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Quantitative Analysis of Sustainable Use of Construction Materials for Supply Chain Integration and Construction Industry Performance through Structural Equation Modeling (SEM)

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Abstract: This research focuses on the mediating role of construction materials, sustainable use between the construction supply chain integration and the construction industry performance. In this concern, the case of Pakistan was considered specifically. The research design employed in this study was quantitative and a close-ended survey questionnaire was used as a research instrument. The sample size used is comprised of 300 participants and analysis was performed through the Structural Equation Modelling (SEM). The results revealed that the effect of the components of supply chain integration on the construction industry performance was statistically significant. Moreover, outcomes also substantiate the mediation role of using construction material sustainably. The scope of the research was limited to the construction industry of Pakistan; however, future research would focus on other countries and industries.

Keywords: supply chain integration; sustainability; industry performance; construction materials

1. Introduction

The awareness of sustainability has been one of the highly discussed topics in the current era where businesses are looking forward to dealing with asset maintenance for attaining substantial benefits. Neri (2016) [1] has highlighted that the construction material required for the building is often extracted from natural resources and its sustainability is imperative for long term use. Moreover, based on the arguments of Jagtap et al. (2017) [2], the sustainability of construction building material is one of the major aspects in the construction and building. Khatib (2016) [3], argued that despite of relying on technology and developed materials, construction companies prefer using the raw materials which are available naturally. According to the assessment of Jajja et al. (2018) [4], the organisations are looking forward to using renewable resources which are sustainable and affordable. The study of Asamoah et al. (2016) [5] has also highlighted the means of implementing construction supply chain integration which are necessary for the organisations to develop

close collaboration with the suppliers in order to improve the response time of the construction business. In this regard (Lushnikova and Dvorkin, 2016) [6], it has also been observed that the construction organisations lookout for better methods that are sustainable and can be improved for reusing the natural resources.

It is necessary for businesses to manage economic operations and increase the efficiency of waste management to gain better performance and profitability (Pakurar et al., 2019) [7]. It has been discussed at various platforms that the efficiency and effeteness of supply chain management are key to a profitable business. It is imperative for businesses to deal with effective and sustainable operations in supply chain management in construction firms (Shaikh et al., 2020) [8]. This research focuses on the sustainability of construction material, supply chain integration and the performance of the construction industry in Pakistan. The reliable results are based on the data which is collected from various sources.

The study of Asamoah et al. (2016) [5] has posited that the environmental burden arrives at different stages within the construction material in terms of its extraction and using natural raw materials. Fernandez et al. (2019) [9] further emphasize that the construction firms must address the issues of sustainability of the natural resources with the regulations of corporate governance. The methods of green supply chain operations can reduce waste and increase efficiency of the system. In this regard, the integration of supply chain methods is absolutely imperative for increasing the effectiveness of supply chain management within construction firms.

Pati et al. (2016) [10] and Werikat (2017) [11] studies highlight the important challenges within the current environment to deal with the sustainability of the construction firms, such as the population growth, clean energy supply and the availability of fresh water. The study of Siagian et al. (2017) [12] explores the salient aspects of climate change and the sustainability of operations to maintain the quality of the raw material of the construction firms.

The research presented herein has contributed towards increasing the sustainability of the raw material which is used in the construction firms. Moreover, the study has also added value towards increasing the efficiency and effectiveness of supply chain management within the construction firms of Pakistan. The study has particularly addresses the challenges and issues that are faced by the maintenance of sustainable operations within the supply chain management in the construction firms. The research has further observed the changing nature, trends and the current performance of construction firms in Pakistan.

The aim of the research is to conceptualise the key points to understand the application of construction materials sustainability, supply chain integration and construction firms' performance in Pakistan. The researcher has aimed to evaluate the construction sustainability within the operations and the processes that are implemented in these firms. Another aspect of the study is to assess and evaluate the mediating role of construction material sustainability on the construction supply chain integration and the current performance of supply chain management in the country. A survey questionnaire, quantitative data and data analysis techniques are adopted to achieve these objectives. The results corroborate with the statistical inferences and depict a significant picture of the impact of supply chain integration on performance through the mediating role of sustainable utilization of construction material.

2. Literature Review

2.1. Construction Material's Sustainable Use

The study of Mesa et al. (2016) [13] has addressed that the means of sustainability within the construction organisations is an important factor for dealing with the issues of governance and solving problems of ethics while performing operations. According to the assessment of Jagtap et al. (2017) [2], the EPA (Environmental Protection Agency) act deals with the construction organisations for better environmental responsibility and becoming resource efficient for the ongoing operations. The authors could find only limited number of publications which address the need of assessing sustainable use of construction material. Fernandez et al. (2019) [9] analysed that there is a variety of operations that can

be used for initiating the sustainable factors for managing efficient use of construction resources. The use of material that is extracted from the natural resources requires effective treatment for dealing with the sustainable resources (Werikat, 2017) [11]. The organisations that are working in the construction business need to reduce the environmental factors which are associated with ethical and sustainable use of resources. Manandhar et al. [14] emphasized on achieving the sustainable development goals that are designed by the government and regulating authorities.

