge of core processes	3.47	1.05	.406**	.422**	.399**
	ISP5	Information sharing with trading partners: mutual sharing of information relevant to planning	4.01	0.78	.500**	.475**	.328**
	ISP6	Information sharing with trading partners: mutual sharing of information about relevant events or changes	3.89	0.74	.501**	.350**	.254*
Al Madi [33]	CR1	Customer relations: frequent customer interaction to improve reliability, responsiveness, and other standards	4.06	0.74	.342**	.198*	0.145
	CR2	Customer relations: frequent evaluation of customer satisfaction	4.25	0.80	.419**	0.139	0.098
	CR3	Customer relations: frequent investigation of future customer expectations	4.36	0.79	.357**	0.08	0.065
	CR4	Customer relations: enabling customers to seek assistance from the firm	3.92	0.90	.510**	.401**	.447**
	CR5	Customer relations: long-term relationship with the customers	4.52	0.59	.426**	.206*	0.189
	CR6	Customer relations: inclusion of customers in planning	3.60	1.10	.353**	.339**	.395**
	CR7	Customer relations: joint problem solving	4.12	0.92	.486**	.352**	.315**
	CR8	Customer relations: inclusion of customers in new product development	3.70	0.96	.417**	.331**	.351**
	CR9	Customer relations: customers helping improve product quality	4.27	0.81	.452**	0.178	0.154
	CR10	Customer relations: formal customer complaints handling system	3.95	0.90	.577**	.485**	.479**
	ISC1	Information sharing with customers: informing customers about relevant issues	3.86	0.92	.629**	.446**	.342**
	ISC2	Information sharing with customers: informing each other about relevant events and changes	3.77	0.86	.615**	.438**	.331**
	IQC1	Quality of information shared with customers: timeliness, accuracy, and completeness	3.87	0.77	.577**	.593**	.472**
	IQC2	Quality of information shared with customers: adequacy and reliability	3.78	0.86	.561**	.485**	.359**

*Note. * significant at 5%, ** significant at 1%*

Table 4. Descriptive statistics for SCP questions

Source	Code	Item	Mean	Std. Dev.	Correlation with Performance Outcomes MP	FP
Al Madi [33]	SCP1	Short product development cycle time	3.08	0.99	0.106	0.129
	SCP2	Good compliance with regulations	4.04	0.75	.301**	.241*
	SCP3	High forecast accuracy	3.69	0.83	.376**	.369**
	SCP4	Short supply chain response time	3.92	0.66	.299**	.258**
	SCP5	Short procurement lead time	3.66	0.81	.421**	.349**
	SCP6	Reliable supplier delivery	4.05	0.61	.389**	.343**
	SCP7	Wide range of products and services	4.28	0.70	.423**	.356**
	SCP8	Conformation to customer specifications	4.35	0.64	.274**	.239*
	SCP9	High-capacity utilization	3.97	0.86	.510**	.427**
	SCP10	Short manufacturing lead time	3.61	0.86	.233*	0.18
	SCP11	High production flexibility	3.77	0.83	.327**	.293**
	SCP12	Short process cycle time	3.40	0.89	0.127	0.105
	SCP13	High scheduling accuracy	3.63	0.72	.452**	.371**
	SCP14	Delivery reliability	3.77	0.78	.483**	.367**

*Note. * significant at 5%, ** significant at 1%*

Table 5. Descriptive statistics for OP questions

Source	Organizational Performance		Mean	Std. Dev.
Li et al [1]	MP1	Marketing performance: increase in market share	3.34	0.95
	MP2	Marketing performance: increase in growth of market share	3.25	0.93
	MP3	Marketing performance: increase in sales growth	3.44	0.98
	MP4	Marketing performance: improved competitive position in the market	3.46	0.91
	FP1	Financial performance: increased return on investments	3.19	0.92
	FP2	Financial performance: increased growth of return on investments	3.21	0.88
	FP3	Financial performance: increased profit margin	3.16	0.88

4.2 Structural Model Analysis

4.2.1 Reliability and Validity of the Measurement Model

We start by presenting the reliability and validity analysis. Table 6 displays the reliability analysis results of the initial model which contains all the indicators listed in section 4.1. Here for model evaluation and modification, the criteria and procedures recommended by Hair et al. [34] are used. Unfortunately, the initial model containing all indicators does not pass the construct validity test since all but one of the AVE values is less than 0.5.

