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Analyzing the Barrier Factors in Implementing On-Site Construction Waste Management: A Structural Equation Modeling Approach

Análisis de los factores de barrera en la implementación de la gestión de residuos de construcción en el sitio: un enfoque de modelado de ecuaciones estructurales

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ABSTRACT

Waste Management Plans must be implemented on all construction sites regardless of site size. With an effective site waste management plans (SWMPs), the amount of waste generated can be controlled, minimized and partially prevented, and financial losses can be monitored and quantified. There is non-compliance with construction SWMP as well as recycling at construction sites. The goal of this study is to conduct ranking of the barrier factors in implementing effective SWMP and in addition to that a structural equation modeling (SEM) of factors to find correlations between them. Data's were collected through a questionnaire survey. Structural equation modeling (SEM) of barrier factors, to evaluate correlation, and hypothesized significance of the relationship between these factors was performed using smartPLS 3 software. The final SEM results showed that the construction-related factor had the highest path coefficient, indicating that the technical factor significantly affects legal aspects. The higher the beta coefficient, the stronger the effect of the exogenous latent construct on the endogenous latent construct. All hypotheses found to be significant have since been accepted. This is mainly useful in policy making in waste management Plans.

Keywords: Site waste-management plans (SWMP), barriers, statistical analysis, Structural Equation Modelling (SEM)

RESUMEN

Waste Management Plans must be implemented on all construction sites regardless of site size. With an effective site waste management plans (SWMPs), the amount of waste generated can be controlled, minimized and partially prevented, and financial losses can be monitored and quantified. There is non-compliance with construction SWMP as well as recycling at construction sites. The goal of this study is to conduct ranking of the barrier factors in implementing effective SWMP and in addition to that a structural equation modeling (SEM) of factors to find correlations between them. Data's were collected through a questionnaire survey. Structural equation modeling (SEM) of barrier factors, to evaluate correlation, and hypothesized significance of the relationship between these factors was performed using smartPLS 3 software. The final SEM results showed that the construction-related factor had the highest path coefficient, indicating that the technical factor significantly affects legal aspects. The higher the beta coefficient, the stronger the effect of the exogenous latent construct on the endogenous latent construct. All hypotheses found to be significant have since been accepted. This is mainly useful in policy making in waste management Plans.

Keywords: Site waste-management plans (SWMP), barriers, statistical analysis, Structural Equation Modelling (SEM)

INTRODUCTION

Construction-related activities produce a lot of waste materials. Infrastructure investment has dramatically increased over the world. The sector is also anticipated to proactive internalize environmental performance in a manner comparable to other industries as a result of a rising number of environmental rules and regulations. Environmental deterioration is said to be largely caused by the construction industry. For instance, the industry uses 40% of the raw resources that are mined while creating 10% to 35% of the garbage that is dumped in landfills. This has a substantial effect on the environment and is raising public concern. Different strategies for reducing construction waste have been put forth to lessen this environmental load, while studies on their efficacy are still ongoing. An estimated 35% of the trash produced by the building industry gets dumped globally. Consequently, it is undeniably possible for sustainable development in the building sector. The benefits of sustainable construction outweigh the risks associated with conventional construction by ensuring pollution management. The incorporation of sustainable goals, however, creates more challenging implementation issues on a global scale. Implementing site waste management strategies like using recycled materials for construction projects is met with a great deal of resistance. People have a strong misunderstanding that employing recycled materials causes buildings to perform worse, such as having less strength and durability. Recent research, however, has shown that recycled concrete has advantages.

NEED OF THE STUDY

Barriers to the implementation of construction waste reduction practices must be identified, which is essential because it allows key decision-makers with the intention of exploring strategies to promote the use of recycled materials. A general application of a construction waste management plan is to minimize the amount of materials going to landfills during construction by diverting construction waste and demolition debris and land clearing from the landfill. The SWMP must be applied to all construction sites regardless of site size. With an effective SWMP, the amount of waste generated can be controlled, minimized and partially prevented, and financial losses can be monitored and quantified. There is reluctance to enforce SWMP in most Indian construction sites and barriers to the same need to be identified. It also helps redirect recyclable recovered resources back into the manufacturing process and redirect reusable materials to appropriate locations.

LITERATURE SURVEY

A detailed literature review was conducted through several journals to identify the barrier factors that cause reluctance to adopt and implement SWMP. The purpose of the literature review was to critically evaluate and identify the application of past studies on construction waste management, structural equation modeling, statistical analysis and interpretation of data obtained from a questionnaire survey.

A. Barriers identified in implementing on-site cwm

From the literature review, the major aspects causing challenges in implementing SWMP and main barriers (20 factors) to be ranked and analysed were identified as shown in Table 1. The factors were finalized from the literature and categories into six groups (financial, environmental, socio-cultural, institutional, technical and legal aspects).