In the study,

Hypothesis 1 (H1). *Components of supply chain integration which affect the construction industry performance significantly.*

2.2. Construction Supply Chain Integration

According to the assessment of Siagian et al. (2017) [12], supply chain operations are based on the nature of the business irrespective of its size or scale of operations. The study of Zeng et al. (2018) [15] has highlighted that the means of effective applications of supply chain operations can be effective for a company to reduce the overall cost of operations and waste management for gaining higher benefits. Based on the assessment of Abebe and Desalegn (2019) [16], the supply chain integration has a higher initiation in the construction field where the businesses can achieve higher sustainability through the operations and maintaining ethical practices. Sameer and Bringez (2019) [17] posited that supply chain integration is necessary for construction companies to improve performance and profitability. According to Kesidou and Sovacool (2019) [18], the key principles to be used within the businesses to deal with environmental safety and ethical practices, the supply chain management provides efficient means of supply chain integration.

The term integration means associating different key members who are involved in the operations under one stage and deal with the management techniques. This integration enhances the collective performance for the distribution and end-support of the products (Liu et al., 2020) [19]. While conducting the assessment of supply chain integration within the construction firms, the study of Pati et al. (2016) [10] has revealed that the means of supply chain integration are based on the collective approach for combining all the key members of the operations under one roof.In this integration, proper distribution of tasks optimises operations and result in better performance.

In the study,

Hypothesis 2 (H2). *Construction material's sustainable use affects construction industry performance significantly.*

In the study,

Hypothesis 3 (H3). *Construction material's sustainable use mediates the relationship between components of supply chain integration and construction industry performance significantly.*

2.3. Construction Industry Performance

The construction industry is one of the highly developing sectors in Pakistan that has been providing a major share within the country's economy. The study of Neri (2016) [1] has highlighted that the construction firms of Pakistan have been contributing towards the socio-economic development and provided opportunities for the development and employment of the country. Based on the assessment of Kesidou and Sovacool (2019) [18], there are some issues that have created problems for this sector. Pakistan is a developing country and nearly 30–35% of the country's population is affiliated with construction sector. According to the assessment of Zeng et al. (2018) [15], a number of issues have curtailed the performance of this industry and it could not excel to make much more profit. One of the major issues is the lack of electricity which makes a huge difference in the profitability of the sector.

According to the assessment of Papadopoulos et al. (2016) [20], the government of Pakistan has invested and planned a major expansion for the infrastructure of the country that requires a sum of nearly the US $36 billion. Similarly, the infrastructure of the water and irrigation systems and other public sectors has also been developed for a better contribution to the country's growth (Kesidou and Sorrell, 2019) [18]. Overall, the country has been making effective progress in the improvement of infrastructure. According to the assessment of Ocheoha and Moselhi (2018) [21], the government of Pakistan has been making remarkable growth in developing the country's infrastructure and has also aimed to deliver the best version of developed infrastructure in the coming years.

2.4. Relationship between Construction Supply Chain Integration and Construction Industry Performance

The study of Kesidou and Sovacool (2019) [18] has emphasised the fact that implementing supply chain management within the construction firms is necessary for increasing the overall performance and profitability. According to the assessment of Abebe and Desalegn (2019) [16], the application of supply chain management operations ensures better operations and higher value for the company. According to the analysis of Othman et al. (2016) [22], the integration of supply chain management deals with enhancing the quality of work and achieving the optimised level of work for supply chain operations. The study mentioned that manufacturing organizations need to implement the strategies for marketing and sales for sustainable practices of supply chain operations.

The study of Mesa et al. (2016) [13] has discussed the strategies of supply chain management which are not only useful but also effective for increasing the quality of operations and enhancing the expertise and reporting of the daily system. According to the research conducted by Demirkesen and Ozorhon (2017) [23], the process of supply chain management is based on involving the business process of other organisations that deal with the main elements of the construction industry.

Jajja et al. (2018) [4] study has added that the means of supply chain management is comprised of different operations that can be used for dealing with the day to day requirements. These include the raw material required for construction, managing the logistics and operations for meeting the needs of supply chain management. There are different participants of supply chain integration that include the suppliers, contractors, sub-contractors, owners, designers and the builders who combine to deal with the requirements of supply chain management. The government of different countries is taking initiatives for solving the issues of supply chain integration to meet the current needs of supply chain management for better performance and profitability of the construction firms (Kesidou and Sovacool, 2019) [18]. The construction firms often face the issues of fear, dishonestly and frustration from the owner and the contractors that might have a different view of thinking for building the new firms and showing the minimal exchange of information for the end-users. According to the assessment of Papadopoulos et al. (2016) [20], the implications of supply chain management integration are imperative for a system that deals with the process of better performance and higher sustainability.

