



Role of Sustainable Manufacturing Practices, Competitive Capabilities, and Sustainable Performance in the SME Sector of Pakistan

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ABSTRACT

The inclusion of sustainable practices in the manufacturing segment has gained importance in protecting the environment from degradation by transforming practices in SMEs. This research investigates the link between sustainable manufacturing practices (SMP) and sustainable performance (SP) of small and medium-sized enterprises (SMEs) while examining the mediating role of competitive capabilities. This study adopts a quantitative research approach and employs a survey method to gather data from managers and employees of Pakistani SMEs with a sample of 420. Data was analyzed using Smart PLS 4.0. As per the results, sustainable manufacturing practices (SMP) significantly improve the sustainable performance of SMEs, while competitive capabilities act as a vital mediating factor between SMP and SP. SMEs must execute SMP to preserve the environment. Moreover, the government needs to develop strategies for SMP implementation in SMEs by providing training and development opportunities to initiate programs. These initiatives can help SMEs in the adoption of sustainable practices to reduce, recycle, and reprocess in order to minimize waste in the manufacturing process.

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INTRODUCTION

Over the last few years, there has been an increase in the significance of sustainability in the manufacturing segment. It is expected from the manufacturers to prioritize social responsibility measures to care for the environment. As there has been an increase in environmental issues like pollution and climate change. Sustainable development has the potential to address all these problems. Joint efforts are needed from the different stakeholders including business organizations, and government for the attainment of sustainable development (Hashmi & Alam, 2019). Responsibilities of businesses towards the society

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and environment are being highlighted through the implementation of sustainable practices as well as generating profit side by side (Gupta & Kumar, 2013).

According to Aboelmaged (2018), sustainable practices are the inclusion of green practices in manufacturing to ensure sustainability in all organizations including large and small. Likewise, Agan et al., (2013) asserted that exploration of SMP implementation needs to be explored in SMEs. Furthermore, Chen et al., (2014) delineated that instead of having financial, HR, and technological constraints SMEs can achieve sustainability goals. Thus, keeping in view the abovementioned elaboration we are focusing on assessing in what way implemented SMP in SMEs can affect the SP.

As per Garetti et al., (2012) sustainable manufacturing, shows the ability of the enterprise to intelligently utilize natural resources so that all economic, social, and environmental problems can be addressed. As a result, the environment will be protected. Accordingly, Jakob et al., (2013) elaborated that the manufacturing of goods seems to be the potential factor causing 20 percent of CO₂ emissions. Likewise, globally 20 percent of CO₂ emissions come from manufacturing goods. Thus, the inclusion of SMP is important for creating awareness about the idea of sustainability so that it can contribute towards the attainment of sustainable development goals.

In addition, due to the use of conventional practices by manufacturing firms, the environment is affected negatively (Huang & Morawska, 2019). Therefore, the concept of sustainable manufacturing is gaining attention from policymakers and academician and their interest has been growing day by day over the last few years (Aboelmaged, 2018). Previous work shows that various practices including sustainable (green) practices affect the environment. However, this area has been neglected (Zambrano-Monserrate et al., 2020). According to Behjati (2017), the contribution of manufacturing SMEs to air pollution is almost 64 percent. Surprisingly only 0.4 percent follow the guidelines for environmental protection.

For sustainable manufacturing, SMEs need to follow the regulations developed globally to protect environment and take complete responsibility to use green practices to ensure less release of waste caused by the production (Thanki et al., 2016). Hence, limited research has been conducted on this topic, especially in underdeveloped countries like Pakistan. Since the effect of SMP is largely not explored. In the last few years, due to climate change and environmental degradation, there have been many challenges the world is facing. This challenge leads to a question that needs to be examined including:

- Does SMP affect SP in SMEs?
- Do competitive capabilities mediate the link between SMP and SP in SMEs?

Consequently, this research aims to assess the impact of sustainable manufacturing practices (SMP) on the sustainable performance (SP) of SMEs, keeping in mind the effect of competitive capabilities as a mediator between SMP and SP. Hence, a gap still exists in understanding the efficient implementation of sustainable manufacturing practices (SMP) on SMEs' sustainable performance (Zambrano-Monserrate et al., 2020). Following are the research objectives proposed for this research including the assessment of the impact between SMP and SP along with mediating role of competitive capabilities such as product cost, product quality, product delivery and product flexibility.

