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Organizational Agility and Sustainable Manufacturing Practices in the Context of Emerging Economy: A Mediated Moderation Model

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Abstract: Since the beginning of the 21st century, agility and sustainability have played a significant role in the global manufacturing industry. The manufacturing paradigm leaning toward green procurement and organizational agility has crossed all levels of sustainability by colossally influencing the firms' sustainable practices, innovation capacity, and eco-friendly procurements. Integrating sustainable practices in manufacturing is a complex task that demands that global economies conduct comprehensive research on the factors influencing the firms' sustainable practices. Therefore, the study considers empirical research between organizational agility and sustainable manufacturing practices. The data was collected from 461 respondents working in the manufacturing sector by applying a convenience sampling technique. We utilized structural equation modeling (SEM) for direct and indirect hypothesis testing. The study results revealed that operational, customer, and partnering agility significantly and positively impact sustainable manufacturing practices and green procurement. Green procurement mediates the relationship between operational, customer, partnering agility and sustainable manufacturing practices. The study results showed a significant moderating role of big data between green procurement and sustainable manufacturing practices. The study findings are helpful to managers and policymakers.

Keywords: environmental sustainability; green economy; smart manufacturing; green procurement; operational agility; big data; Pakistan

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1. Introduction

In recent years, significant changes in customer demand, technological innovation, and market competition have demanded worldwide sectors to embrace novel business modifications. The increasing competition has called the world's corporate industries to redesign their business processes and practices through sustainable adoptions. The Pakistani manufacturing sector is a prime contributor to the world's economy. Even though it plays a fundamental role in economic development, the Pakistan manufacturing industry has significantly wagered the world's eco-system [1,2].

The attention to sustainable manufacturing has grown exponentially over the last decades. Today, achieving sustainability has become the prime priority of firms, with the world's largest industries reporting an increase in their environmental footprints. However, despite the increasing role of sustainable manufacturing practices, history reveals that fewer organizations have realized the need for sustainable practices in the context of the Pakistani manufacturing industry [3]. The circular economy has gained considerable popularity among industrialists over the past years because of its profound environmental and social benefits. However, limited attention has been provided to its implementation in the context of emerging economies, such as Pakistan. The circular economy helps the country to maximize the firms' manufacturing practices by producing and maintaining sustainable practices. In Pakistan's manufacturing industry, sustainable practices are still in their infancy stage. Given the scenario, this rising gap proposes the Pakistani manufacturing industry to enfold the idea of green practices ensuring the firms' stability [4]. The prior literature demands organizations to become more efficient in adopting sustainable alternatives to gain ecological success (e.g., green innovations) [5].

Concurringly, this progressing need for sustainable practices has essentially lead to global industries adopting tangible resources to stay ahead in the competitive market. Operational agility involves redefining the firms' processes, thus gaining a superior market position [6]. It plays a strategic role in responding to external changes. It fosters the company's operations, therefore swiftly handling business changes with dexterity [7]. Interestingly, some agility definitions are based on operations, but others are expressed in terms of implementation. Given the explanation, the study shows that customer agility encourages organizations to make decisions to fulfill customer needs [6]. Customer agility becoming the priority has caused organizations to deal with the increasing market dynamics, thus fostering manufacturing practices [8]. Indeed, for manufacturing sustainability to meet the customer needs also requires building the organization–supplier relationship to enhance the firms' agilities. In this regard, partnering agility allows firms to leverage the supplier's knowledge, assets, and capabilities [6], thus colossally achieving sustainable practices. Strategic partnering enhances the supply chain flow, causing companies to resolve and manage unexpected market disturbances [9].

Presently, green procurement has gained popularity in dealing with emerging disturbances. Green procurement manufacturing enables organizations to think positively. It makes the suppliers' products, designs, materials, and knowledge benefit the firms' operations [10]. This greener concept encourages companies to reduce environmental waste, pollution, and emissions, thereby contributing to sustainable manufacturing [11]. Indeed, in recent years, this green concept footing in the manufacturing industry has led to an increase in the practices of adopting eco-friendly innovations. Hence, in this regard, the immense usefulness of big data in the manufacturing industry has brought new business opportunities for firms [12]. The big data capabilities have enabled organizations to manifest from green logistics and procurement. In particular, it has become the key driver of the greener revolution. As big data becomes popular in academia, organizations are massively taking over new ways of driving the manufacturing supply chain flow [13].

Even though the Pakistani manufacturing industry plays a critical role in the world's economy, Pakistan is still in its initial stage of sustainability. Due to this gap, this paper discusses the impact of the organizational agility approaches (i.e., operational, customer, partnership) on sustainable manufacturing practices. Additionally, the study highlights the mediating role of green procurement and moderation of the big data nexus to green procurement and sustainable manufacturing practices.

Significantly, in addressing the critiques of the previous articles, this study includes the various stakeholders (e.g., customers and suppliers) with the newly proposed phenomenon of green procurement and big data analytics. It is a unique contribution that improves the understanding of agility and sustainable practices by exploring organizational agility dimensions. However, to our knowledge, this is the first study that widens the scope of the topic by highlighting, mediating, and moderating the role of green procurement and big data analytics in the context of Pakistan. As the previous literature shows that Pakistan's manufacturing industry has emerged in fewer areas of sustainability, the study suggests that organizations must adopt green initiatives to enjoy the benefit of sustainable practices. Altogether, this study helps organizations find answers to the previous critiques. It makes the practitioners understand the increasing impact of agility on sustainable practices. The world's manufacturing industries are redefining their systems to deal with market complexities. Hence, the benefit driven by these unique philosophies provides implications for the manufacturing staff to all the stakeholders.

