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Assessing Economic Benefits through Waste Efficient Drivers in Mega Construction Projects: A Case of Pakistan

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Abstract *Waste disposal has become an issue worldwide and the major cause of this issue is considered to be the construction activities producing wastes. Pakistan being the 6 most populated country in the world is considered to have a huge amount of waste due to the various construction and particularly megaprojects and this amount of construction waste is increasing consistently in the country. Pakistan produces of construction waste per year and is increasing annually by 2%. These increasing wastes and issues associated with these construction wastes lead to a crucial need for improvement of waste management practices in the construction industry of the country through various measures. Despite of the large need for waste minimization research in Pakistan, , deductive approach was used, and quantitative method was selected, the present study has used cross-sectional design. The researcher used a sample of 323 individuals and conducted a questionnaire-based study.*

Key Words: Construction Waste Reduction, Waste Efficient Bill Quantity, Effective Materials Delivery Management

Introduction

Construction waste has really become an issue in projects that are mostly caused by a number of activities and practices carried out in all stages of the process of project delivery. Many past researchers have focused their efforts on studying different construction stages of projects. However, few scholars studied material procurement processes and waste efficient drivers in order to diminish the possibilities of waste in construction projects. There is seen less focus of scholars on strategies formulation and execution for using waste efficient drivers in the projects for the sake of reducing construction costs of projects. In developing economies, waste recycling and disposal is really becoming a challenge. A huge portion of waste in those countries is not properly reused and discarded by construction firms thus creating difficulties for waste management by those firms (Maleka, Nyirenda, &Fakoya, 2017). The challenge of waste generation and disposal in Pakistan is also giving tough time and causing ecological pressure on the construction firms and projects operating in the country. The growing amount of waste materials have caused a big issue of sustainability for all the construction firms and construction projects. It has created a big chaos in various construction activities and practices in the Pakistan. Therefore, waste efficient practices and techniques are largely needed by those firms and projects in order to meet with this ecological challenge to enhance and achieve their economic (Ajayi et al., 2015). The solid waste created by construction projects and its processing is really a big challenge for the community and environment worldwide. This is because waste generation per capita is continuously facing incremental trend that seems a real-time challenge for construction project managers and firms and this challenge is more serious specifically in the developing economies of nations. Due to this increased challenge and issue in developing countries, particularly the construction firms in those countries are likely to face a large pressure in terms of environmental,

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social and economic requirements and responsibilities because they have to diminish the ecological impacts and ecological issues and problem possibly arising due to the operations and construction activities of those firms. For overcoming and reducing this ecological pressure, the construction firms really need such operations and practices that assist them to reduce their wastes and adverse impacts of those wastes on the environment. In the EU, a regulatory framework has been set up with the Directive 99/31/EC on landfill to comply with the 3R regulations (Reduce, Reuse and Recycle) aiming towards sustainable construction. (Calvo, Varela-Candamio, & Novo-Corti, 2014). The waste generates by construction and devastation activities in the construction industry needs to be diminished because its reduction is beneficial to both the environment as well as construction firms. Its reduction contributes to the environment by eliminating ecological issues and hazards along with contributing to the firms by reducing their costs overall.

Scholars suggest that when construction firms or projects increase their expenditure on waste management. Similarly, its practices then are likely to come in a position to diminish their waste portion and their ability to achieve targets of waste lessening is expected to augment. Consequently, the achievement of targets regarding waste reduction incorporates various economic as well as ecological benefits for the firms or projects operating in the construction industry and their profitability is expected to augment (Maleka et al., 2017). Studies also suggest that when construction projects or firms focus their efforts on the process of material procurements in terms of waste reduction. They adopt such practices and techniques that have the ultimate effect of reducing waste and cost in the process of material procurement of construction project consequently making the project waste-efficient as well as cost-efficient in those processes. These waste-efficient processes of the material acquisition have a positive influence on waste minimization of construction projects (Ajayi&Oyedele, 2018). Due to the increased significance of the waste minimization for a construction firm from both economic and ecological perspectives, the need for research on exploring and analyzing various causative elements and precautionary measures for waste minimization has evolved and heightened. Many past scholars have conducted researches and also have given a call to future researchers to conduct studies on such instrumental factors. Additionally, measures at various stages of projects like plan & design, procuring & purchasing material as well as the construction stage in order to reduce the waste and to make projects or firm waste-efficient. The inadequate management of MSW is one of the principal challenges for African cities achieving ambitious sustainable development goals (SDGs). Sustainability entails processes and services that meet the needs of the current generations without compromising the ability to serve future generations (Aryampa, Maheshwari, Sabiiti, Bateganya, &Bukenya, 2019).