B. Conceptual Model of Hypothesis Framework

In the assessment of factors (barrier to SWMP implementation), PLS-SEM structural equation modeling (Partial Least Square Structural Equation Modeling) was used and a conceptual model was proposed. The proposed model is analysed in two different stages, the first models consist of latent variables (measurement models) that define the relationships between latent indicators and their manifest variables, and second, the structural model consists of the relationships between latent variables. The conceptual model explained the relationships between the latent variables and their associated manifest variables. The conceptual model presenting the relationship between these aspects are exhibited in Figure 1.

The study hypotheses are as follows:

H1: Environmental aspects have positive effect on Institutional aspects

H2: Socio- Cultural aspects have positive effect on Institutional aspects

H3: Legal / Policy aspects have positive effect on Institutional aspects

H4: Legal / Policy aspects have positive effect on Socio- Cultural aspects

H5: Technical aspects have positive effect on Socio- Cultural aspects

H6: Environmental aspects have positive effect on Socio- Cultural aspects

H7: Technical aspects have positive effect on Legal/ Policy aspects

H8: Technical aspects have positive effect on financial aspects

H9: Environmental aspects have positive effect on financial aspects

RESEARCH METHODOLOGY

A. Questionnaire Survey

The designed questionnaire was prepared based on the knowledge obtained from reviewing the literature and from expert advice which was then distributed to clients, contractors, consultants, managers, engineers and other construction professionals through questionnaires. This questionnaire includes questions on implementation challenges at organizational level and project level. The questionnaires consisted of two main sections: (1) respondent profile (2) respondent's perception survey.

The first section includes the questions on respondent's profile. The second section includes the questions on respondent's perception about various challenges faced in implementing on site construction waste management plans. The Questionnaire contained 20 questions in section two. Each question was a 5-point Likert item: strongly disagree, disagree, neutral, agree and strongly agree expressed as 1-5 points. The questionnaire survey was done by the means of Google forms and the data were analysed by using Excel sheets.

B. Demographic Analysis

Total 250 questionnaires were distributed to respondents working in construction sector. 107 sets of responses to questionnaires were returned out complete, resulting in 107 valid responses and effective response rate of 42.80%. The respondents include Managers /engineers, consultants, Contractors, and client. Following figures shows the graphical representation of detailed demographics of the respondents.

C. Structural Equation Modeling Data Analysis

Simulation work in calculating the influence of observed variables and their latent constructs on SWMP barriers (aspects) was drawn in smart-PLS version 3. PLS-SEM is mostly used for theory development in exploratory research. Major applications of SEM include path analysis, confirmatory factor analysis, second-order factor analysis, regression models, covariance structure models, and correlation structure models. In addition, SEM allows the analysis of linear relationships between latent constructs and manifest variables. It also has the ability to produce accessible parameter estimates for relationships between unobserved variables. In general, SEM allows one to test several relationships at once in a single model with different relationships instead of examining each relationship individually. The hypothesized structural model in Figure 1 was analysed using Smart-PLS version 3, which has advantages over regression-based methods in assessing multiple latent constructs with different manifest variables. PLS involves a two-step procedure that involves evaluating an external measurement model and evaluating an internal structural model. Moreover, PLS-SEM is currently known as the technique that is the best suitable method for multivariate analysis. Table 3 provides a comprehensive explanation of descriptive statistics such as kurtosis and skewness. The kurtosis and skewness results (values lie between -1 and +1) indicated that the data were normally distributed.

1) Evaluation of Outer Measurement Model

The external measurement model is aimed at calculating the reliability, internal consistency and validity of observed variables (measured by questionnaire) together with unobserved variables. Consistency assessment is based on single observed and constructed reliability tests, while convergent and discriminant validity are used to assess validity. The reliability of a single observed variable describes the variance of an observed individual relative to an unobserved variable by evaluating the standardized external loadings of the observed variables. Observed variables with external loadings of 0.6 or greater are considered highly acceptable, while external loadings of less than 0.6 can be discarded (Gefen and Straub, 2005). In this study, external loads that are very low (F2, F3, F6, I3, I4, T2, SC1) were discarded. Cronbach's alpha and composite reliability (CR) were used to assess the internal consistency of construct reliability. However, compared to Cronbach's alpha, CR is considered a better assessment of internal consistency because it preserves the standardized loadings of the observed variables. Table 5 shows that CR for all constructs. It was noted that not all latent construct values exceeded the minimum threshold value of 0.70. To verify the convergent validity of the variables, the average variance extracted (AVE) of each latent construct was calculated (Table 5). The lowest 50% of the variance from the observed variable should be accounted for by the latent constructs in the model.