2. Materials

2.1. Operational Agility, Green Procurement, and Sustainable Manufacturing Practices

Sustainability is the prime issue that has massively affected the world's manufacturing sector. In today's turbulent market, the growing competitiveness has led organizations to adopt manufacturing agility to foster the firms' sustainable practices. Today, the manufacturing sector has moved toward sustainable manufacturing practices, with operational agility playing a fundamental role [14]. Operational agility is an effective construct that adds value to the firms' activities. It enables firms to adapt to the changing environment by colossally identifying loopholes in the business processes. It enhances the firms' abilities to detect discrepancies. Indeed, it helps organizations in resource planning and production, addressing the potential market problem. Its operational excellence results in organizations adapting to real-time data and tools and assisting firms in decision making. The prior study shows that operational agility tapping into sustainability increases flexibility and resilience [15], thereby contributing to sustainable practices. Hence, with its growing significance in academia, the literature reveals that operational agility led to manufacturing organizations adopting innovative tools and fostering sustainable business practices [16]. Hence, based on these arguments, the hypothesis states:

H1. *Operational agility has a positive and significant effect on sustainable manufacturing practices.*

Natural disasters bringing numerous disturbances in the supply chain process have drastically affected the organization procuring. The market distributions weakening the supply chain have created difficulties in the firms' business processes. As a result, manufacturing the products from the conversion of raw material to the finished goods demands that organizations to adopt eco-friendly deliveries. Today, the green concept footing in the manufacturing industry has resulted in organizations adopting green practices, thus significantly dealing with increasing climatic problems. In manufacturing, operational agility makes the green notion to re-engineer the firms' processes [17]. It leads manufacturers to embrace green procurement practices to support efficient workflow. Operational agility helps the firms to adopt green operations, thus turning down the problematic issue of the environment. It enables organizations to become strategically responsible in purchasing and delivering environmentally friendly products [18]. It helps firms manage business demand, orders, and flow. The term green procurement drastically fosters supply chain manufacturing. It reduces market volatility by identifying and minimizing the firms' damaging operations. The study shows that operational agility supporting green procurement helps companies identify and discard unfriendly business practices [19]. Hence, based on these studies, our hypothesis concludes:

H2. *Operational agility has a positive and significant effect on green procurement.*

2.2. Customer Agility, Green Procurement, and Sustainable Manufacturing Practices

Fast-changing customer tastes, increasing competition, and global environmental awareness have compelled institutes to adopt sustainable manufacturing practices. During the past few years, industrialization severely affecting the environment has raised customers' concerns regarding climate change. This shift in customer demand has compelled organizations to eliminate unsustainable activities from the manufacturing process. Customer agility enables firms to meet the need of the stakeholders without compromising the companies' productivity. Customer agility increases customer satisfaction by accelerating the firms' responsiveness to changing requirements [20]. Its integration increases the firms' cost-effectiveness and competitiveness [21]. It makes the firms identify new business opportunities by realizing the stakeholders' demands. The stakeholder significantly influences the firms' practices [22–24]. Although many classifications of stakeholders exist, among which, customers have gained the most prominence. Therefore, today, enhancing the customer experience by quickly understanding their needs has become the priority of manufacturing businesses. Deploying innovative practices, eliminating uncertainties, and fulfilling customer demands have led to firms adopting sustainable practices. Therefore, the hypothesis concludes:

H3. *Customer agility has a positive and significant effect on sustainable manufacturing practices.*

The increasing ecological degradation and the rising technological advancement have made the organization adopt green procurement practices. Consumers are the most critical enablers of sustainable development [8]. They fundamentally shape the business practices by making the organization focus on its needs. In recent years, customer value for green consumption has made organizations emphasize eco-logistics. Concerning environmental concerns, the prior study shows that customers prioritizing eco-friendly products have encouraged organizations to participate in environmental protection activities. Indeed, the agility concerned with the customer demands a quick response from the firms' side in delivering eco-friendly products [22].

Today, companies have found a reason to focus on green purchasing. Customers purchase products that have powerful eco-friendly credentials. The consumer pressure for greener procurement compels organizations to embrace green manufacturing processes. Fundamentally, these increasing environmental concerns require organizations to enfold a green purchasing system valuing customer expectation. The clients are becoming much more aware of green products [25]. Indeed, the progressing ecological knowledge has made green procurement a critical part of the manufacturing supply chain. Altogether, the hypothesis states:

H4. *Customer agility has a positive and significant effect on green procurement.*

2.3. Partnering Agility, Green Procurement, and Sustainable Manufacturing Practices

Sustainability requires increased cooperation from the supplier side. A modular supply chain environment emphasizes developing a technical bond with the suppliers. Significantly, partnering agility connects companies with their suppliers [26]. Fundamentally, it ensures the involvement of the firms' stakeholders, thus maintaining a higher degree of coordination among the supply chain members. Though communication and information sharing with the stakeholders provide a competitive advantage, a close partnership with the supplier facilities the firms' sustainable practices. The supplier–organization relationship impacts the firms' practices. The strategic partnership compels the companies to reach operational excellence. Potentially, it assists the firms in resolving the abnormal issues that are hurdles in the supply chain. Partnering agility overcomes market uncertainty, contributing to sustainable practices [27]. Partnering agility reconfigures the firms' manufacturing methods. It identifies the firms' value-adding activities by significantly shifting the organization's focus toward the suppliers' capabilities, skills, and knowledge. The prior study shows that partnering agility enhances the supplier–organization relationship, becoming an effective enabler of sustainable practices [28]. Hence, based on the previous review, our hypothesis concludes:

H5. *Partnering agility has a positive and significant effect on sustainable manufacturing practices.*

Undoubtedly, the strategic purchasing conducted by the company impacts the supplier –organization bond. Partnering agility accelerates organizational trust in the supplier's capabilities. Supplier innovativeness, knowledge, and efficiency affect the firm practices. The prior study shows the organizations aiming to leverage the suppliers' production capacities and knowledge adds value to the firms' productivity [29]. Stakeholders play a distinctive role in green procurement. Green procurement depends on the firms' abilities to access the partners' resources. The partnering agility fosters the firms' green purchasing systems. It manages the flow of the supply chain from raw material to product delivery. The supplier–organization partnership elevating green procurement leads to the customers purchasing green products [30]. It fundamentally widens the organization's competitiveness by rigorously adopting green initiatives. However, partnering agility allows the supply chain participants to become involved in green procuring. Based on this perspective, the study shows that green procurement planning with the supply chain partners enhances the systematic capabilities of the firms [31,32], thus colossally reducing the adversity of the firms' unsustainable activities. Consequently, based on the previous findings, the hypothesis concludes:

H6. *Partnering agility has a positive and significant effect on green procurement.*

2.4. The Mediating Role of Green Procurement

Cleaner manufacturing practices are a significant area of research that has received considerable attention in today's world. Manufacturing firms face colossal challenges that may hinder their effective performances. In this regard, green procurement has emerged as a fundamental construct of sustainable practices. Green procurement fosters the firms' logistics operations, thereby improving firms' practices [33]. Green procurement can enhance firms' resources and practices. The optimizing effect of this green initiative increases the firms' performances by minimizing damaging waste production. Indeed, green procurement reduces the ecological impact of unsustainable activities. It increases the organizations' logistic efficiencies, resulting in organizations concentrating on greener production systems. Indeed, sustainable manufacturing is an efficient way of resource management. It fundamentally reduces the adversity of the environment by creating value for the organizations. Green procuring is an integral element in firms' sustainability. This green paradigm upgrades environmental conditions, resulting in firms' sustainable practices. The ecological benefit of green procurement encourages organizations to comply with environmental standards. It develops new standards for supply chain firms, ensuring the adoption of sustainable practices [34]. Hence, green procurement plays a crucial role in identifying the hidden path toward sustainable practices. Therefore, based on this notion, the hypothesis states:

H7. *Green procurement has a positive and significant effect on sustainable manufacturing practices.*

The green procurement initiative has gained considerable limelight in the manufacturing sector. The advent of environmental awareness among stakeholders has strongly supported the firms' activities [35]. Over the last few years, green procuring has extended firms' boundaries beyond traditional logistics to green services. Green procurement is closely related to the firms' sustainable practices and leverages the firms' functions. In manufacturing, green procurement significantly affects the firms' sustainable practices. Manufacturing companies using the green principle rapidly adapt to the changing environmental demands. Green procurement enhances the firms' attributes, features, and processes without increasing costs and lead times [36]. With increasing sustainable production today, green procurement guides the firms' sustainable practices. Green procurement supports the integration of technology, thus resulting in eco-friendly product delivery. The prior study reveals that eco-friendly procurement causes the firms to adapt to the changing market demand, potentially shifting swiftly from traditional practices to green manufacturing [37]. Hence, in line with these arguments, the hypothesis concludes:

H7(a): *Green procurement mediates the relationship between operational agility and sustainable manufacturing practices.*

Green procurement has played a prominent role in aligning manufacturing agility with sustainable practices. Today, customers have become more aware of environmental sustainability and green initiatives [38]. As a result, organizations have increasingly minimized waste-producing systems, thus ensuring sustainable practices [11]. Customer agility increases the organizations' adoptions of external market changes. It boosts customer satisfaction by realizing the need for green product demand. Customer agility leads to green procurement that enhances the firms' efficiencies, resource utilization, and performances. As a result, today's organizations have rigorously integrated the green procurement method to satisfy the concerns of the customer and the public.

The green procurement system enables manufacturers to value customers' environmental expectations. Green procurement helps firms manage the pressure of eco-friendly products on manufacturers. Therefore, today's organizations evaluate eco-friendly procurement as the most fundamental approach to enduring practices [33]. The customers' tastes, environmental concerns, and social demands compel manufacturers to integrate novel environmental fronts by seamlessly producing green products and services. Environmentally-friendly manufacturing scale up the customization, thereby tackling the customers' tastes and preferences to become more agile [39]. Hence, based on the previous research findings, the hypothesis reveals:

H7(b): *Green procurement mediates the relationship between customer agility and sustainable manufacturing practices.*

Undoubtedly, every phase of the manufacturing process questions the firms' environmental sustainability. Supply chain agility captures the market sensitively, thus increasing organizational flexibility and responsiveness. In recent years, the identification of green procurement has become compulsory for minimizing the delivery time of eco-friendly products. Partnering agility has eliminated material shortages, drops in production, and sudden demand spikes, thus leading organizations to sustainable manufacturing. It enhances the firms' commitments to sustainable practices [33], such as utilizing the suppliers' abilities to manage the environment, implementing pro-environmental actions, and so on. Significantly, partnering agility is a fundamental construct of the supply chain business. The prior study shows this growing phenomenon has made today's firms embrace green procurement activities to achieve sustainability [35]. As a result, today's agility companies focus on developing a high level of responsiveness by valuing the stakeholders' needs, exchanging information with the suppliers, and sensing disturbances before they happen. Hence, in line with the present arguments, the hypothesis states:

H7(c): *Green procurement mediates the relationship between partnering agility and sustainable manufacturing practices.*

In recent years, the technological opportunity has derived from sustainable manufacturing. The detailed mapping of innovative technologies has improved resource efficiency, reduced operational waste and influencing manufacturing practices. Today, the rising agility and sustainability issues have challenged the world to embrace sustainable manufacturing in the digital age [40]. In this regard, big data analytics have gained considerable attention in academics. Fundamentally, they have helped organizations to extend their procurement systems beyond the firms' boundaries. The digital characteristics have resulted in firms improving their innovation processes, thus achieving sustainable goals. The configuration of big data analytics has enhanced the availability of firms' resources and sustainable production [41].

Surprisingly, the previous work shows that environmental sustainability in green management has caused organizations to move toward green logistics and procurement. This green optimization has made firms excel in different business areas with the help of this innovation. Big data have inspired sustainable practices to form a strong link between green procurement and the firms' eco-friendly practices. Its innovative capacity has radically revolutionized the firms' traditional structures. It has significantly upgraded company operations to the next level of efficiency and performance [42]. Altogether, today's environmental standards have led organizations to look for technological alternatives by embracing sustainable and eco-friendly practices [43]. Hence, based on the previous literature, the study hypothesis are presented in the Figure 1.