However, in contrast to the activities at the stages of specific design and construction (that have been largely examined and analyzed in terms of making projects waste- efficient), limited research has been performed on the waste efficiency through the material procurement process and waste efficient drivers of construction waste and cost minimization. Following four vital waste efficient drivers and factors in process of material procurement and acquisition have been recognized in the literature that need investigation ad further confirmation in terms of their contributive role in diminishing construction waste and cost of projects to have ultimate positive influences on success and economic benefits of the construction project: (Ajayi&Oyedele, 2018).

- ‘Suppliers’ commitment to low waste measures’ (SCLWM)
- ‘Low waste material purchase management’ (LWMPM)
- ‘Effective material delivery management’ (EMDM)
- ‘Waste efficient bill of quantity’ (WEBOQ)

Problem Statement

The waste disposal has become an issue worldwide and the major cause of this issue is considered the construction activities producing wastes. The waste produced by construction practices in the construction industry needs to be reduced because its reduction is necessary for the atmosphere. Training and education is another effective way of minimizing waste generation (Udawatta, Zuo, Chiveralls, &Zillante, 2015). Pakistan is considered to have a huge amount of waste due to the various construction and particularly megaprojects and this amount of construction waste is increasing consistently in the country. These increasing wastes and issues associated with these construction wastes lead to a crucial need for improvement of waste management practices in the construction industry of the country through various measures. Furthermore, the literature on

waste minimization in the context of Pakistan is limited and no study is found to give insights and assistance about waste minimization in the construction projects particularly undertaking in Pakistan. This gap of research really needs to be filled with empirical research.

Research Objectives

The proposed study will try to find a solution to the above problem by working on the following research objectives in the context of Pakistan:

- To check the relationship between suppliers' commitment to low waste measures (SCLWM) and construction waste reduction.
- To check the relationship between low waste material purchase management (LWMPM) and the construction waste reduction.
- To check the relationship between effective materials delivery management and the construction waste reduction.
- To check the relationship between waste efficient bill of quantity (WEBOQ) and the construction waste reduction.
- To check the relationship between the construction waste reduction and the economic benefits to the construction project.

Research Questions

The proposed study will address the following research questions in the context of Pakistan:

- What is the relationship between suppliers' commitment to low waste measures (SCLWM) and construction waste reduction?
- What is the relationship between low waste material purchase management (LWMPM) and construction waste reduction?
- What is the relationship between effective materials delivery management and construction waste reduction?
- What is the relationship between waste efficient bill of quantity (WEBOQ) and the construction waste reduction?
- What is the relationship between construction waste reduction and the economic benefits of the construction project?

Literature Review

The Pakistan is facing the serious challenge of waste and its disposal particularly at construction sites and it is deliberated as one of the major producer states of waste. According to the Pakistan Interact (2007), 75 percent of the total waste produced in the Pakistan is considered to be produced by the construction industry. In terms of waste proportion per capita, Pakistan comes at the second number to the USA in the ranking of all countries of the world according to the waste share per capita. Pakistan is expected to have a large number of landfills for the dumping of huge amounts of construction waste and this amount of construction waste is increasing day by day in the country. In addition, a study has shown that construction waste minimization also needs to focus on the design stage of pre-construction projects, which can directly reduce construction waste from sources (Wang, Yu, Tam, Li, &Xu, 2019). These increasing wastes and issues associated with these construction wastes cause an urgent need to arise for improving waste management in the construction industry of the country through waste efficient techniques and processes. As the construction industry of PAKISTAN is booming extraordinarily due to a large number of mega projects and construction contracts that in turn are likely to enhance the waste and ecological concerns, therefore, the need for improving the positive attitude of builders and construction contractors towards waste management and its measurements has augmented. Many prior studies suggested the need for ecological concerns arising due to such mega projects in Pakistan (Lin &Raza, 2019).