Supply chain integration is an effective procedure that can be used by organisations for gaining better performance and profitability in the organisations. The study of Ocheoha and Moselhi (2018) [21] on supply chain management theory can be applied within the current study as it is comprised of logistics theory that effectively deals with the aspects of waste management within the organisations. Moreover, it is also based on the logistics operations and the processes that can be used for effective processes and procedures for creating value. The study of Kesidou and Sorrell (2019) [18] has highlighted that supply chain management improves the production of operations and carries out lean thinking for better processes and better profitability. According to the assessment of Munro and Childerhouse (2018) [24], the operations based on supply chain integration can be used for effective workflow and just in time practices for timely construction of delivery processes. Similarly, the research conducted by Abebe and Desalegn (2019) [16] has also highlighted the need for social interaction theory that can be used for promoting the processes and

procedures for effective supply chain integration and the process that are related to the processes of construction firms. The conceptual model is presented in Figure 1:

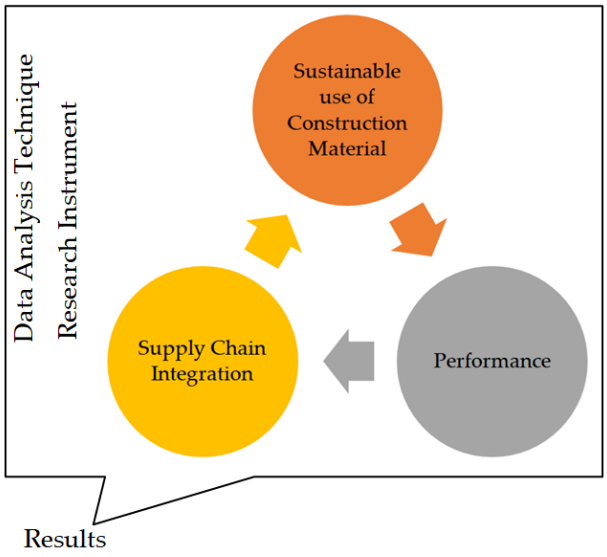


Figure 1. Conceptual model.

2.5. Mediating: Sustainable Use of Construction Material

The conceptual model shown in Figure 1 is used for testing and evaluating the variables selected in this study. The selected variables include supply chain integration, the performance of construction firms and the sustainable use of construction material. The model presents the interrelation between these variables. The model was analysed through quantitatively analysis method. In the analysis, supply chain integration is considered as independent and organisational performance as dependent variable. Since the study has emphasised on the sustainable use of construction material, therefore mediating is selected as another major variable. The selection and analysis of these variables has been carried out for systematic assessment of the topic and showing considerable changes with the study variables. The variables are presented in a manner that can be used for understanding the interrelation between the variables and making considerable changes for dealing with it. The studies conducted by Kisku et al. (2017) [25] and Sharma et al. (2017) [26] show that the aspect of sustainable use in construction material is highly ethical which is based on the corporate responsibility for safeguarding the natural resources.

3. Data Collection

3.1. Data Collection Technique

The process of data collection is one of the most important components of the research methodology. A quantitative approach to data collection was adopted with deductive reasoning. A survey questionnaire was designed to collect this data from the research respondents. The short listing of respondents and inviting them to participate in the research study was performed convincingly without compromising on the quality of this research.

Prior to the study, a consent form was provided to all the participants. This form included important aspects of the research study, such as the title, aims and objectives, research questions and their research hypotheses and so forth. The participants were shortlisted by using a sampling technique which is described in the next subsection. A survey questionnaire was provided to the selected participants to fill up the primary quantitative data which was used subsequently as a research instrument. The completed survey forms were collected through emails or personal visits.

3.2. Sample Size and Sampling Technique

The sample size and sampling strategy are the most important concerns primarily due to the reason that these set the ground for the reliability, validity and triangulation of analysis of the research. The appropriate sample size in terms of the magnitude or the number of participants is important. However, some other aspects related to the sample are also vital, such as the strategy deployed to collect the data and the extent to which it represents the overall population to get the ecological validity of the results.