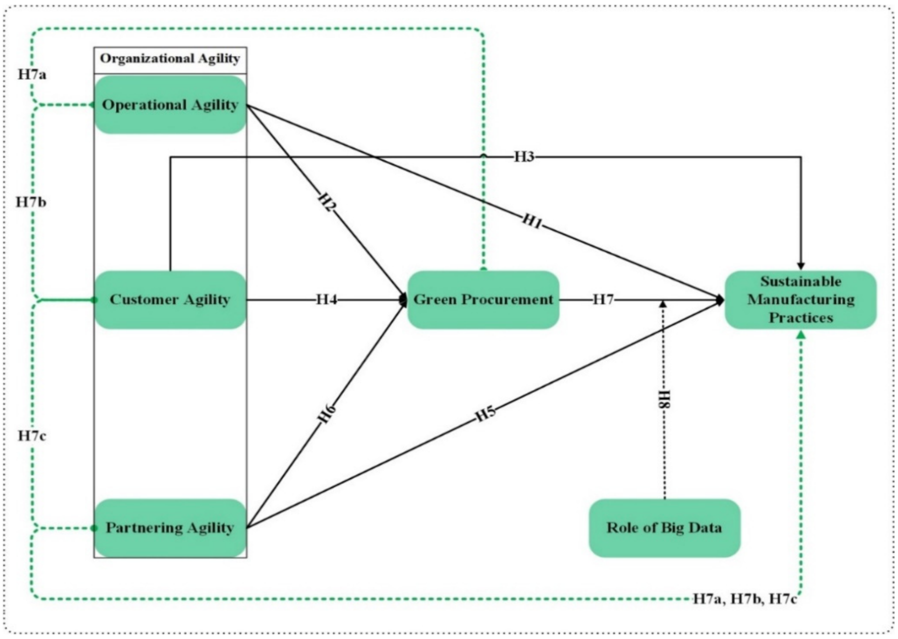

Figure 1. Conceptual Framework.

H8. *Role of big data moderates the relationship between green procurement and sustainable manufacturing practices.*

3. Study Methodology

The study's primary purpose is to examine the effect of organizational agility on sustainable manufacturing practices, considering the mediating role of green procurement and the moderating role of big data. The study is explanatory research, and the quantitative approach was adopted because it is more reliable to measure the independent–dependent relationships between variables. In quantitative research, the findings could be more generalized [44,45]. Data for this study were gathered using a questionnaire by adopting the convenience sampling technique. The research design is a framework for collecting and selecting data. The study considers the moderating relationship of the role of big data with mediating and independent variables. For a developing country, such as Pakistan, the manufacturing industry plays a significant role in economic growth. According to Shabbir et al. (2020), a considerable amount of GDP comes from the manufacturing industry of Pakistan. Fundamentally, today, it is the most dominant industry within the industrial sectors [46]. In this study, the data were collected from the employees working in the manufacturing companies of Pakistan. The questionnaire was sent to the respondents through emails with introductory letters to obtain a higher response rate. A total of 550 questionnaires were received, and 461 were considered valid for data analysis based on a response rate of 85%.

In this study, 250 were male, and 211 were female. Male respondents comprised 53.5% of the sample and female respondents the remaining 45.18%. Fifty-five respondents were aged 19–30, 11.7% of the total respondents. A higher response rate was observed from respondents (180) aged 31–40, 38.54% of the total respondents. The last question of the questionnaire section was about the respondent's marital status. Study results show that most participants were married (340), 72.8% of total respondents.

3.1. Study Measures

Operational agility was measured on the six-item scale adapted from the study of Akhtar et al. [47]. All items were assessed on the five-point Likert scale (strongly disagree = 1 and strongly agree = 5). The sample items include "Our offerings are more cost-efficient than competitors." and "We accomplish greater speed in delivering our offerings.” The six-item scale was used for customer agility and was adapted from Roberts and Grover [48], and the partnering agility scale was adapted from Liu et al. [49].

Green procurement is a mediating variable in this study measured on the seven-item scale adapted from the study of Wu et al. [50] and Carter and Jennings [51]. The role of big data was a moderating variable in the current study and was assessed on the four-item scale adopted from the study of Singh and El-Kassar [52]. Sustainable manufacturing practices (independent variable) were measured on the seven-item scale. The questionnaire items on firm performance were taken from the study of Abdul-Rashid et al. [53] (see Appendix A). This study applied the common method bias technique utilizing Harman’s single-factor approach. This study has no common method bias because the variance extracted by one single factor is 13.352%, less than 50% [54,55].

3.2. Statistical Procedure

We used Smart PLS (Version 4.0.7.8) to conduct the statistical analysis and utilized the partial least square structural equation modeling (PLS-SEM) to assess the hypothesized relationships of the study. This data analysis approach has several advantages over other techniques, including conventional regression analysis and covariance-based SEM; it is less restrictive about data assumptions, such as the normality of data and its capability of handling complex theoretical models [56].

4. Results

Table 1 shows the study’s reliability and validity analysis. The findings demonstrate that the first standardized factor loadings for all 35 items were more than 0.6, which ranged from 0.658 (for RBD_3) to 0.809 (for PA_3) [57]. We used average variance extracted (AVE), construct reliability (CR), and Cronbach’s alpha to assess the reliability. Table 1 shows that the AVE value of all the variables was greater than 0.5, which is considered a cut-off value [58]. AVE values ranged between 0.526 (role of big data) and 0.579 (customer agility). The Cronbach’s Alpha value ranged between 0.817 (role of big data) and 0.904 (sustainable manufacturing practices).

Table 1. Reliability and Validity Analysis.

Construct	Items	Loading	α	CR	AVE
Operational agility	OA_1	0.780	0.883	0.884	0.556
	OA_2	0.777			
	OA_3	0.659			
	OA_4	0.745			
	OA_5	0.757			
	OA_6	0.752			
Customer agility	CA_1	0.754	0.892	0.893	0.579
	CA_2	0.746			
	CA_3	0.794			
	CA_4	0.753			
	CA_5	0.714			
	CA_6	0.802			
Partnering agility	PA_1	0.759	0.871	0.872	0.575
	PA_2	0.713			
	PA_3	0.809			
	PA_4	0.774			
	PA_5	0.734			

Table 1. *Cont.*

Construct	Items	Loading	α	CR	AVE
Green procurement	GrP_1	0.723	0.902	0.902	0.567
	GrP_2	0.760			
	GrP_3	0.783			
	GrP_4	0.724			
	GrP_5	0.758			
	GrP_6	0.794			
	GrP_7	0.724			
Role of big data	RBD_1	0.736	0.817	0.818	0.526
	RBD_2	0.754			
	RBD_3	0.658			
	RBD_4	0.750			
Sustainable manufacturing practices	SMP_1	0.712	0.904	0.905	0.572
	SMP_2	0.776			
	SMP_3	0.803			
	SMP_4	0.753			
	SMP_5	0.758			
	SMP_6	0.697			
	SMP_7	0.790			

Figure 2 shows the results of the measurement model. The circle shape represents the latent constructs, while rectangle shapes show the values of items. Cronbach alpha's value is represented inside the latent construct.