Constructions wastes are actually the by-products produced and eliminated from construction, restoration, and destruction at factories or at sites of construction or at public manufacturing structures. Construction waste is described by Environmental Act (1990) as, "Scrap material or effluent or other surplus substances arising from the application of any process." The construction waste is produced at various stages of a construction project

that needs to be reduced at each stage in order to achieve overall waste reduction targets. The past studies suggest many source factors for construction waste but the four main source factors and activities of waste generation in a construction project. There are dominant and recognized in the literature that is 'design, procurement, holding of material and operations of construction' When performing the stage of design of a construction project, a huge amount of waste produces due to several design issues (Huang et al., 2018). It is revealed in past literature that the design of construction projects has a major impact on construction waste thus requiring designers to use models for producing designs that are waste efficient. In this way, the waste minimization process is encouraged and started at the starting stages of the construction projects. On the other hand, the lack of effective regulation is not the root cause of these disparities in Europe. The relationship between environmental innovation and policy is also important (Le Hesran, Ladier, Botta-Genoulaz, &Laforest, 2019).

Waste minimization is about the set of activities carried out to diminish the waste. The activities that are encompassed in waste minimization are first of all waste inhibition in which the construction waste is prevented to be produced, secondly re-use of waste produced and thirdly, the recycling of waste to convert it to something useful. The waste inhibition can be achieved through waste efficient drivers at construction sites. These drivers may encompass industry, governmental policies and constraints, economy and environmental principles. The government may induce waste minimization in construction projects through various strategies and tools including policies, contracts, etc (Umar, Shafiq, & Isa, 2018). Some environmental standards serve as means for construction projects and firms to diminish their waste generation and its impact on the environment as well as to induce their waste minimization.

There are many financial advantages associated with waste minimization because there is a huge cost that is incurred for waste disposal. Therefore, if a construction project or firm works on waste minimization in the stages of the project then it can avoid that huge cost associated with waste disposal. These financial benefits enhance the economic worth of waste minimization along with its ecological worth for firms. A large number of studies have been performed in order to examine the significance of waste minimization, its various drivers and their contribution towards economic benefits to the construction projects or firms (Ajayi&Oyedele, 2018). However, no such research has been performed in the context of Pakistan and Pakistan to investigate these phenomena in the construction projects undertaking particularly in Pakistan.

The planning of material logistics has gained increased importance in construction projects because it can act as a strategic device for the effective operations and management of the construction projects. Material logistics planning is actually about the management of a set of activities involved in the purchase of material, its storage, its wastage and disposal, its alteration and it's delivery. The activities involved in this whole process are covered in material logistics management. Its proactive and effective management is likely to enhance economic benefits for the projects by decreasing cost. Along with cost-saving benefits, it is also expected to have a contribution towards the environmental performance of the project by realizing the sustainability of the construction environment. The enhanced contribution of the management of material logistics towards environmental stability has galvanized the increased awareness about the environmental effects of material logistics (Guzzo, Trevisan, Echeveste, & Costa, 2019). Along with environmental impacts, a large number of past studies are found in the literature that suggests the importance of material procurement measures and their proper management in promoting construction waste and cost reduction. The critical measures used in this process have the potential to diminish the cost and waste of the construction project. Procurement measurements can serve as significant tools for waste minimization in the purchase material stage thus contribute to the overall waste reduction of the project throughout the supply chain.

There are four significant measures recognized in the literature that can assist firm or projects to achieve a waste reduction in material procurement process i.e. the commitment of suppliers towards waste efficient measures, waste efficient purchase management, effective material delivery man agent and low waste bill of quantity (Ajayi&Oyedele, 2018). The SCLWM requires the suppliers to be flexible for supplying varying quantities, the modification and alignment of products with design, determination for plan take back for recycling and reusing materials, providing quality product and avoiding the use of extra packaging. When these measures are adopted at the stage of material procurement then potentials of cost and waste saving enhance. Therefore, the first hypothesis of the current study will be:

LWMPM measure in material procurement enhances the acquisition of such materials as well as technology that is waste efficient and incur a minimal cost and waste at the construction site. It promotes the acquisition of the secondary material for recycling and reusing it. The purchase of such material is encouraged through LWMPM measure that material is suitable, correct and is of good quality in order to avoid the waste and extra cost required for its alteration and any other logistics management (Ajayi&Oyedele, 2018). The proper adoption and management of these measurement activities are likely to diminish the construction waste of the projects. So, the second hypothesis of the current study will be:

EMDM measure is also very important for decreasing the waste portion in the procurement process and in the overall construction. Through this measure, the material is properly endangered during the whole process of transportation, stacking, releasing, etc. for avoiding any waste or cost. The delivery schedules are effectively formulated and applied in order to avoid any delay in the procurement process. The most effective measure that is used under EMDM is the use of 'Just in time inventory' in which the chances of waste of material as well as cost decrease (Ajayi&Oyedele, 2018). These all measures are very likely to have potentials for waste as well as cost minimization in the whole process. Thus, the third hypothesis of the current study will be:

The consideration of WEBOQ requires the procurement process to take off correct materials and to avoid extra or less ordering. It enforces the managers to order the appropriate amount or quantity of material that is exactly required for the construction process instead of under or over-ordering. When the bill of quantity includes the consideration of waste efficiency then it bounds the managers to minimize the allowance for waste. All these practices in this measure, in turn, contribute towards minimization of the waste and cost in procurement processes (Ajayi&Oyedele, 2018). Thus, the forth hypothesis of the current study will be:

The construction waste reduction achieved through various measures then, in turn, has the potential to generate many economic benefits for the projects. It augments the chances of cost cut due to the waste minimization and efficiency of the stages of the project. These cost cuts ultimately enhance the profitability of the construction projects or firm. Therefore, it is suggested that waste reduction islikely to generate several economic benefits the profitability from which seems a prominent economic benefit (Platonova, Asutay, Dixon, & Mohammad, 2018). Thus, the fifth hypothesis of the current study will be:

Hypothesis Deducted

H1: "Suppliers' commitment to low waste measures (SCLWM) has a positive and significant influence on the construction waste reduction."

H2: "Low waste material purchase management (LWMPM) has a positive and significant influence on the construction waste reduction."

H3: "Effective materials delivery management has a positive and significant influence on the construction waste reduction."

H4: "Waste efficient bill of quantity (WEBOQ) has a positive and significant influence on the construction waste reduction."

H5: "Construction waste reduction behavior has a positive and significant influence on the economic benefits of construction waste minimization."

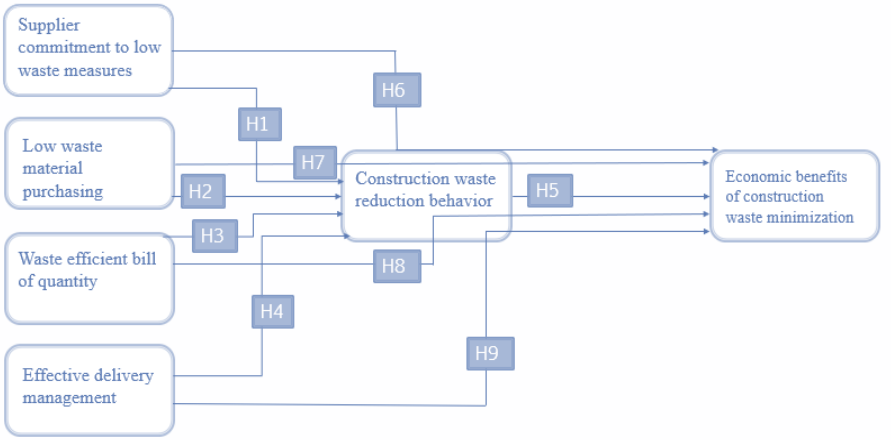
H6: "Construction waste reduction behavior has significant mediating role in the relationship between supplier's commitment to low waste measures and economic benefits of construction waste minimization."

H7: "Construction waste reduction behavior has significant mediating role in the relationship between low waste material purchase management and economic benefits of construction waste minimization."

H8: "Construction waste reduction behavior has significant mediating role in the relationship between effective materials delivery management and economic benefits of construction waste minimization."

H9: "Construction waste reduction behavior has significant mediating role in the relationship between waste efficient bill of quantity and economic benefits of construction waste minimization."

Theoretical Framework



Research Methodology

Quantitative method is selected because this study give us the findings of results by descriptive statistics for the sake of getting the relationship of variable with another variable and to identify the effect of one variable on other. Quantitative method is used because of minimum budget and time. Because as discussed earlier qualitative needs extra time for interviewing, and getting a common result by different opinion. Other reason of choosing quantitative is to avoid biasness in research. Sample size relays on selected target population, technique of analysis, time and resource availability. Sample size is selected is 350, almost 400 questionnaires were distributed and response from 323 respondents was received. Data is collected through survey based questionnaire from the construction industry of Pakistan.

Data Analysis

Demographic Traits

For data collection 400 questionnaires were distributed and 323 questionnaires were received back from the respondents. The above table shows there were 169 male respondents and 164 female respondents. However gender equality couldn't be obtained the figure shows male respondents are more than the female. The reason can be that construction industry is mostly male dominant industry. The majority frequency of the education of the respondent is post-graduation showing 140 which 43.3% of our total respondents. Then come the respondents whose education is of master are 106 in number which is 32.8% of our respondents. The respondents of graduate level are 40 which is 12.4% of our total respondents. While with more or less education level respondents were 37 that is 11.5% of our all respondents. Similarly data of age concludes respondents of age group between 40 to 49 were 97 which is 30% of our total respondents. With the age group between 31 to 39 respondents were 96 which represents 29.7% of our total respondents. With the age limit below 30 respondents were 81 which represents 25.1% of total respondents. With the age limit 50 or above the respondents were 49 which were 15.2% of total respondents.