In this study, the contractors were selected who were registered with the Pakistan Engineering Council (PEC). Till to date, a total of 20,593 contractors are registered with PEC under eight different categories which depend on the project cost limit. For example, in category CA a total of 195 are registered which ask no cost limit, in category CB a total of 123 are registered which limits the project cost up to 4000 million PKR, in C1 a total of 353 are registered which restricts the project cost up to 2500 million PKR, in C2 a total of 1013 are registered in which project cost is limited up to 1000 million PKR, in C3 a total of 1627 are registered and project cost is limited up to 500 million PKR, in category C4 a total registered contractors are 3521 and project cost is limited up to 200 million PKR, in C5 a total of 4686 are registered in which cost is up to 65 million PKR and the last category is C6 in which total registered contractors are 9075 and project cost is up to 25 million PKR. Dillman et al. (2014) [27] concluded that a minimum sample size of 246 is a good approximate for such a population size with a confidence interval 95% and sampling error of 5%. Considering this, in this study a sample size of 300 (n = 300) is selected and primary quantitative data is collected from 300 different individuals.

The sampling strategies can be categorized into probability sampling strategies and non-probability sampling strategies. This research has deployed a non-probability sampling strategy, namely the purposive sampling. Purposive sampling is a judgmental sampling strategy in which the reliance is based on the judgment of the individuals who are involved in conducting research and the choices of the participants are significant for the analysis.

3.3. Qualitative Research Instrument

As stated earlier, the survey questionnaire was used to collect data from the research participants. Apuke (2017) [28] has discussed various research instruments that pertain to contemporary research and are used by contemporary scholars and researchers. In this connection, qualitative research instruments are different from quantitative research instruments. Survey questionnaire provides numerous advantages to the researcher. Therefore, this instrument is adopted for collecting the desired data from the research participants. One of the most important advantages of this research instrument is the simplicity by virtue of which it can connect the desired data. The speed with which data can be collected by using a survey questionnaire is also paramount to the selection of the research instrument (Schutt, 2019) [29]. Survey questionnaire provides an opportunity to collect primary data in a fast manner, as compared to other research instruments, such as interview questionnaires and case studies.

For the presented study, the designed questionnaire is divided into two main sections. The first section comprised of the demography of respondents and company information that is the qualification, designation, years of experience and contractor category type. The second section included the latent construct variables which as tabulated in Table 1. The respondents were asked to score it considering a likeness scale of 1 to 5 (1 strongly disagree; 2 disagree; 3 neither agree nor disagree; 4 agree; 5 strongly agree). The five point Likert scales is a highly acceptable and reliable scale for questionnaire surveys (Dillman et al., 2014) [27]. Table 1 summarizes the demography of respondents and received responses.

Table 1. Respondents' demography and received responses.

Contractor Category	Position of Respondents	Experience (Years)	Number of Responses Received
CA	Project managers	10–15	15
	Resident engineers	12–16	18
CB	Construction managers	08–12	20
	Site inspectors	06–19	25
C1	Project managers	12–15	27
	Site inspectors	05–15	27
C2	Resident engineers	11–14	33
	Construction managers	12–16	18
C3	Directors	15–20	25
	Resident engineers	08–12	32
C4		12–15	20
C5	Resident engineers	10–16	20
C6		12–14	20
	Total		300

4. Research Methodology

4.1. SEM and CFA

Partial least squares structural equation modelling (PLS-SEM) has become a highly accepted tool for analysing relationships between latent variables. SmartPLS software offers a graphical user interface for modelling variance-based structural equations. In this study, SMARTPLS has been used as the primary data analysis technique along with the structural equation modelling (SEM). Structural equation modelling is a multivariate statistical analysis technique which combines factor analysis and multiple regression analysis. It is used to analyse the structural relationship between measured variables and latent constructs. The main advantage of this technique is that it approximates the multiple and interrelated dependence in a single analysis. Moreover, this approach provides the theoretical reliability and validity and measurement errors can also be incorporated which provides a strong case for such type of research study. Due to these advantages, structural equation modelling was used a confirmative approach in this research.

Researchers have applied SEM in construction research to examine the medication effects on performance of construction projects, bonding relationship and collaborative behaviour. For instance, Iyer and Jha (2003) [30] applied SEM and evaluated that if the materials supplier are engaged at the project planning stage, they have influential role in determining the contractors' supervision and project growth. Sarkar et al. [31], studied different variables to evaluate the mediation role of construction material providers on contractors. Molenaar et al.'s [32] examined the multiple effects on contract disputes between owners and construction materials contractors with the help of SEM. Lee et al. used SEM to study the effects of different variables on and the user satisfaction in terms of the construction management efficiency [33]. Xiong et al. (2014) [34], studied the influence of participant performance factors on contractor satisfaction through a structural equation model. Likewise, Chen et al. (2012) [35] investigated the success variables of construction partnering using structural equation modelling. Chinda et al. (2008) [36] adopted a structural equation model to evaluate the construction safety culture.

Usually, a structural equation model is developed with two main components, a structural model and some measurement models. The measurement model involves latent variables, observed variables and related measurement errors. For example, Figure 2 explains the structural equation model investigating the effect of LV Y1 on LV Y2., Where, the arrows indicate the direction of the effects, ellipses show the LVs, rectangles represent measurement variables (MVs) and circles show the measurement errors. The model is analysed through confirmatory factor analysis (CFA) when directional arrows between Y1 and Y2 are replaced by the correspondence two-way arrows.