To achieve construct validity in the model, firstly the indicators with less than 0.4 loading value on their respective latent variables are removed from the measurement model. Then, out of the indicators with loading values between 0.4 and 0.7, the ones with the smallest loading values are removed from the model one by one until the respective construct reaches an AVE value greater than 0.5. Once the desired validity level is achieved, the remaining indicators are left in the model even if their loading value is less than 0.7. These loading values (along with all cross-loading values) can be seen in Table 10. The reliability analysis of the reduced measurement model is presented in Table 7.

Next, discriminant validity of the model is assessed, first through Fornell-Larcker criterion displayed in Table 8. According to Fornell-Larcker criterion, a good discriminant validity is achieved when the diagonal values are higher than the values in the row and column corresponding to that diagonal. In other words, discriminant validity is achieved if the square root of the AVE value for a variable is higher than its correlation with other variables. This criterion is satisfied for ISCM and OP. The correlations

Table 6. Validity and reliability measures for the initial model with all indicators

	Cronbach's α	Composite reliability (ρ_a)	Composite reliability (ρ_c)	Average variance extracted (AVE)
SRM	0.878	0.9	0.899	0.403
ISCM	0.846	0.884	0.872	0.409
CRM	0.914	0.925	0.926	0.393
SCP	0.858	0.896	0.888	0.398
OP	0.926	0.938	0.941	0.695

Table 7. Validity and reliability measures for the reduced measurement model

	Cronbach's α	Composite reliability (ρ_a)	Composite reliability (ρ_c)	Average variance extracted (AVE)
SRM	.891	.899	.910	.505
ISCM	.879	.886	.903	.509
CRM	.917	.922	.929	.503
SCP	.877	.879	.901	.504
OP	.926	.938	.941	.695

between CRM and SRM (0.792); CRM and SCP (0.753) are higher than the square root of their AVE values. This indicates potential conceptual overlap between these constructs. While this does not necessarily invalidate the measurement model, it indicates that CRM and SRM, as well as CRM and SCP, are closely related in the studied context of Pakistan's fan manufacturing SMEs, where supplier and customer collaboration may be highly intertwined in practice.

The Heterotrait-Monotrait ratio (HTMT) is examined next to further evaluate discriminant validity. As shown in Table 9, all HTMT values are less than 0.90 threshold value recommended by Henseler et al. [35]. Here we adopt a threshold of 0.90 instead of the more conservative 0.85, due to the conceptual similarity among the constructs in our model, SRM, CRM and ISCM, which include questions related to communication and collaboration.

Finally, cross-loadings are also evaluated for discriminant validity. The cross-loadings displayed in Table 10, reveal that each indicator loaded highest on its respective construct, supporting sufficient discriminant validity.

Table 8. Discriminant Validity - Fornell - Larcker Criterion

	CRM	ISCM	OP	SCP	SRM
CRM	0.709				
ISCM	0.690	0.714			
OP	0.603	0.451	0.834		
SCP	0.753	0.625	0.570	0.710	
SRM	0.792	0.709	0.590	0.703	0.711