Descriptive Study Variable

Table 1. Descriptive statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
SupComLWM	323	1.00	5.00	3.5498	1.14873	-.829	.136
LowWasPM	323	1.00	5.00	3.6272	1.10875	-.769	.136
WasEffeBQ	323	1.00	5.00	3.5488	1.12967	-.752	.136

EffecMDelM	323	1.00	5.00	3.5882	1.12720	-.820	.136
ConWRB	323	1.00	5.00	3.4334	1.08574	-.351	.136
EcoBenCWM	323	1.00	5.00	3.5757	1.12922	-.794	.136
Valid N (listwise)	323						

NOTE: SupComLWM represents supplier commitment to low waste measures.
LowWasMp represents low waste material purchase management.
WasEffeBQ represents waste efficient bill of quantity.
EffecDeIM represents effective material delivery managerment.
ConlowWRB represents construction waste reduction behavior.
EcoBenCWM represents economic benefits of construction waste minimization.

The table above shows the minimum, maximum, mean, standard deviation and skewness for all the variables discussed in this research. Minimum and maximum value in descriptive statistics shows the outlier. If the value range is between 1 to 5 it means there is no outlier. The minimum value for all variables is 1 and maximum value for all variables is 5 which means that there is no outlier. The data collected is from normal distribution. The mean value for supplier commitment to low waste measure is 3.54, low waste material purchase management is 3.62, waste efficient bill of quantity 3.54, effective material delivery management 3.58, construction waste reduction 3.43 and for economic benefits of construction waste minimization is 3.57. The mean value basically shows where the results are being tilted. The standard deviation value for supplier commitment to low waste measure is 1.14, low waste material purchase management is 1.10, and waste efficient bill of quantity 1.12, effective material delivery management 1.12, construction waste reduction 1.08 and for economic benefits of construction waste minimization is 1.12. The standard deviation basically average degree to which figures diverge from the mean. The skewness value for supplier commitment to low waste measure is -.82, low waste material purchase management is -.76, waste efficient bill of quantity -.75, effective material delivery management -.82, construction waste reduction -.35 and for economic benefits of construction waste minimization is -.79. The skewness values show the normality. If the value is between -1 and +1 it means there is normality in the data. Our values show there is normality in the data.

KMO AND BARTLETT, S TEST

Table 2. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling	Adequacy.	.930
	Approx. Chi-Square	10521.758
Bartlett's Test of Sphericity	Df	406
	Sig.	.000

This table shows that how much data is suitable for structure detection. The Kaiser-Meyer-Olkin Measure if Sampling Adequacy is statistical tool that shows the percentage of variance in variables that may be caused by fundamental factors. If the value is 1 to one it means data is suitable for factor analysis. If the value is less than the .50 it means data may not be suitable for factor analysis. Our score is .930 which is close to 1 which means data is suitable for factor analysis. Bartlett's Test of Sphericity is done to test the hypothesis that the correlation matrix is an identity matrix. It shows that variables are unmatched and are not suitable for structure detection. In this case value less than .05 shows data is suitable for factor analysis. Our value is .000 which means data is suitable for factor analysis.

Factor Loading Matrix

Table 3. Rotated Components Matrix

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
SC1			.789			

Rotated Component Matrix[a]								
SC2			.765					
SC3			.827					
SC4			.832					
SC5			.792					
LW1		.801						
LW2		.839						
LW3		.841						
LW4		.858						
LW5		.851						
WE1				.809				
WE2				.838				
WE3				.883				
WE4				.807				
ED1								.794
ED2								.847
ED3								.797
CW1						.722		
CW2						.757		
CW3						.802		
CW4						.727		
EB1	.837							
EB2	.869							
EB3	.873							
EB4	.868							
EB5	.874							
EB6	.887							
EB7	.858							
EB8	.819							

NOTE:
SC represents supplier commitment to low waste measures.
LE represents low waste material purchase management.
WE represents waste efficient bill of quantity.
ED represents effective material delivery managerment.
CW represents construction waste reduction behavior.
EB represents economic benefits of construction waste minimization.