LITERATURE REVIEW

Natural Resource-Based View

NRBV is the expansion of a resource-based view that stresses the significant part of resources in achieving and maintaining competitive advantages. For instance, the reduction of waste and pollutants can decrease the cost of manufacturing and enhance productivity. Moreover, NRBV focuses on addressing stakeholder pressures and integrating them into structural practices and approaches to attain sustainable development. Countless academics have applied this theory within the SME framework. Likewise, according to Wu et al., (2019), SP and efficiency can be improved by the adoption of environmental innovation in SMEs' business strategies. The theory posits that natural resources serve as foundational elements in shaping societal development and sustainability. Just as ecosystems rely on a delicate balance of resources to thrive, human societies depend on the responsible management and utilization of natural resources for their economic, social, and environmental well-being.

Sustainable Manufacturing Practices

According to Garetti et al., (2012), sustainable manufacturing denotes the firm's capability to intelligently utilize natural resources so that all economic, social, and environmental problems can be addressed. Key Sustainable Manufacturing Practices (SMP) encompasses the execution of the 3Rs principles including reduction, reuse, and recycling of waste while minimizing the use of dangerous substances through utilization of green energy (Vanalle et al., 2017). Correspondingly, Chin et al., (2015) asserted that SMP is a procedure to reduce, reuse, recycle, and team up to regain product components. Subsequently, reducing the consumption of resources during the process of manufacturing can lead to a better influence on the environment.

Sustainable Performance

To analyze the sustainable performance of SMEs, in the extant literature, studies are focused on investigating sustainability related to large organizations, with relatively less consideration given to smaller enterprises (Johnson & Schaltegger, 2016). Therefore, investigating various aspects of manufacturing practices and their impact on social, economic, and environmental factors in SMEs leads to advancing the United Nations' sustainable development goals (Wu et al., 2019). The effects of green practices, lean methodologies, inventions, and other facilitators of sustainable performance in SMEs need to be explored further (Dey et al., 2021). Prieto-Sandoval et al., (2018) demarcated that further studies are needed to examine the association between circular economy implementation, sustainable practices, and sustainable development in SMEs. However, while developing SMEs can extensively contribute to GDP nationally, yet can have an adverse environmental impact due to a lack of naturally sustainable approaches in their strategies (Rita et al., 2018).

The SP perspective, in comparison to the conventional performance viewpoint, encompasses the following indicators: economic, social, and environmental. In building a comprehensive structure for business operations and meeting the expectations of the stakeholders' economic performance holds significant prominence (Gupta et al., 2021). The social element of supportability integrates various pointers which incorporate open positions (work), fairness, neediness, human personal satisfaction, normal driving time, political steadiness, well-being, prosperity (well-being changed future), legitimate perspectives, and social capital (Abid et al., 2022). Concerning safety and human dignity, including employees' desires to follow what is seen as appropriate following factors of measurements are associated with social SP involve enhanced responsibility (Habidin et al., 2015).

Competitive Capabilities

A firm engages in a series of organizational procedures and values to position its resources effectively to achieve strategic objectives and competitive capabilities (Kogut & Zander, 1992). Firms develop capabilities accidentally rather than in proper planning (Collins & Porras, 1994). But mostly learned from their successes and failures (McGrath et al., 1995). The pathways to becoming a competitor in the market and enhancing profitability primarily revolve around two strategies: cost leadership and differentiation of products (Porter, 1980).

SMP and Sustainable Performance

According to research studies, SMP significantly improves economic, social, and environmental performance (Afum et al., 2020; Hong et al., 2018). In addition, a significant link exists between sustainable practices and SP. Furthermore, Zailani et al., (2019) specified that companies' integration of environmentally sustainable practices, such as focusing on packaging and waste reduction, results in favorable outcomes. Besides, Abdul-Rashid et al., (2017) found that SMP positively affects SP in the Malaysian manufacturing sector. Likewise, Li et al., (2020) shared similar results in Chinese-intensive energy-based firms related to recycling efforts and SP. Therefore, sustainability practices can help address sustainability issues (Yildiz Çankaya & Sezen, 2019) and improve sustainable manufacturing practices.