Table 9. Heretotrait monotrait values

	SRM	ISCM	CRM	SCP	OP
SRM					
ISCM	0.789				
CRM	0.871	0.747			
SCP	0.777	0.711	0.826		
OP	0.648	0.494	0.65	0.614	

Table 10. Cross loadings of the reduced measurement model

	SRM	ISCM	CRM	SCP	OP
SSR1	0.74	0.545	0.672	0.475	0.501
SSR2	0.661	0.495	0.522	0.492	0.397
SSR3	0.687	0.54	0.529	0.464	0.275
SSR4	0.695	0.408	0.557	0.429	0.402
SSR5	0.631	0.41	0.492	0.385	0.494
SSR6	0.616	0.49	0.369	0.367	0.298
ISS1	0.808	0.594	0.691	0.602	0.549
ISS2	0.788	0.534	0.626	0.533	0.452
ISS3	0.716	0.538	0.534	0.58	0.401
IQS	0.741	0.473	0.585	0.584	0.409
ISCM1	0.324	0.656	0.24	0.371	0.172
ISCM2	0.475	0.792	0.49	0.477	0.373
ISCM3	0.537	0.709	0.529	0.409	0.372
IIS1	0.432	0.733	0.425	0.444	0.252
IIS2	0.454	0.64	0.413	0.394	0.308
IIQ1	0.49	0.645	0.48	0.371	0.371
EQ1	0.623	0.79	0.614	0.501	0.354
EQ2	0.676	0.763	0.683	0.544	0.38
P1	0.484	0.673	0.471	0.456	0.295
ISP2	0.5	0.425	0.681	0.461	0.409
ISP3	0.561	0.488	0.768	0.544	0.41
ISP4	0.528	0.384	0.663	0.411	0.422
ISP5	0.543	0.421	0.735	0.508	0.438
ISP6	0.529	0.498	0.716	0.566	0.33
CR4	0.606	0.541	0.715	0.525	0.434
CR7	0.561	0.487	0.587	0.479	0.343
CR8	0.46	0.333	0.535	0.389	0.358
CR10	0.638	0.549	0.779	0.586	0.504
ISC1	0.542	0.584	0.732	0.63	0.424
ISC2	0.576	0.577	0.746	0.627	0.417
IQC1	0.608	0.47	0.759	0.568	0.572
IQC2	0.643	0.521	0.763	0.566	0.491
SCP3	0.594	0.48	0.588	0.78	0.396
SCP4	0.51	0.461	0.562	0.727	0.302
SCP5	0.476	0.35	0.52	0.735	0.409
SCP6	0.421	0.423	0.459	0.688	0.392
SCP7	0.478	0.54	0.439	0.645	0.415
SCP8	0.405	0.531	0.448	0.677	0.278
SCP9	0.514	0.468	0.533	0.718	0.499
SCP13	0.571	0.399	0.6	0.717	0.441
SCP14	0.489	0.368	0.625	0.695	0.463
FP1	0.487	0.398	0.515	0.513	0.889
FP2	0.515	0.373	0.489	0.478	0.866
FP3	0.391	0.265	0.337	0.278	0.673
MP1	0.551	0.391	0.553	0.487	0.866
MP2	0.439	0.361	0.5	0.506	0.883
MP3	0.528	0.432	0.558	0.54	0.872
MP4	0.525	0.385	0.527	0.459	0.764

Taken together, the Fornell-Larcker criterion, the HTMT ratio and the cross-loadings evaluation results support the presence of acceptable discriminant validity in the measurement model, despite some conceptual proximity between constructs such as CRM, SRM, and SCP, which may reflect the integrated nature of supply chain collaboration in the studied industry context.

Next, we check for collinearity among the indicators and the constructs. Table 11 represents the VIF values of the outer model while Table 12 represents the VIF values for the inner model. As all VIF values are less than the threshold of 5, there is no indication of critical collinearity in the model [34].

4.2.2 Model Evaluation

The explanatory power of the model is assessed using R^2 values. As shown in Table 13, CRM, ISCM, and SRM explained 60.6% of the variance in SCP, while SCP explained 32.4% of the variance in OP. These values indicate moderate to substantial explanatory power [34].