Factor loading is basically a relationship coefficient for the variable and factor. It tells about the variance elaborated on the particular factor. The score of factor loading should be more than .7 and variable values should not be loaded in front of each other but should be loaded in different rows. In our data the value is above or equal to .7 and variable factors are not loaded in front of each other nut in different rows.

Convergent and Discriminant Validity

Table 4. Convergent and Discriminant Validity

	CR	AVE	MSV	CL	SC	LW	WE	ED	EB
CW	0.909	0.714	0.486	0.845					

	CR	AVE	MSV	CL	SC	LW	WE	ED	EB
SC	0.936	0.744	0.362	0.558	0.863				
LW	0.954	0.806	0.362	0.336	0.602	0.898			
WE	0.941	0.798	0.352	0.404	0.527	0.593	0.893		
ED	0.905	0.761	0.333	0.416	0.546	0.577	0.463	0.872	
EB	0.929	0.797	0.486	0.697	0.485	0.344	0.410	0.430	0.893

NOTE:
SC represents supplier commitment to low waste measures.
LE represents low waste material purchase management.
WE represents waste efficient bill of quantity.
ED represents effective material delivery managerment.
CW represents construction waste reduction behavior.
EB represents economic benefits of construction waste minimization.

Convergent validity is sub section of construct validity. It indicates test form to calculate a particular construct. The composite reliability CR value should be more than .7. AVE average variance value should be more than .5. The CR for supplier commitment to low waste measure is 0.93, low waste material purchase management is 0.95, waste efficient bill of quantity 0.94, effective material delivery management 0.90, construction waste reduction 0.90 and for economic benefits of construction waste minimization is 0.92. The AVE for supplier commitment to low waste measure is 0.74, low waste material purchase management is 0.80, waste efficient bill of quantity 0.94, effective material delivery management 0.90, construction waste reduction 0.90 and for economic benefits of construction waste minimization is 0.92. The value of MSV maximum shared variance for supplier commitment to low waste measure is 0.36, low waste material purchase management is 0.36, waste efficient bill of quantity 0.35, effective material delivery management 0.33, construction waste reduction behavior 0.48 and for economic benefits of construction waste minimization is 0.48. the figures show convergent validity is in the data.

Discriminate validity is that the diagonal figures above should be bold and their value should be more in comparison with the figures below. Means to say a variable show be more strongly associated with itself in contrast with other variables. The figures in the above table show such sequence which proves the discriminately validity of our data.

Confirmatory Factor Analysis

Table 5. Confirmatory Factor Analysis

Indicators	Threshold Range	Current Values
CMIN/DF	Less or equal 3	2.224
GFI	Equal or greater .80	.855
CFI	Equal or greater .90	.958
IFI	Equal or greater .90	.958
RMSEA	Less or equal .08	.062

Confirmatory factor analysis is a tool that is used to test the verification or rejection theory of measurement. Data shows value of CMIN/DF is 2.22 its range shows its value should be less than or equal to 3, value of GFI is .855 its range shows its value should be equal or greater than .80 , value of CFI is .958 its range shows its value should be equal or greater than .80 , value of IFI is .958 its range shows its value should be equal or greater than .80, value of RMSEA is .062 its value should be less than or equal to .08. Based on our data our model is fit and acceptable.