Competitive Capabilities and Sustainable Performance

Viewing the competitive capabilities, allows firms to maintain a competitive advantage over others while focusing on addressing issues related to environmental, social, and economic levels. However, competitive capabilities can aid in improving SP. In addition, firm performance can be affected substantially

when environment-friendly green practices are implemented such as recycling and lessening the wastage of resources (Li et al., 2020). This can be possible through the adoption of sustainable practices to ensure the robustness of firms' working, procedures, and operations to resolve environmental, financial, and societal issues. According to Hong et al., (2018), competitive capabilities and SP have been linked especially when sustainable practices are adopted in the manufacturing, procurement, and distribution of products. Therefore, competitive capabilities such as product cost, quality, delivery, and flexibility can be crucial factors in sustainability practices and performance. So, strong capabilities can help improve sustainable performance (Li et al., 2020).

SMP and Competitive Capabilities

SMP incorporates various initiatives and strategies to optimize resources and implement green strategies to lessen the environmental effects on the manufacturing side. Hence, gaining a competitive edge over others. Moreover, Chin et al., (2015) elaborated that SMP refers to decreasing, recycling, and reutilizing resources for product recovery to minimize resource consumption in manufacturing. Similarly, a positive link exists between SMPs and SP in the manufacturing sector of Pakistan (Abdul-Rashid et al., 2017). On the other side, the importance of SMPs can be observed in improving sustainable development (Prieto-Sandoval, 2018). It not only boosts the preservation of the environment but also improves operational efficiency and product quality improves the competitive position in the market. Hypotheses are shown in table 1.

Table 1
Research Hypotheses

Hypotheses	Effect Description
H ₁	SMP positively influences sustainable performance.
H ₂	SMP positively influences product cost.
H ₃	SMP positively influences product flexibility.
H ₄	SMP positively influences product quality.
H ₅	SMP positively influences product delivery.
H ₆	Product cost capabilities mediate the link between SMP and sustainable performance.
H ₇	Product flexibility capabilities mediate the link between SMP and sustainable performance.
H ₈	Product quality capabilities mediate the link between SMP and sustainable performance
H ₉	Product delivery capabilities mediate the link between SMP and Sustainable performance.

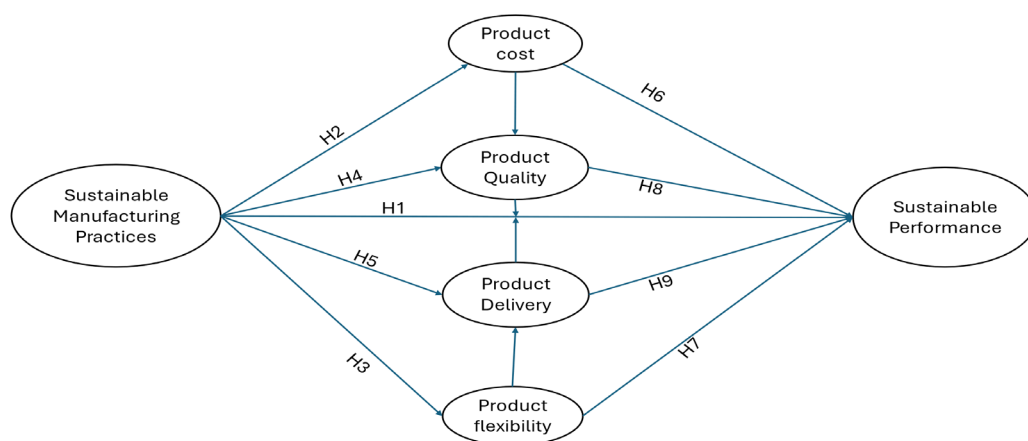


Fig. 1. Conceptual Framework

METHODOLOGY

In this study, the quantitative approach was adopted by using a cross-sectional design. For data collection, the survey method was used to gather data from the managers and employees of Pakistani SMEs specifically the manufacturing sector with a sample of 420. A structured questionnaire with Likert-

scale items was used to measure the variables identified in the conceptual model. Partial least squares-structural equation modeling (PLS-SEM) was used for analysis. The reason for choosing PLS-SEM is that it provides flexibility in the development of the model and is best suited for research with small sample size and the assumption that the normal distribution of multivariate data is not present in the data set, and the main goal is anticipation, and target constructs need to be explained (Hair et al., 2012; Kura et al., 2016). This study used convenience sampling to collect data from the target population based on availability.