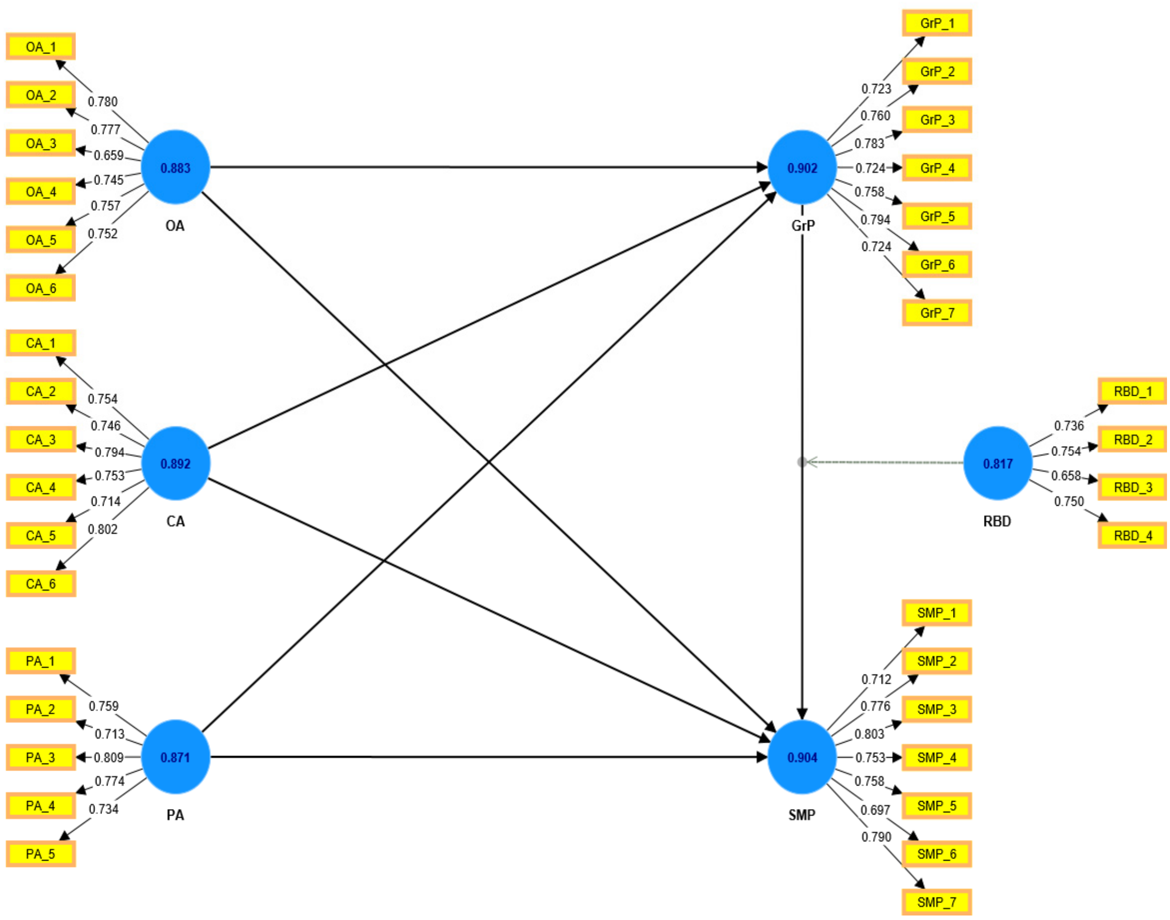

Figure 2. Assessment of Measurement Model.

Table 2 presents discriminant validity analysis results and the variables' interrelationships. All the study variable values are within range, and variables are correlated with each other.

Table 2. Discriminant Validity Analysis (Fornell Larcker and HTMT).

Constructs	1	2	3	4	5	6
1. Customer agility	*0.761*	0.626	0.630	0.607	0.386	0.615
2. Green procurement	0.628	*0.753*	0.608	0.614	0.634	0.610
3. Operational agility	0.63	0.610	*0.746*	0.600	0.346	0.627
4. Partnering agility	0.607	0.615	0.601	*0.758*	0.324	0.621
5. Role of big data	0.387	0.633	0.347	0.324	*0.726*	0.411
6. Sustainable manufacturing practices	0.616	0.610	0.629	0.622	0.412	*0.757*

Note: Values on the diagonal (italicized) represent the square root of the average variance extracted, while the off diagonals are correlations.

Kock [59] suggested that variance influence factor (VIF) value should be less than 3.3. Therefore, that study model can be considered free of common method bias. In the current study, all variable VIF values are less than 3.3 (see Table 3).

Table 3. Variance Influence Factor.

Constructs	1	2	3	4	5	6
1. Customer agility		1.918				2.107
2. Green procurement						3.177
3. Operational agility		1.894				2.033
4. Partnering agility		1.811				1.995
5. Role of big data						2.475
6. Sustainable manufacturing practices						

Table 4 represents the results of direct hypothesis testing. All the hypotheses presented in Table 4 were accepted because the *p*-values were less than 0.05. Hypothesis H1 states a significant relationship exists between operational agility and sustainable manufacturing practices; the t-value and *p*-value of operational agility in predicting sustainable manufacturing practices were 4.016 and less than 0.05, respectively. Therefore, H1 was accepted. Hypothesis H2 states that there is a significant relationship between operational agility and green procurement; the t-value and *p*-value of operational agility and green procurement were 3.908 and less than 0.05, respectively. Therefore, H2 was accepted.