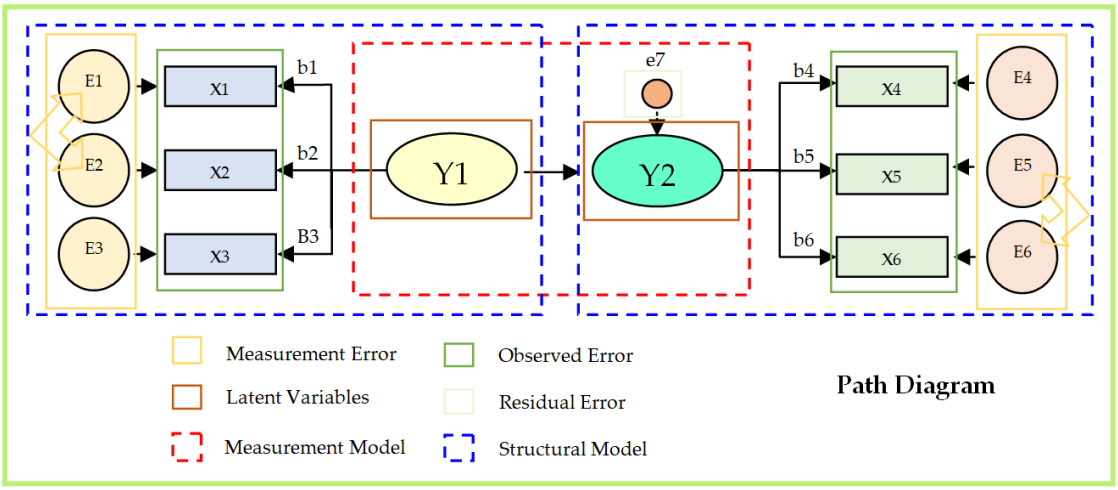


Figure 2. Structural equation modelling (SEM).

Confirmatory factor analysis (CFA) is deemed a primary step towards the application of the SEM model. The confirmatory factor analysis (CFA) is a multivariate statistical method. It is used to estimate how well the measured variables correspond to the number of constructs. Confirmatory factor analysis (CFA) technique is convincingly applied in many cases because it allows specifying any number of factors required in the data and identify which measured variable are related to which latent variable. On the basis of outcomes, CFA is used to verify or refuse the measurement theory. SEM approach in this study is explained in Figure 3.

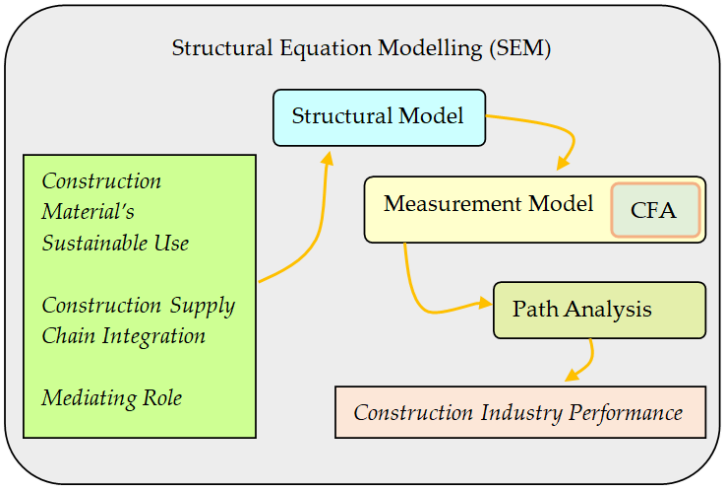


Figure 3. Variable for structural equation modelling.

Firstly, it examines the validity of the indicators of the latent constructs that are based on their outer loadings. The study conducted by Kline (2015) [37] proposed that an outer loading above 0.6 is most appropriate. In this concern, the results presented in Table 2 can be regarded as showing valid indicators as all the indicators possess higher values than 0.6. In addition, the reliability of the constructs has been tested by using Cronbach Alpha and composite reliability. The research of Brown (2015) [38] indicated that the threshold for both reliability metrics can be assumed 0.7. Considering this, the values presented in Table 2 can be considered reliable as none of the constructs reliability value is below 0.7. Besides the convergent validity, where it relates to the two constructs, AVE is used whose threshold is considered to be 0.5. The results presented in Table 2 indicate that all the latent constructs are statistically valid.

Table 2. Reliability and convergent validity.