Measures

To examine the SMP, SP, and competitive capabilities, items were adopted from the established scale as shown in table 2. Responses of the participants were recorded on a scale of 5 points, starting from 'strongly disagree=1 to strongly agree=5'. Primary data was obtained from the respondents (Bell, 2014; Thornhill et al., 2009). 500 questionnaires were distributed to the respondents out of which 420 questionnaires were useful for analysis.

Table 2
Summary of Research Instrument

Variables	Authors / Source	No. of items	Scale
Sustainable Manufacturing Practices		6	1-5
Sustainable performance	Ali et al., (2021)	11	1-5
Competitive capabilities		14	1-5

RESULTS & FINDINGS

Respondents Profile

Profiles of the respondents are presented below in Table 3. Most of the respondents were female. In terms of education, more than half of the respondents (55.9 %) are graduates, followed by postgraduate degrees.

Table 3
Respondent Profile

Demographic Characteristics		Frequency	Percentage
Gender	Female	290	69.04%
	Male	130	30.9%
Age	18 to 24	195	46.42%
	25 to 34	210	50%
	35 to 44	15	3.57%
	45 and above	0	0
Education	Bachelors	235	55.9%
	Masters	180	42.8%
	PHD	5	1.19%

Validity and Reliability Analyses

Table 4
OL, AVE, and CR for all Constructs

Constructs	Measurement items	Outer Loadings	AVE	CR	
Sustainable Manufacturing Practices	SMPs 1	0.603	0.415	0.809	
	SMPs 2	0.711			
	SMPs 3	0.582			
	SMPs 4	0.597			
	SMPs 5	0.711			
	SMPs 6	0.649			
Competitive Capabilities	PC1	0.697	0.568	0.798	
	PC2	0.781			
	PC3	0.780			
	PD1	0.842	0.723	0.839	
	PD2	0.858			
	PF1	0.648	0.526	0.814	
	PF2	0.825			
	PF3	0.797			
	PF4	0.609			
	Sustainable Performance	PQ1	0.790	0.611	0.886
		PQ2	0.818		
		PQ3	0.780		
		PQ4	0.848		
		PQ5	0.661		
Sustainable Performance	ES1	0.749	0.464	0.896	
	ES2	0.696			
	ES3	0.684			
	ENS1	0.709			
	ENS2	0.594			
	ENS3	0.597			
	ENS4	0.694			
	SS1	0.747			
	SS2	0.719			
SS3	0.594				

The function of the outer loading is to indicate a correlation between the measurement item and its constructs which is associated with it. A value that is close to 1 indicates good correlations. SMP correlation is moderate to good because it ranges from 0.582 to 0.711. Outer loading for the competitive capabilities items is high, which indicates a strong correlation. Sustainable performance outer loading also ranges from 0.594-0.749 therefore it shows a moderate to strong correlation. Whereas the AVE of sustainable manufacturing practices and sustainable performance is 0.415 and 0.464 respectively. Which is below 0.5 which shows that the construct does not define the majority of variance in its indicator. AVE for competitive capabilities is above 0.5. CR examines the construct’s reliability. Its value above 0.7 is acceptable. CR of Sustainable manufacturing practices and competitive capabilities is more than that therefore it is acceptable. CR of sustainable performance is also high which indicates strong internal consistency also. Below figure 2 shows that key construct values of R-square are satisfactory high which shows the suitability of the chosen model. The figure below displays the path values for all the constructs and items.