Table 4. Hypotheses Testing Direct Effect.

Hypothesis	Direct Relationships	Beta	SE	T-Value	*p*-Value
H1	OA → SMP	0.240	0.06	4.016	***
H2	OA → GrP	0.253	0.065	3.908	***
H3	CA → SMP	0.185	0.06	3.061	**
H4	CA → GrP	0.296	0.073	4.036	***
H5	PA → SMP	0.249	0.06	4.130	***
H6	PA → GrP	0.284	0.067	4.213	***
H7	GrP → SMP	0.197	0.072	2.729	**

** $p < 0.01$, *** $p < 0.001$.

Hypothesis H3 states there is a significant relationship between customer agility and sustainable manufacturing practices. The t-value and *p*-value of customer agility and sustainable manufacturing practices were 0.185 and less than 0.05, respectively. Therefore, H3 was accepted. Hypothesis H4 states there is a significant relationship between customer agility and green procurement; the t-value and *p*-value of customer agility and green procurement were 0.296 and less than 0.05, respectively. Therefore, H4 was accepted.

Hypothesis H5 states there is a significant relationship between partnering agility and sustainable manufacturing practices; the t-value and *p*-value of environmental passion and firm performance were 4.130 and less than 0.05, respectively. Therefore, H5 was accepted. Hypothesis H6 states that there is a significant relationship between partnering agility and green procurement, while hypothesis H7 states green procurement has a positive and significant effect on sustainable manufacturing practices. Hypotheses H6 and H7 were accepted in this study.

Table 5 illustrates mediation results. All the mediating paths were significant because the *p*-values were less than 0.05. Hence, hypotheses H7(a), H7(b), and H7(c) were accepted. H5(a) shows the relationship between operational agility and sustainable manufacturing practices mediated by green procurement. Bootstrapping results showed that the indirect effect of operational agility on sustainable manufacturing practices mediated by green procurement was significant at 0.001 level; β = 0.050, T-value = 2.084, $p < 0.001$. Therefore, H7(a) was accepted in this study. H7(b) shows the relationship between customer agility and sustainable manufacturing practices mediated by green procurement. Bootstrapping results showed the indirect effect of customer agility on sustainable manufacturing practices mediated by green procurement was significant at 0.001 level; β = 0.058, T-value = 2.073, $p < 0.001$. Hence, H7(b) was accepted in this study.

Table 5. Mediation Effect Analysis. * $p < 0.05$.

	Mediating Relationship	**Beta**	**SE**	**T-Value**	***p*-Value**
H7(a)	OA → GrP → SMP	0.050	0.024	2.084	*
H7(b)	CA → GrP → SMP	0.058	0.028	2.073	*
H7(c)	PA → GrP → SMP	0.056	0.024	2.279	*

H7(c) shows the relationship between partnering agility and sustainable manufacturing practices mediated by green procurement. Bootstrapping results showed the indirect effect of partnering agility on sustainable manufacturing practices mediated by partnering procurement was significant at 0.001 level; β = 0.056, T-value = 2.279, $p < 0.001$. Hence, H7(c) was accepted in this study.

Figure 3 signifies the results of the path analysis between study variables. The path value between operational agility and green procurement is 0.253. Partnering agility and green procurement path relationship value are 0.284. Figure 3 shows a significant path relationship between study variables.

As shown in Table 6, the interaction term of the role of big data in predicting green procurement and sustainable manufacturing practices was statistically significant at 0.05 level; β = 0.118, T-value = 2.251, $p < 0.01$.

Table 6. Moderating Hypothesis Effect.

	Moderating Effects	**Beta**	**SE**	**T-Value**	***p*-Value**
H8	Interaction RBD x GrP → SMP	0.118	0.052	2.251	*
	Level of the Moderator	Effects	Boot SE	LLCI	ULCI
H8	+1 Std Dev	0.633 ***	0.070	0.496	0.770
	Mean	0.551 ***	0.049	0.454	0.648
	−1 Std Dev	0.469 ***	0.049	0.372	0.565

* $p < 0.05$, *** $p < 0.001$

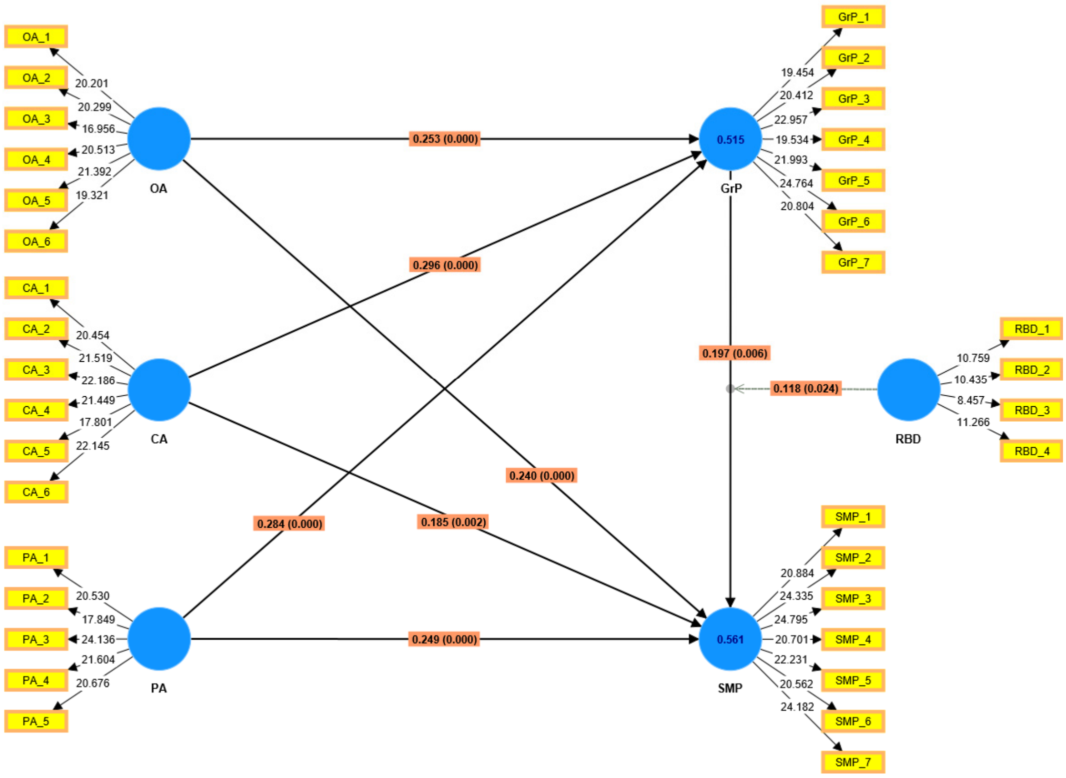

Figure 3. Structural Model.