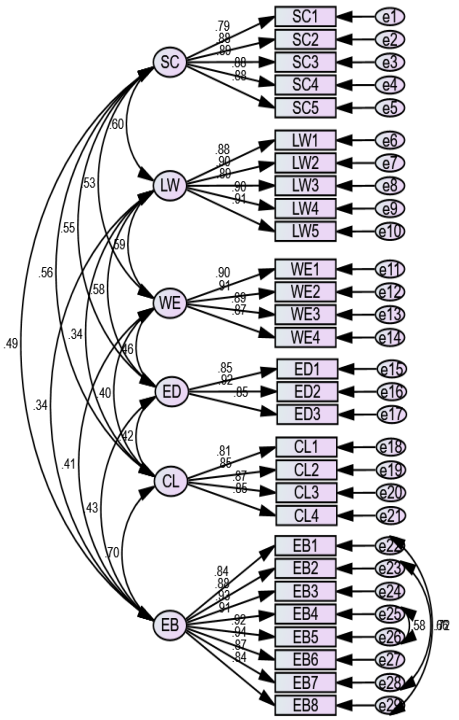


Figure 1: CFA

Structure Equation Modeling

Table 6. Structure Equation Modeling

Total Effect	EffecDelM	WasEffeBQ	LowWasMP	SupComLWM	ConLowWRB
ConLowWRB	.127**	.036	.257**	.375***	.000
EcoBenCWM	.186**	.068	.190**	.458***	.432***
Direct Effect	EffecDelM	WasEffeBQ	LowWasMP	SupComLWM	ConLowWRB
ConLowWRB	.127**	.036	.257**	.375***	.000
EcoBenCWM	.131**	.052	.079*	.297**	.432***
Indirect Effect	EffecDelM	WasEffeBQ	LowWasMP	SupComLWM	ConLowWRB
ConLowWRB	.000	.000	.000	.000	.000
EcoBenCWM	.055**	.016	.111**	.162**	.000

NOTE:
SupComLWM represents supplier commitment to low waste measures.
LowWasMp represents low waste material purchase management.
WasEffeBQ represents waste efficient bill of quantity.
EffecDelM represents effective material delivery managerment.
ConlowWRB represents construction waste reduction behavior.
EcoBenCWM represents economic benefits of construction waste minimization.

In the structure equation modeling first of all we see the direct impact of dependent variable with the independent variables and mediator. The direct effect of economic benefits of construction waste minimization on effective material delivery management is .131** which is positive and significant. We can say if we increase one unit of effective material delivery management 13.1% increase in economic benefits of construction waste

minimization is shown. The direct effect of economic benefits on construction waste reduction on waste efficient bill of quantity is .052 which is insignificant, if we increase one unit of waste efficient bill of quantity 5.2% increase in economic benefits of construction waste minimization. The direct effect of economic benefits of construction waste minimization on low waste material purchase management is .079* which is positive and significant which means if we increase one unit of low waste material purchase management 7.9% increase in the economic benefits of construction waste minimization. The direct effect of economic benefits of construction waste minimization on supplier commitment to low waste measures is .297** which is positive and significant. Which means if we increase one unit of supplier commitment to low waste measures 29.7% increase in economic benefits of construction waste reduction. The direct effect of economic benefits of construction waste reduction on construction waste reduction behavior is .432*** which is positive and significant. Which means if we increase one unit of construction waste reduction behavior 43.2% increase in economic benefits of construction waste reduction.

To explain the mediation role construction waste reduction behavior the indirect effect is seen where the indirect impact of mediator is seen on independent variables. In case of effective material delivery management the construction waste reduction behavior shows positive and significant mediating role with the value of .055**. Which means if one unit of effective material delivery management is increased the mediating role of construction waste reduction behavior is increased by 5.5%. In waste efficient bill of quantity construction waste reduction behavior does not show significant mediating role with having the value .016 which means increasing one unit of waste efficient bill of quantity only 1.6% mediating role is construction waste reduction behavior is increased. In low waste material purchase management construction waste reduction behavior shows positive and significant mediating role with the value of .111** which means if one unit of low waste material purchase is increased mediating role of construction waste reduction is increased by 11.1 %. In Supplier commitment to low waste measures mediating role shown by construction waste reduction behavior is positive and significant with the value of .162** which means if supplier commitment to low waste measures is increased by one unit. The mediating role of construction waste reduction is increased by 16.2%.

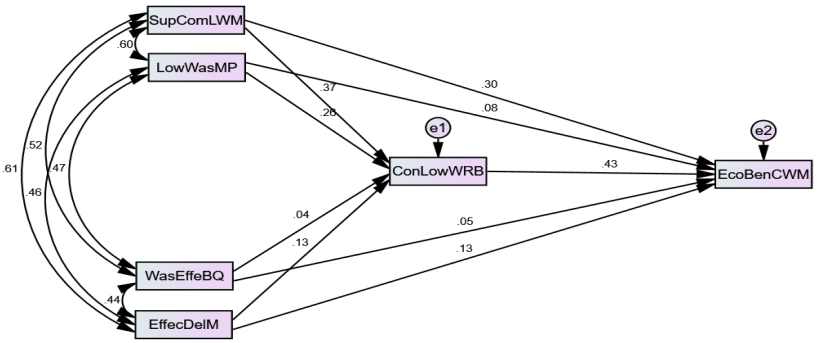


Figure 2: SEM

Discussion and Conclusion

Discussion

The purpose of this study was to assess the economic benefits through waste efficient drivers in mega construction projects in context with the Pakistan. Our first hypothesis was Suppliers' commitment to low waste measures (SCLWM) has a positive and significant influence on the construction waste reduction. According to the results of structural equation modeling the hypothesis has been accepted. In past research (Paz & Lafayette, 2016) has also tested this hypothesis which was accepted. Our second hypothesis was low waste material purchase management (LWMPM) has a positive and significant influence on the construction waste reduction. According to the results of structural equation modeling the hypothesis has been accepted. In past research (Barbudo, Ayuso, Lozano, Cabrera, & López-Uceda, 2020) has also tested this hypothesis which was accepted. Our third hypothesis was Effective materials delivery management has a positive and significant influence on the construction waste reduction. According to the results of structural equation modeling the hypothesis was