Next, we calculate the effect sizes or f^2 values to assess the relative contribution of each exogenous construct to the endogenous variables. The results are exhibited in Table 14. The path from CRM to SCP showed a medium effect size indicating that customer relationship management plays a moderately strong role in enhancing supply chain performance. The SRM→SCP path produced a small effect suggesting supplier relationship management has a modest but meaningful influence on supply chain outcomes. Conversely, ISCM → SCP path demonstrated a negligible effect, indicating that internal supply chain practices contribute only marginally to supply chain performance in this context. Most notably, SCP exhibited a large effect on OP, affirming the critical mediating role of supply chain performance in linking SCM practices to improved organizational outcomes. These findings support the theoretical proposition that while CRM and SRM enhance performance, it is the effectiveness of the supply chain itself that most directly drives organizational success.

Finally, we study the predictive relevance of the model. Table 15 displays the Q^2 values of the model which are obtained through blindfolding process. According to [34], Q^2 values must be greater than 0 and the higher the Q^2 values are, the more predictive strength the model has. This condition is satisfied as Q^2 values are greater than 0. We also present the predictive power of the indicators in Table 16. Here,

Table 11. Collinearity statistics (VIF) - Outer model

Indicator	CR10	CR4	CR7	CR8	EQ1	EQ2	FP1	FP2	FP3	IIQ1	IIS1	IIS2
VIF	2.392	1.973	1.553	1.597	4.531	4.428	3.647	3.169	1.654	1.548	2.248	1.649
Indicator	IQC1	IQC2	IQS	ISC1	ISC2	ISCM1	ISCM2	ISCM3	ISP2	ISP3	ISP4	ISP5
VIF	2.826	2.549	2.526	3.513	3.753	2.308	2.87	1.887	2.529	2.981	1.998	2.852
Indicator	ISP6	ISS1	ISS2	ISS3	MP1	MP2	MP3	MP4	P1	SCP13	SCP14	SCP3
VIF	3.211	2.444	2.633	2.694	3.069	3.464	3.144	1.894	1.538	2.208	2.076	2.406
Indicator	SCP4	SCP5	SCP6	SCP7	SCP8	SCP9	SSR1	SSR2	SSR3	SSR4	SSR5	SSR6
VIF	2.2	2.281	2.168	2.01	2.203	1.855	2.083	1.849	2.301	2.902	2.157	1.919

Table 12. Collinearity statistics (VIF) - Inner model

	VIF
CRM -> SCP	2.945
ISCM -> SCP	2.207
SCP -> OP	1.000
SRM -> SCP	3.11

Table 13. Coefficient of determination

	R-square	R-square adjusted
OP	0.324	0.318
SCP	0.606	0.593

Table 14. Effect sizes of the model

Predictor → Outcome	f^2 Value	Interpretation
CRM → S 0CP	0.201	Medium effect
ISCM → SCP	0.019	Very small effect
SRM → SCP	0.043	Small Effect
SCP → OP	0.480	Large effect

Table 15. Predictive relevance of the model

	Q^2predict	RMSE	MAE
OP	0.347	0.826	0.668
SCP	0.562	0.673	0.538

only one of the Mean Absolute Error (MAE) values for the PLS-SEM model is slightly greater than that of the naïve linear Regression Model (LM) benchmark while all other MAE and RMSE (root mean square error) values are smaller than the LM benchmark and the Indicator Averages (IA) benchmark. Hence, following Hair et al.'s [34] recommendation we can conclude that the model has high predictive power.

4.2.3 Path Analysis

After the evaluation of the model, we proceed to the path analysis. The measurement model with 48 indicators and their outer loading values are shown in Figure 2.

In order to test the statistical significance of the path coefficients of this model we ran a bootstrapping analysis of 10000 samples. The analysis results for the direct effects and hypothesis conclusions are presented in Table 17. We conclude that hypotheses H1a, H3a and H4 are significantly supported by the data. Hypothesis H2a is directionally supported however the path coefficient is not statistically significant. In other words, SRM and CRM practices significantly improve SCP, and SCP improves OP. Bootstrapping results are also displayed in Figure 3.

Table 18 shows the results for the indirect effects. Hypotheses H1b and H3b are significantly supported by the data. The effect of ISCM on OP is directionally conforming to hypothesis H2b, yet the p-value slightly exceeds 5%.