Latent Constructs	Indicators	Outer Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
BMCC Eco-Design (BED)	BED1	0.90 ***	0.94	0.95	0.84
	BED2	0.91 ***			
	BED3	0.92 ***			
	BED4	0.94 ***			
Backward Integration (BI)	BI1	0.79 ***	0.88	0.91	0.67
	BI2	0.84 ***			
	BI3	0.80 ***			
	BI4	0.83 ***			
	BI5	0.83 ***			
Construction Industry Performance (CIP)	CIP1	0.90 ***	0.89	0.93	0.81
	CIP2	0.93 ***			
	CIP3	0.87 ***			
Construction Waste Sustainable Treatment (CST)	CST1	0.90 ***	0.90	0.94	0.83
	CST2	0.94 ***			
	CST3	0.90 ***			
Forward Integration (FI)	FI1	0.87 ***	0.92	0.94	0.80
	FI2	0.92 ***			
	FI3	0.88 ***			
	FI4	0.91 ***			
Material Procurement and Consumption (MPC)	MPC1	0.84 ***	0.80	0.88	0.72
	MPC2	0.91 ***			
	MPC3	0.79 ***			
Reverse Logistics (RL)	RL1	0.88 ***	0.85	0.91	0.77
	RL2	0.88 ***			
	RL3	0.88 ***			

*** Indicating significance at 1%.

The heterotrait-monotrait ratio of correlations (HTMT) is used to evaluate discriminant validity in partial least squares structural equation modelling. This is an important building block to evaluate the model validity. As compared to the classic approaches, such as Fornell-Larcker criterion and (partial) cross-loadings, HTMT method provides excellent means to validate discriminant. Considering this, the HTMT ratio has been used in this study. The maximum acceptable value of HTMT is 0.85 (Leguina, 2015) [39]. The results presented in Table 3 indicate that all constructs are distinct in nature as none of the values is higher than 0.85.

Table 3. Discriminant validity using heterotrait-monotrait ratio of correlations (HTMT) ratio.

	BMCC Eco-Design	Backward Integration	Construction Industry Performance	Construction Waste Sustainable Treatment	Forward Integration	Material Procurement and Consumption
Backward Integration	0.696					
Construction Industry Performance	0.549	0.516				
Construction Waste Sustainable Treatment	0.513	0.496	0.583			
Forward Integration	0.753	0.717	0.591	0.574		
Material Procurement and Consumption	0.490	0.553	0.607	0.378	0.546	
Reverse Logistics	0.606	0.733	0.252	0.282	0.616	0.505

4.2. Path Analysis

The bootstrap method is an important re-sampling technique. It is used to approximate statistical inferences by taking a random sample with replacement. Most often, this is applied as an alternative tostatistical inference when the assumption in a parametric model involves complicated formulas for the calculation ofstandard errors. Bootstrapping applies

bias, variance, confidence intervals and so forth, to sample estimates to evaluate accuracy. Moreover, this technique can also be applied for constructinghypothesis tests. For the examination of the hypotheses made earlier, bootstrapping technique is applied (Hair et al., 2016) [40]. This technique helped in obtaining the significance values.

The results of direct effect presented in Table 4 indicate that the effect of RL (B = −0.257; *p*-value < 0.05), BI (B = 0.131; *p*-value < 0.05) and FI (B = 0.193; *p*-value < 0.05) on CIP is significant. Here, all the effects are computed positive except for RL on CIP. The effect of RL (B = 0.124; *p*-value < 0.05), BI (B = 0.256; *p*-value < 0.05) and FI (B = 0.466; *p*-value < 0.05) on BED is also significant and positive. In addition, CST was another mediator which shows the impact of RL (B = −0.154; *p*-value < 0.05), BI (B = 0.263; *p*-value < 0.05) and FI (B = 0.435; *p*-value < 0.05) is significant. Also, the effect of RL (B = 0.153; *p*-value < 0.05), BI (B = 0.196; *p*-value < 0.05) and FI (B = 0.264; *p*-value < 0.05) on MPC is computed to be statistically significant. Lastly, the impact of mediator BED (B = 0.173; *p*-value < 0.05), CST (B = 0.241; *p*-value < 0.05) and MPC (B = 0.318; *p*-value < 0.05) have significant and positive effect on CIP on Pakistan.

Table 4. Direct effect.