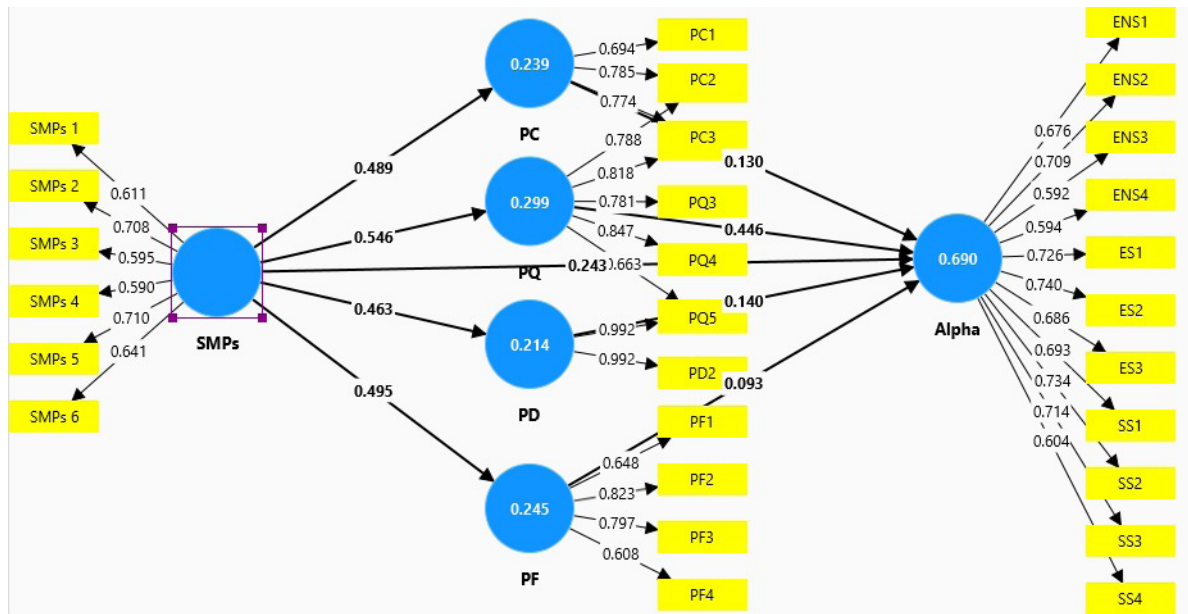


Fig. 2. Measurement Model

The following table indicates that each latent variable is distinct. The diagonal values, representing the R-squares of each latent variable with itself, are higher than with any other variable.

Table 5

Discriminant Validity (Vertical Collinearity)

Constructs	PC	PD	PF	PQ	SMPs	SP
PC	0.754					
PD	0.374	0.850				
PF	0.448	0.424	0.725			
PQ	0.278	0.668	0.465	0.782		
SMP	0.488	0.546	0.495	0.548	0.644	
SP	0.443	0.753	0.546	0.753	0.662	0.681

Table 6 highlights that the item's values are higher both horizontally and vertically compared to all the other values. This indicates that each indicator variable or item has the greatest loading on its corresponding latent variable in both directions. According to Chin (1998), this helps reduce multicollinearity among constructs, emphasizing that the average variance extracted (AVE) of a latent variable must be greater than the squared correlation between that latent variable and other variables. An indicator item should not load onto two latent variables; if it does, it is not good and it should be removed accordingly.

Table 6
Cross Loading

CONSTRUCTS	PC	PD	PF	PQ	SMP	SP
PC1	0.697	0.262	0.235	0.233	0.308	0.310
PC2	0.781	0.302	0.324	0.196	0.363	0.351
PC3	0.780	0.283	0.435	0.205	0.424	0.340
PD1	0.279	0.842	0.412	0.655	0.465	0.615
PD2	0.356	0.858	0.311	0.485	0.464	0.664
PF1	0.471	0.268	0.648	0.195	0.439	0.369
PF2	0.314	0.384	0.825	0.423	0.330	0.477
PF3	0.331	0.326	0.797	0.349	0.387	0.382
PF4	0.140	0.235	0.609	0.397	0.260	0.344
PQ1	0.275	0.503	0.522	0.790	0.438	0.611
PQ2	0.213	0.448	0.301	0.818	0.496	0.560
PQ3	0.268	0.520	0.383	0.780	0.422	0.547
PQ4	0.233	0.629	0.360	0.848	0.425	0.694
PQ5	0.079	0.506	0.236	0.661	0.355	0.517
SMPs 1	0.200	0.280	0.239	0.218	0.603	0.281
SMPs 2	0.349	0.415	0.359	0.260	0.711	0.447
SMPs 3	0.268	0.266	0.161	0.353	0.582	0.390
SMPs 4	0.265	0.406	0.325	0.363	0.597	0.463
SMPs 5	0.331	0.350	0.239	0.334	0.711	0.398
SMPs 6	0.408	0.356	0.483	0.509	0.649	0.508
SS1	0.308	0.527	0.447	0.623	0.397	0.747
SS2	0.292	0.510	0.332	0.587	0.532	0.719
SS3	0.205	0.445	0.217	0.424	0.480	0.594

The following table demonstrates the value of R² for the specific model.