Table 16. Predictive power of the indicators

	Q^2predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE	IA_RMSE	IA_MAE
FP1	0.250	0.800	0.634	0.992	0.803	0.924	0.706
FP2	0.242	0.771	0.621	0.986	0.788	0.885	0.713
FP3	0.126	0.833	0.668	0.953	0.772	0.891	0.703
MP1	0.286	0.804	0.651	0.968	0.752	0.951	0.801
MP2	0.227	0.819	0.667	1.060	0.835	0.931	0.753
MP3	0.287	0.831	0.705	1.134	0.934	0.985	0.846
MP4	0.250	0.797	0.674	0.832	0.664	0.920	0.790
SCP13	0.340	0.588	0.479	0.735	0.574	0.724	0.638
SCP14	0.324	0.642	0.524	0.765	0.612	0.781	0.663
SCP3	0.358	0.665	0.522	0.842	0.665	0.83	0.707
SCP4	0.305	0.555	0.440	0.657	0.525	0.666	0.484
SCP5	0.243	0.704	0.551	0.782	0.629	0.810	0.700
SCP6	0.200	0.548	0.428	0.783	0.591	0.613	0.403
SCP7	0.234	0.612	0.493	0.800	0.614	0.700	0.610
SCP8	0.206	0.574	0.463	0.687	0.538	0.644	0.577
SCP9	0.289	0.727	0.591	0.944	0.731	0.862	0.669