Path	Path Coefficient	T Statistics	*p* Values
BMCC Eco-Design → Construction Industry Performance	0.173 **	2.191	0.029
Backward Integration → BMCC Eco-Design	0.256 ***	3.175	0.002
Backward Integration → Construction Industry Performance	0.131 **	1.962	0.050
Backward Integration → Construction Waste Sustainable Treatment	0.263 ***	3.082	0.002
Backward Integration → Material Procurement and Consumption	0.196 **	2.433	0.015
Construction Waste Sustainable Treatment → Construction Industry Performance	0.241 ***	3.815	0.000
Forward Integration → BMCC Eco-Design	0.466 ***	7.227	0.000
Forward Integration → Construction Industry Performance	0.193 **	2.537	0.011
Forward Integration → Construction Waste Sustainable Treatment	0.435 ***	5.788	0.000
Forward Integration → Material Procurement and Consumption	0.264 ***	3.634	0.000
Material Procurement and Consumption → Construction Industry Performance	0.318 ***	5.062	0.000
Reverse Logistics → BMCC Eco-Design	0.124 **	2.041	0.041
Reverse Logistics → Construction Industry Performance	−0.257 ***	4.057	0.000
Reverse Logistics → Construction Waste Sustainable Treatment	−0.154 *	1.914	0.056
Reverse Logistics → Material Procurement and Consumption	0.153 **	2.130	0.033

*** Indicating significance at 1%, ** at 5%, * at 10%.

The results presented in Table 5 indicate the specific indirect effect. It is evident that except for mediation of BED between BI and CEP, BED between RL and CIP and CST between RL and CIP, all are statistically significant because their computed *p*-values are lower than 5%.

Table 5. Specific indirect effect.

Path	Path Coefficient	T Statistics	*p* Values
Backward Integration → BMCC Eco-Design → Construction Industry Performance	0.044 *	1.858	0.063
Forward Integration → BMCC Eco-Design → Construction Industry Performance	0.081 **	2.085	0.037
Reverse Logistics → BMCC Eco-Design → Construction Industry Performance	0.022	1.264	0.206
Backward Integration → Construction Waste Sustainable Treatment → Construction Industry Performance	0.064 **	2.389	0.017
Forward Integration → Construction Waste Sustainable Treatment → Construction Industry Performance	0.105 ***	3.076	0.002
Reverse Logistics → Construction Waste Sustainable Treatment → Construction Industry Performance	−0.037 *	1.708	0.088
Backward Integration → Material Procurement and Consumption → Construction Industry Performance	0.062 **	2.195	0.028
Forward Integration → Material Procurement and Consumption → Construction Industry Performance	0.084 ***	2.875	0.004
Reverse Logistics → Material Procurement and Consumption → Construction Industry Performance	0.049 **	1.990	0.047

*** Indicating significance at 1%, ** at 5%, * at 10%.

Table 6 indicates that the total computed effect is significant. Therefore, BI, FI and RL significantly affect the CIP of Pakistan, however, only RL is found to have a negative effect.

Table 6. Total effect.

Path	Path Coefficient	T Statistics	*p* Values
Backward Integration → Construction Industry Performance	0.301 ***	4.000	0.000
Forward Integration → Construction Industry Performance	0.463 ***	6.969	0.000
Reverse Logistics → Construction Industry Performance	−0.224 ***	3.448	0.001

*** Indicating significance at 1%.

4.3. Quality of the Model and Predictive Relevance

The main model is indicated by the construction industry's performance. The results given in Table 7 indicate that the variance of CIP is 48.17% and its value is reduced to 47.11% by applying adjusted R-squared. In terms of predictive relevance, the blindfolding technique was applied to obtain Q-square. It is recommended to have Q-square above 0 (Hair et al., 2016) [40], therefore, the results shown in Table 7 illustrate that the model used in this study possesses predictive relevance.

Table 7. Model's quality and predictive relevance.

	R Square	R Square Adjusted	Q Square
BMCC Eco-Design	55.57%	55.12%	0.435
Construction Industry Performance	48.17%	47.11%	0.362
Construction Waste Sustainable Treatment	30.49%	29.79%	0.237
Material Procurement and Consumption	28.16%	27.43%	0.184

4.4. Hypotheses Assessment Summary

The hypotheses constructed earlier are summarized in this section. The results are shown in Table 8.

Table 8. Summary of hypotheses.

Hypotheses	Decision
H1: Components of supply chain integration affect the construction industry performance significantly	Proved
H2: Construction material's sustainable use affects construction industry performance significantly	Proved
H3: Construction material's sustainable use mediates the relationship between components of supply chain integration and construction industry performance significantly	Proved

5. Discussion

The results and the findings of this research study are believed to be important for contemporary research in the domain of supply chain integration and industry performance. The ability of a construction firm to integrate its processes with the supply chain partners set a construction firm in a position to respond to the dynamic needs of the market. It is evident from the literature review that construction firms have faced a major challenge in the integration of supply chains internally as well as externally. As a result of this, successful integration can potentially be a major contributor to performance improvement. The supply chain integration attempts to resolve the challenges that are encountered within the business environment and enhance the external and internal linkages.

Nevertheless, it is important to understand that an element of trust with the supply chain partners is extremely important. This is where integration is impeded by vested interests and conflicting goals (Neri, 2016) [1]. Consequently, the aim of this research study was to investigate the integration impact on industry performance of construction firms. The critical mediating role of sustainable utilization of construction material on the performance has been explored specifically. In the literature review, it is discussed that the

element of internal integration is primarily coordinated and it is a strategic alignment of business processes. It also undertakes the functions of the construction firm within the organizational context so that maximum performance may be attained (Othman et al., 2016) [22].