Bootstrapping results indicate the effect of big data's role on sustainable manufacturing practices is positively significant and strong in the high level of green procurement (+1 Std Dev, β = 0. 0.633; error = 0.070, 95% confidence interval CI is 0.496 and 0.770). The 95% boot CI bias corrected did not straddle a 0 in between, indicating a significant effect from the role of big data on sustainable manufacturing practices in all three high, medium, and low levels of green procurement as moderating variables (see Figure 4).

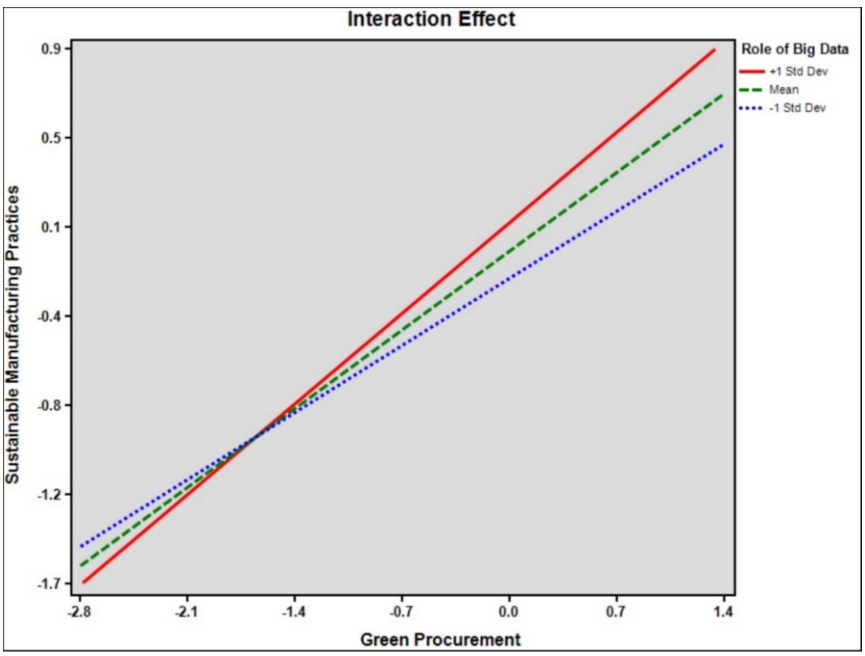

Figure 4. The Moderating Outcome.

5. Discussion

Organizational agility is an integral part of the business process. The literature concludes its distinctive capabilities have made organizations adopt sustainable practices. The organization's prime goal is to satisfy the stakeholders' needs. Organizational agility enables the stakeholders (i.e., customers and suppliers) to contribute toward firms' sustainable practices. As a result, today's industries have increasingly relied on environmentally friendly innovations and green industrial procurement.

The previous studies reveal the organizational agility entailing the market changes demands organizational efficiency, service, and effectiveness. Pakistani manufacturing companies are less agile due to the lack of sustainable practices. The successful implementation of sustainable manufacturing practices leads to green innovation, reduced waste, environmental awareness, and improved operations.

In recent years, manufacturing companies have considered their survival by utilizing the concept of organizational agility in business areas. Organizational agility is an essential element ensuring the firms' long–term practices. Adapting to the new environment requires firms to adapt to changing market demands. In this regard, developing operational agility has become a crucial phenomenon, inspiring firms to gain sustainable practices. Wamba et al. [60] stated that operational agility is a firm's strategic capability that makes the company respond to market changes by ensuring sustainable practices [61]. In manufacturing, it is a view as the most significant construct, enhancing the firms' sustainable performances and green purchasing [62]. In the same vein, customer agility also plays an integral role in improving business practices. The organizations' prime goals are to satisfy the stakeholders' needs [63]. Hence, today, the dynamic capability of customer agility has made organizations move to a sustainable and greener business model. Greenness plays an exemplary role in satisfying consumer needs. According to Devayani et al. [25]), customers are well aware of the importance of green products. Indeed, the literature states this rise in customer needs motivates manufacturers to deliver green products as their priority [64]. Hence, compared with the previous literature, our analysis surprisingly shows a positive relationship between operational and customer agility with sustainable manufacturing practices and green procurement (i.e., H1, H2, H3, and H4).

Moreover, partnering agility has also become a strategic tool, accelerating market responsiveness and product delivery [22]. According to Tarigan [65], partnering agility increases the firms' sustainable business model, thereby relying on the partners' capabilities to produce green products. Partnering agility is a profound concept that involves not only the production of green products but also the selection of eco-friendly suppliers. This close relationship between the supplier and the manufacturer increases trust, reduces transaction costs, and increases firm efficiencies, thus promoting the development of both sides. Indeed, our results also support this concept by proving partnering agility improves manufacturing practices through eco-friendly suppliers, materials, and production [66]. Altogether, our study confirms the positive relationship between partnering agility with sustainable practices and green procurement (e.g., H5 and H6).