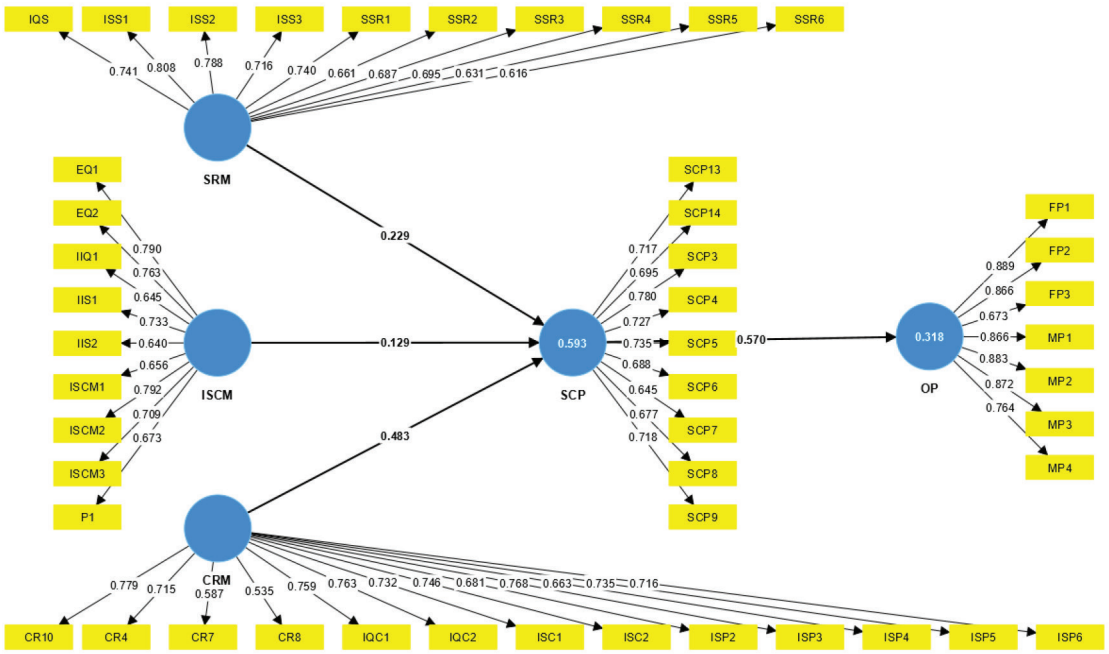

Figure 2. Outer loadings of the structural model

Table 17. Bootstrapping analysis results for the direct effects

		Original Path Coeff.	Mean Path Coeff. from Bootstrapping	Std. Dev.	T statistic	One-sided P value	Conclusion
H1a	SRM→SCP	0.229	0.237	0.128	1.79	**0.037**	*Supported*
H2a	ISCM→SCP	0.129	0.127	0.088	1.465	0.071	*Weakly supported*
H3a	CRM→SCP	0.483	0.485	0.11	4.388	**0.000**	*Supported*
H4	SCP→OP	0.57	0.578	0.059	9.593	**0.000**	*Supported*

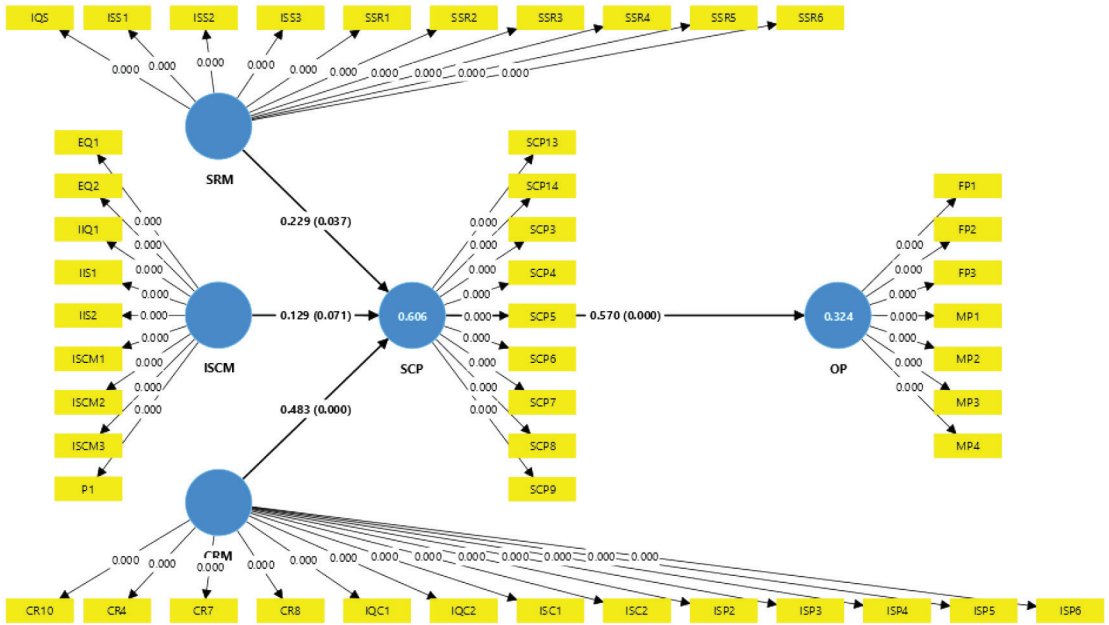

Figure 3. PLS-SEM bootstrapping results. (Path coefficients are written on paths along with P-values in parentheses. R-squared values are written on dependent variables.)

Table 18. Bootstrapping analysis results for the indirect effects

		Original Path Coeff.	Mean Path Coeff. from Bootstrapping	Std. Dev.	T statistic	One-sided P value	Conclusion
H1b	SRM→OP	.130	.138	.077	1.686	**0.046**	*Supported*
H2b	ISCM→OP	.073	.073	.052	1.424	0.077	*Weakly supported*
H3b	CRM→OP	.275	.280	.069	3.963	**0.000**	*Supported*

5. Discussions and Conclusion

In this paper we analyze the effects of SCM practices on the financial and marketing performance of the organization through a survey study conducted with Pakistan fan manufacturing SMEs. This paper is the first to scientifically analyze the present state of the Pakistan fan industry in terms of supply chain management applications. We show that both SRM and CRM meaningfully improve supply chain and organizational performance. However, the impact of CRM is stronger than SRM. ISCM also affects the performance variables positively, yet the effect is not significant. The correlation between supply chain performance and organization performance is also strong and significant. Theoretically, the study contributes to the literature by offering evidence from a previously unexplored industrial context and highlights that external relationship management—particularly with customers—plays a more critical role in driving performance than internal coordination, especially in resource-constrained environments.