Table 7
(R-Square)

	R-square	R-square adjusted
PC	0.238	0.237
PD	0.298	0.297
PF	0.245	0.243
PQ	0.300	0.298
SP	0.720	0.717

Cronbach's alpha evaluates how strong all items are as a set. it is a coefficient of consistency and reliability. The following table shows that there is strong internal consistency among items that constitute individual constructs.

Table 8
Construct Validity and Reliability

	Cronbach's alpha	(rho_a)	Composite reliability	(AVE)
PC	0.621	0.628	0.798	0.568
PD	0.616	0.617	0.839	0.723
PF	0.692	0.704	0.814	0.526
PQ	0.839	0.846	0.886	0.611
SMPs	0.721	0.725	0.809	0.415
SP	0.870	0.876	0.896	0.464

The table below shows collinearity statistics for the outer VIF values indicating that all variables have a variance inflation factor below 3, demonstrating the lack of multicollinearity across various variables.

Table 9
Collinearity Statistics (VIF)

	VIF
ENS1	2.145
ENS2	1.478
ENS3	1.544
ENS4	2.167
ES1	2.395
ES2	2.155
ES3	2.005
PC1	1.190
PC2	1.282
PC3	1.231
PD1	1.247
PD2	1.247
PF1	1.184
PF2	1.746
PF3	1.747
PF4	1.247
PQ1	1.884
PQ2	2.082
PQ3	1.856
PQ4	2.291
PQ5	1.390
SMPs 1	1.451
SMPs 2	1.641
SMPs 3	1.300
SMPs 4	1.200
SMPs 5	1.490
SMPs 6	1.204
SS1	2.101
SS2	2.338
SS3	1.782

According to the benchmark provided by Hair et al., (2012), in which skewness values between -2 and +2 and kurtosis values between -2 and +2 are generally considered acceptable, all constructs including PC, PD, PF, PQ, SMP, SP lie within the acceptable limits for both skewness and kurtosis. Therefore, based on these statistics all constructs exhibit distributions that are within acceptable bounds which indicates no substantial evidence of no normality in the data.

Table 10
Normality of the Data

	Kurtosis	Skewness
PC	-0.409	-0.240
PD	0.522	-0.774
PF	0.179	-0.544
PQ	0.223	-0.441
SMPs	-0.399	-0.341
SP	0.605	-0.527

Hypothesis Testing

The following table shows that all the hypotheses proposed are not rejected. Structural model is shown in figure 3.

Table 11
Hypotheses Testing

Hypothesis	Beta	P value	Decision
H ₁ : SMP → SP	0.243	0.00	Supported
H ₂ : SMP → PC	0.489	0.00	Supported
H ₃ : SMP → PF	0.546	0.00	Supported
H ₄ : SMP → PQ	0.463	0.00	Supported
H ₅ : SMP → PD	0.495	0.00	Supported
H ₆ : SMP → PC → SP	0.062	0.00	Supported
H ₇ : SMP → PF → SP	0.071	0.00	Supported
H ₈ : SMP → PQ → SP	0.218	0.00	Supported
H ₉ : SMP → PD → SP	0.207	0.00	Supported