Significantly, today, state-of-the-art eco-logistics have made organizations implement green information systems to ensure sustainability. The efforts for green procurement have transformed supply chain practices, thereby colossally reducing the unsustainable effect of climate change. Green procurement is a gateway to sustainable manufacturing practices. It is a prominent boundary for manufacturing businesses that helps the firms incorporate environmental factors into firm policies, procedures, and plans. Traditionally, purchasing decisions were derived from the manufacturing costs and delivery [67], but now, green procurement has taken this phenomenon beyond this criteria to environmental well-being [68]. However, in recent years, green procurement has received considerable attention from the world's dominant industries [69]. Green procurement has become the best practice that has reduced the firms' discrepancies, thus enhancing their operations and customer needs [36]. Realizing the significance of green procurement, firms have maximized their relationships with their stakeholders (e.g., suppliers), coordinating the purchasing of green products and services [70]. Green procurement, indeed, has become today's need for manufacturers. Laying the foundation of development, it has played a fundamental role in business sustainability practices [33]. Hence, in line with the study findings, we concluded that green procurement strongly mediates the relationship between a strong relationship with the firms' operational, customer, and partnering agility and sustainable practices (i.e., H7, H7(a), H7(b), and H7(c)).

In addition, previous research shows the significance of big data has also powered manufacturing operations and activities [71]. Our study supporting the previous research confirms big data have increased the firms' green operations, thus facilitating sustainable manufacturing practices [72]. Significantly, based on our analysis, we concluded a positive moderating role of the big data nexus to green procurement and sustainable manufacturing practices. Altogether, our study showed positive results, potentially supporting all the assumptions made in the previous literature.

Theoretical and Managerial Implications

The study contributes to the classical organizational theory by emphasizing and restoring the organization according to the goals, objectives, and more importantly, the needs of the customers. Organizational agility focuses more on the interaction of knowledge workers and the processes and active collaboration for achieving value and its early and continuous delivery to the customers. Likewise, organizational agility helps in adaptive planning, iterative replanning for value delivery, and customer engagement. The most important premise of agility is process control in a safe environment through simplicity in processes and operations. Lastly, the study added to the knowledge management theory by focusing on organizational resources, their man-agreement, utilization, and optimization.

The study outcomes are also beneficial for managers and decision-makers. The study found that organizational agility has gained more popularity in the dynamic world. Therefore, organizations must twist their operations and projects according to the needs and requirements of the market and customers' demands. It improves flexibility, pragmatism, dynamism, adoption, and absorption, bringing optimization to the processes and reducing costs and wastage. These processes lead to lean management, attract customers, and gain above-average returns, rapport, and image. Organizations can have a good picture of the discrepancies and correct them on time, avoiding too many organizational losses. These also lead to organizational sustainability, resilience, and flexibility. The more important concept which came out in the study is organizational agility creates a focused environment where all the required resources are collocated for the desired operations, optimal utilization of the sources, and most importantly, keeping the customer in the loop. This further leads to the development of customer knowledge bases and bolsters effectiveness, efficiency, and organizational performance.

Moreover, organizational agility strives for corporate sustainability performance, where motivations and drivers are aligned with customers' needs, government regulations, enterprise environmental factors, and organizational process assets and goals. Therefore, managers should pay more attention to the social, environmental, and governance factors, which directly and indirectly lead to cost and waste reduction, performance improvement, sustainability, maintainability, and organizational development. Hence, agility in the dynamic business world can provide capability, flexibility, and innovation.

6. Conclusions

Over the years, the manufacturing industry has faced considerable pressure regarding sustainable manufacturing practices. Today, in this regard, organizational agility has emerged as a phenomenal construct ensuring the firm's sustainable practices and green procurement. Significantly, the research provides valuable insight into the firms' sustainable practices. The current study shows a positive impact of operational, customer, and partnering agility with sustainable manufacturing practices. It also concludes a positive mediating and moderating role of green procurement and big data with sustainable manufacturing practices. This study helps manufacturing firms understand the critical factors influencing sustainable practices. It encourages researchers and practitioners to formulate a new understanding of agility. It drives industry professionals to redesign their business operations and processes to satisfy customers' needs. Altogether, the study suggests the integration of profound constructs (e.g., green procurement, big data) in the manufacturing sector of Pakistan.

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Appendix A. Measurement Scales

Independent Variable: Organizational Agility	
Operational Agility	The reliability of our offerings [i.e., services and products] has increased.
	Our offerings are more cost-efficient than competitors.
	We accomplish greater speed in delivering our offerings.
	We have greater flexibility in our offerings to adopt market changes.
	We efficiently redesign our offerings to adopt market changes.
	We are very quick to adopt market opportunities.
Customer Agility	We extrapolate key trends to gain insight into what users in a current market will need in the future.
	We attempt to develop new ways of looking at customers and their needs.
	We sense our customers' needs even before they are aware of them.
	When we identify a new customer need, we are quick to respond to it.
	We quickly implement our planned activities regarding customers.
	We quickly react to fundamental changes regarding our customers.
Partnering Agility	When we partner, employees accomplish greater soft skills required to manage customer encounters
	When we partner, we can combine, recombine, and create new business processes at short notice.
	Through online, rapid, and up-to-date communication across the partnership, we can reduce information discrepancies.
	Working with partners gives us the ability to innovate our service offerings technologically.
	Working with partners brings about new ways of managing organizational structures and partnerships.
Dependent Variable: Sustainable Manufacturing Practices	

Sustainable Manufacturing Practices	Savings of energy during the manufacturing process
	Emissions reduction during the manufacturing process
	Improve manufacturing and machines efficiency
	Utilize lean production process
	Commitments to sustainable programs, standards, or regulations
	Setting sustainable targets and objectives
	Measure and inspection of material flows or wastes
Mediator Variable: Green Procurement	
Green Procurement	Our organizations' purchase eco-labeled products.
	Our organization cooperates with suppliers for environmental objectives.
	Our organization enforced supplier's ISO 14001 certification.
	Our purchasing department participates in the design of products for recycling or reuse.
	Our purchasing department actively contributes to the reduction of packaging material.
	Our purchasing department seeks suppliers with low energy consumption.
	Our purchasing department asks suppliers to commit to waste reduction goals.
Moderator: Role of Big Data	
Role of Big Data	The incorporation of big data technology helps the company to carry out operations related to environmental sustainability.
	The lack of big data technological advancements results in an adverse effect on the company's performance.
	Big data technology is essential for the company as these involve increased efficiency of the company.
	Capability integrates the operations of the business.

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