accepted. In past research (Galán, Viguri, Cifrian, Dosal, & Andres, 2019) was conducted in which same hypothesis was accepted. Our fourth hypothesis was Waste efficient bill of quantity (WEBOQ) has a positive and significant influence on the construction waste reduction. According to the structural equation modeling this hypothesis was rejected. In past researches (Hoang, Ishigaki, Kubota, Yamada, & Kawamoto, 2019) this hypothesis was also tested which was rejected. Our fifth hypothesis was Construction waste reduction behavior has a positive and significant influence on the economic benefits of construction waste minimization. According to the results of structural equation modeling the hypothesis has been accepted. In past research (Esa, Halog, & Rigamonti, 2017) has also tested this hypothesis which was accepted. Our sixth hypothesis was construction waste reduction behavior has significant mediating role in the relationship between supplier's commitment to low waste measures and economic benefits of construction waste minimization. According to the results of structural equation modeling the hypothesis has been accepted. In past mediating role with the independent and dependent variable has not be checked but studies has been conducted discussing these variables individually which rely with our results. Our seventh hypothesis is Construction waste reduction behavior has significant mediating role in the relationship between low waste material purchase management and economic benefits of construction waste minimization. According to the results of structural equation modeling the hypothesis has been accepted. In past (Huang et al., 2018) mediating role with the independent and dependent variable has not be checked but studies has been conducted discussing these variables individually which rely with our results. Our eight hypothesis Construction waste reduction behavior has significant mediating role in the relationship between effective materials delivery management and economic benefits of construction waste minimization. According to the results of structural equation modeling the hypothesis has been accepted. In past mediating role with the independent and dependent variable has not be checked but studies has been conducted discussing these variables individually which rely with our results. Our ninth hypothesis is construction waste reduction behavior has significant mediating role in the relationship between waste efficient bill of quantity and economic benefits of construction waste minimization. According to the results of structural equation modeling the hypothesis has been rejected. In past (Akinade et al., 2016) mediating role with the independent and dependent variable has not be checked but studies has been conducted discussing these variables individually which rely with our results.

Conclusion

In the proposed study, the impact of economic benefits was assessed on the material procurement measures by keeping construction waste reduction behavior as mediator. This was investigated in the context of Pakistan. Results shows construction waste reduction behavior has positive impact on supplier commitment to law waste measures, low waste material purchase management, waste efficient material delivery management for gaining economic benefits. While waste efficient bill of quantity does not seems to be impactful in the construction industry of Pakistan. By applying the material procurement measures discussed in the study economic benefits and the construction waste reduction behavior can be achieved. It will be a quantitative study that will contribute theoretically to the literature of waste reduction and will enhance its scope by checking its applicability in Pakistan.

Implications

It was a quantitative study and it has contribute theoretically to the literature of waste reduction behavior, economic benefits of construction waste minimization and relationships among the variables. And will enhance its scope by checking its applicability in Pakistan. This study would have practically benefit the construction industry, manufacturing industry, medical industry because where there is waste theory, results of this research can be applicable. Similarly this research has benefited the overall project management domain. At the government level for policy making this research could be helpful that by using the variables mentioned in the study the waste minimization policies can be made to covert the economy to green economy.

Limitations and Future Research

Prominent limitations are that sample size for our research was small although it was calculated through a formula but in future to increase the generalizability the sample size can be increased in future researches. We

have just study the construction sector of Pakistan. In future studies can be conducted on two or more countries. Similarly the concept of waste minimization, waste reduction behavior is not only limited to construction sector but this problem is being faced by manufacturing sector, medical sector and at municipal level. We have conducted cross sectional research. There is necessary for such topic there should be investigative study on low waste, normal waste and compare the results of economic benefits regarding this. In future longitudinal study can be conducted. We have taken construction waste reduction as mediator. In future researches cost of product, productivity can also be taken as mediator. Similarly our focus was on mega construction project. Future research can be conducted on medium construction projects or residential construction projects.

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