The results of this study are aligned with the previous findings available in published literature. The diverse range of elements or contributors in the supply chain integration necessarily impacts the performance. These elements may include cost reduction or limitation of responsibilities of various departments within an organization. In the context of the obtained results, it has been found that the impact performance is enhanced and strengthened by the mediating role of utilizing construction material sustainably. In this research, both of these concepts, namely the supply chain integration and sustainable utilization of construction material have been used as important constructs or variables. Various hypothesises were considered to execute the statistical techniques and evaluate the statistical inferences. Consequently, it has been explicitly deduced that the results of supply chain integration impact the performance through the mediating role of sustainable utilization of construction material.

The first objective was to assess the components of supply chain integration that affect the industry performance due to the construction firms. The investigation was based on quantitative analysis and provided promising results. This means that supply chain integration plays a major role in increasing the supply chain performance of the organizations which depend on construction firms. The results also corroborate with the findings of Al-Werikat, (2017) [11]. Additionally, the researcher has also addressed the increasing profitability of construction firms with the help of better supply chain methods. It was analysed that waste management can be profitable for companies in this regard. The second objective was to carry out a detailed investigation on the sustainable use of construction material that can be effective for initiating renewable energy for better operations adopted by the construction teams.

The research finding has also been supported with the discussion of Kesidou et al. (2019) [18]. The work provided several facts regarding the sustainable and long term use of resources for construction organizations. The researcher has addressed several arguments that have created a synthesized aspect for the organizations for gaining higher profitability. Similar research was carried out by Kisku et al. (2017) [25]. Their work highlighted that the sustainable use of resources can be more profitable for construction firms. These firms must maintain ethical practices and shall apply the strategies of corporate governance that is necessary for gaining long term sustainability. Another hypothesis that was designed for the presented research focuses on the fact that construction material's sustainable use mediates the relationship between components of supply chain integration and construction industry performance.

6. Conclusions

To conclude, the main aim of this research was to investigate the relationship between supply chain integration and its performance while taking into account the mediating role of sustainable utilization of construction material. This aim was realized through quantitative research for the conventional construction firms in Pakistan. A survey questionnaire was designed and quantitative data were collected. Data analysis techniques were employed with explicit objectives to statistically evaluate the selected hypotheses. The results presented a statistically significant picture of the impact of supply chain integration on performance through the mediating role of sustainable use of construction material.

On the basis of findings and results, the hypotheses were approved. The outcomes were also supported with the available published reports. For example, the obtained results corroborate with the study conducted by Sudharsan et al. (2018) [41]. The work emphasised on the factors which are linked with sustainable use of resources and supply chain integration and lead towards enhancing profitability and progress of construction firms.

This research is useful for the construction industry in general and the conventional construction firms in particular. The significance of this research is twofold. Firstly, from an academic perspective, this research provides a valuable insight into the theoretical con-

cept of supply chain integration. Secondly, it elaborates the concept of sustainable use of construction material and its paramount significance on the performance. From an academic perspective, it also illustrates the three operational concepts that are significant in the construction industry. From the industry perspective, this research is also highly significant. The construction firms may seek the benefits of supply chain integration in their business.

Various areas may be improved under the banner of supply chain integration. At the same time, sustainable use of construction material can also be potentially expanded throughout the construction industry for attaining better results from the construction sector. It is obvious that by promoting the sustainable use of construction material, like a 'best practice' across the construction industry, the construction sector would be a significant contributor to the country's gross domestic product. Moreover, it is highly likely that this boom would create immaculate options for growth.

7. Recommendations

Two important recommendations may be drawn from the analysis. First, the concept of supply chain integration must not be limited to the integration of one or two aspects of the supply chain. This concept entails and encapsulates four distinct aspects: namely the customer integration, supplier integration, internal integration and information integration. Working on all of these aspects is important to obtain the benefits of supply chain integration. The second recommendation emphasizes the expansion of sustainable use of construction material because the construction material is an important contributor to the performance of construction firms.

8. Limitations and Future Research Directions

The research outcomes are in form of ecologically valid and reliable results. Especially, the relationship between supply chain integration and performance is statistically significant. However, the most important limitation is that only the quantitative aspect of research design is explored; there are other important aspects that give an insight into the concept of sustainable use of construction material and supply chain integration in the construction industry. Studying other aspects would have added value to contemporary research in this domain. There exists a wide opportunity for exploring other variables involved in this domain of research. More importantly, this research was limited to the construction industry of Pakistan; therefore, future research studies would consider other countries and industrial sectors.

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