More importantly, this study highlights critical weaknesses in information sharing and collaboration across supply chain partners within the fan industry of Pakistan. Several structural barriers commonly observed across Pakistan's all manufacturing sectors may help explain the limited information sharing and collaboration in the fan industry. Technological barriers, such as high IT costs and limited financial resources, restricted digitalization, and poor information quality, are widespread and continue to constrain effective communication among supply chain partners, even in relatively advanced sectors like textiles and auto parts [36]-[39]. In addition, persistent trust and communication issues, including low inter-firm trust and inadequate collaborative dialogue, reduce firms' willingness to share critical information [36], [38], [40]. Organizational and cultural resistance, such as unsupportive work environments, limited openness to change, and conflicting managerial perspectives on the value of collaboration, further hinder joint initiatives [36], [40], [41]. Lastly, limitations in logistics capabilities and the shortage of qualified personnel undermine the operational reliability needed for effective coordination [37]. While these challenges are not exclusive to the fan industry, they reflect broader systemic issues that likely also shape the collaboration and information-sharing deficiencies observed in this sector.

To address these issues, several practical steps can be taken by firms and supported by industry stakeholders. However, the feasibility of these interventions must be considered within the constraints of the sector. Practical implications that derive from the results are as follows: first, firms should prioritize supplier selection criteria that emphasize quality and lead time, while also fostering strategic relationships to enable joint problem-solving. However, limited trust and fear of dependency on a few suppliers may pose challenges, requiring formal agreements and long-term commitment strategies. Second, organizations should invest in cultivating a collaborative internal culture and provide employee training aligned with supply chain goals. Yet, financial and managerial resource constraints could limit the feasibility of extensive training programs. Third, actively involving customers in product development and quality improvement initiatives can align offerings with market expectations. Nevertheless, a lack of structured customer relationship management systems and low digital maturity could restrict systematic engagement efforts. Fourth, timely, accurate, and comprehensive information sharing both internally and externally is critical for operational excellence. However, ICT infrastructure limitations and competitive secrecy among SMEs may undermine efforts to establish transparent information flows. Finally, emphasizing reliable supplier delivery, accurate forecasting, and flexible production capabilities is essential for sustained performance. Nonetheless, frequent supply chain disruptions, resource shortages, and limited forecasting capabilities in SMEs remain significant barriers.

Given the structural limitations faced by SMEs, support from external stakeholders is essential to drive change at large scale. Higher-level institutions such as chambers of commerce, industry associations, and SME support agencies must play a proactive and facilitative role in enabling supply chain improvements. These entities are uniquely positioned to address systemic constraints that individual firms may be unable to tackle alone. Specifically, they can provide shared infrastructure such as centralized digital platforms for supplier and customer engagement, collaborative forecasting tools, or standardized quality databases that reduce individual technology investment burdens. They can also design incentive schemes, including financial subsidies, tax breaks, or co-funded technology grants, to encourage SMEs to invest in collaboration-enhancing practices such as supplier development programs, CRM systems, or internal training initiatives. Furthermore, these institutions should host collective training programs tailored to the specific needs of the sector, focusing on areas such as forecasting, information sharing, quality management, and customer relationship development. This would help build a baseline of skills and awareness across the industry.

Future research could expand on this work by conducting longitudinal studies to observe the evolution of SCM practices over time, especially as digital adoption increases in emerging markets. Comparative studies across other sectors or regions within Pakistan may also help generalize these findings or highlight sector-specific patterns. Additionally, incorporating behavioral and cultural factors, such as trust, informality, or managerial attitudes, could offer deeper insight into why certain practices are more successful than others in SME environments.

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