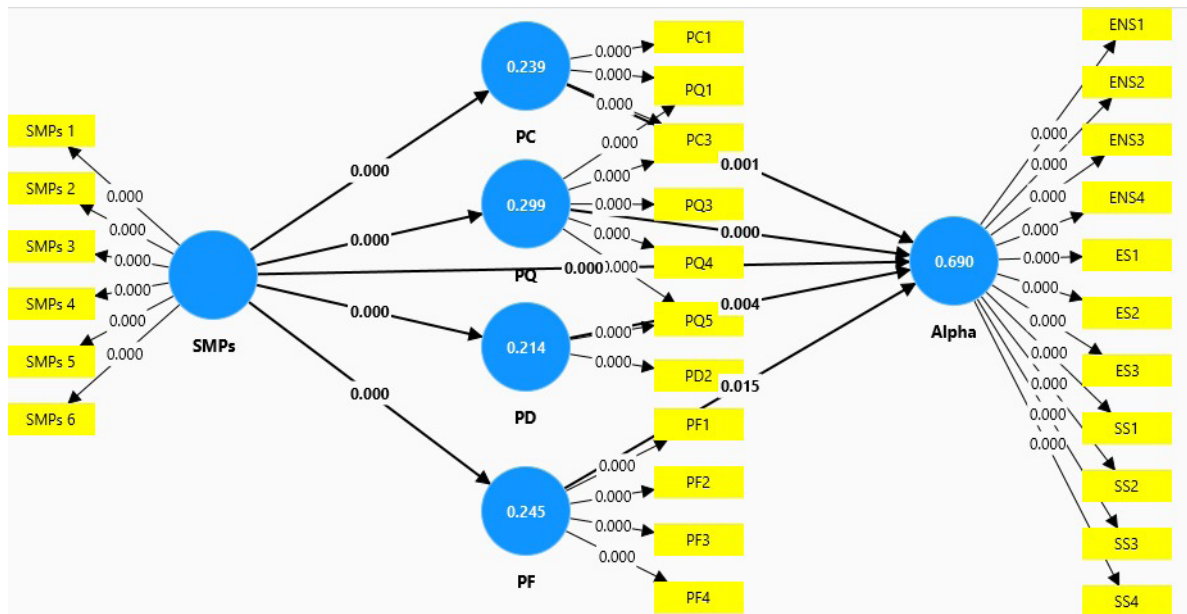


Fig. 3. Structural Model

Discussion

This study has confirmed that SMPs significantly enhance the sustainable performance of SMEs. It indicates that implementing sustainable practices directly contributes to better overall performance outcomes. This result aligns with the previous research results (Hong, 2018). SMP not only reduces environmental impact but also enhances operational efficiency and market competitiveness and efficiency. As per result, product quality, cost, flexibility, and delivery can lead to improved sustainable performance. In addition, SMP also significantly affects product quality. This signifies strong quality control aspects can help to improve the performance of SMEs (Chin et al., 2015). Therefore, the adoption of SMP can augment the SP (Abdul-Rashid et al., 2017). Furthermore, the mediating role of product cost, flexibility, quality, and delivery exists between SMP and sustainable performance. Subsequently, efficient processes enabled by SMP ensure timely assessment and delivery of products which is crucial for sustaining performance (Li et al., 2020).

CONCLUSION

Our study focuses on assessing the role of SMP and competitive capabilities for Pakistani SMEs specifically manufacturing in improving sustainable performance. Furthermore, a quantitative approach was adopted to examine the hypotheses. According to the results, SMP significantly affect the SP. Moreover, competitive capabilities from the view of product quality, cost, delivery, and flexibility mediate the link

between SMP and SP in SMEs.

Recommendations

The government needs to develop strategies to devise incentives for the adoption of SMP in SMEs. There is a need to develop a mechanism for the development of initiatives to provide training and development opportunities to initiate programs for sustainable practices implementation. These initiatives can help SMEs in adopting and implementing sustainable practices to reduce, recycle, and reprocess in order to minimize waste in manufacturing and operations. Such practices can help to attain the UN's 2030 sustainable development goals across the region by fostering sustainability practices in SMEs.

Limitations

The sample size was limited to 420. This may not present the diverse manufacturing landscape of Pakistan. Future researchers may examine the model on a larger sample size. The reliance on convenience sampling might introduce bias since the sample might not be entirely reflective of the larger SME group. The research was carried out within the particular setting of Pakistan, potentially restricting its applicability to other cultural and regulatory settings. Subsequent studies should concentrate on determining core SMP acquired by SMEs and exploring how these practices enable SMEs to develop competitive advantage in terms of product cost, production flexibility, quality, and delivery. There is a need for empirical research to examine the indirect effect of various types of environmental regulations on firms' sustainable performance across various situations.

Competing Interests

The authors declared no competing interests.

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