So this says that AVE for all constructs should be greater than 0.5. It can be seen from Table 5 that all AVE values except one exceeded 0.5, which confirms the convergent validity of this study model. These results confirmed the convergent validity and good internal consistency of the measurement model. The next attempt was the discriminant validity of the latent constructs. Diagnostic validity defines that the manifest variables of each component are different from other components of the path model. The cross-loading value of the latent variable is higher than other components. Fornell and Larcker criteria and cross-loading were used to evaluate the differential validity. The proposed criterion is that a construct should not show the same variance as other constructs beyond its AVE value. Table 6 shows the Fornell and Larcker criterion test of the model, which compares the squared correlations with the correlations of other latent constructs. Table 6 shows that all correlations were small compared to the root mean of the added variance along the diameter, indicating satisfactory discriminant validity. The Hettrait Monotrait (HTMT) ration is an advanced standard for checking the validity of discriminants and accepts values less than 0.85. Table 7 shows that the ratio of HTMT and the majority value is less than 0.85. From the structural cross-correlation of all other observed variables in the model. These findings therefore confirmed the cross-loading criteria and provided acceptable validity for the discriminant validity of the measurement model. As a result, the proposed conceptual model was confirmed to have sufficient reliability, convergent validity and discriminant validity, and the research model was confirmed and acceptable.

2) Evaluation of the Inner Structural Model

It was confirmed that the measurement model was valid and reliable. The next step was to quantify the internal structural model results. This includes observing the predictive accuracy and consistency of the model (R^2 and Q^2) and the relationships between the constructs (path significance)

(a) Measuring the Value of R^2 and Q^2

The coefficient of determination measures the overall effect size and variance explained in the endogenous construct for the structural model and is thus a measure of the model's predictive accuracy. The goodness of the model is determined by the strength of each structural path determined by the R^2 value from the dependent variable, the value of R^2 should be equal to or greater than 0.1. The result in Table 8 shows that all R^2 values are greater than 0.1. Hence predictability is established. Next Q 2 establishes the predictive consistency of endogenous constructs. A Q^2 above 0 shows that the model has predictive fit (Table 8). The result shoes that are important here in the prediction of formations.

(b) Estimation of Path Coefficients (β) and T-statistics

Path coefficients in PLS and standardized β coefficient in regression analysis were similar. The significance of the hypothesis was tested using the β value. P indicated the expected variation in the dependent construct for unit variation in the independent construct(s). β values were calculated for each path in the hypothesized model, the larger the β value, the greater the substantial effect on the endogenous latent construct. However, the significance level of the β value had to be verified using the T-statistic test as shown in Table 10. H1, H2, H4, H5, H8 and H9 had no significance. Table 10 shows the path coefficient and T-statistics values, p- value (measured variables) and $p < 0.01$ indicates significance of measured variables. The greater the beta coefficient (β), the stronger the effect of an exogenous latent construct on the endogenous latent construct. Figure 3 shows the graphical representation of all path coefficients of the model.

(c) Correlation Coefficient of Latent Variables

Finally, Table 9 shows the latent variable correlation coefficient. Correlation value range between -1 to +1 (least correlated to highly correlated).

DISCUSSION AND CONCLUSION

In the present study,barriers to implementing SWMP at construction sites are identified and analysed. The main contribution of this study is to empirically uncover the structure that causes difficulties in the adoption of SWMP and examine more closely the main influencing factors using the PLS-SEM method. Statistical characteristics such as mean, standard deviation, skewness and kurtosis values were measured. The internal consistency of the structural model was assessed with uniform reliability, and Cronbach's alpha and value were obtained above the recommended value (0.70) for all constructs. The power of convergence was determined as greater than the cut-off value (0.50) for all constructs. Discriminant reliability was tested using criteria (Fornell and

Larcker 1981). The correlation of a variable is less than the square root of the AVE of that variable. Specific loadings provide additional support for indicator validity and discriminant validity. Some items are dropped because the AVE of the build is increased. All item loadings are greater than the value of 0.06, which indicates the exploratory nature of this research. The intercepts for all items were lower than the individual loadings, further confirming the discriminant validity. Then, the goodness of the model is determined by the strength of each structural path determined by the value of R 2 of the corresponding variable, the value of R 2 must be equal to or greater than 0.1. The results show that all of them have an R 2 value greater than 0.1. Therefore, the ability of prediction is made. In addition, Figure 2 determines the predictive value of the endogenous constructs. A score of 2 above 0 indicates that the model is predictively significant. The results here are important in predicting footwear and construction. The institutional factor has the highest R^2 of 0.185, representing 18.5% of the total predicted by other constraints (environmental, social, cultural and legal). SEM summary results revealed that the construction-related factor had the highest path coefficient (β = 0.405), indicating that the technical factor had a significant effect on the legal aspect. The significant effect implies that improvements or changes in the technical aspects of waste management can positively impact compliance with legal regulations. For example, if a construction project implements advanced waste sorting and recycling systems, it may be better equipped to meet legal standards for waste diversion and recycling targets. The larger the beta coefficient (β), the stronger the effect of the exogenous latent construct on the endogenous latent construct. H1, H2, H4, 5, H8 and H9 are not significant since $p > 0.01$. All other hypotheses are accepted.

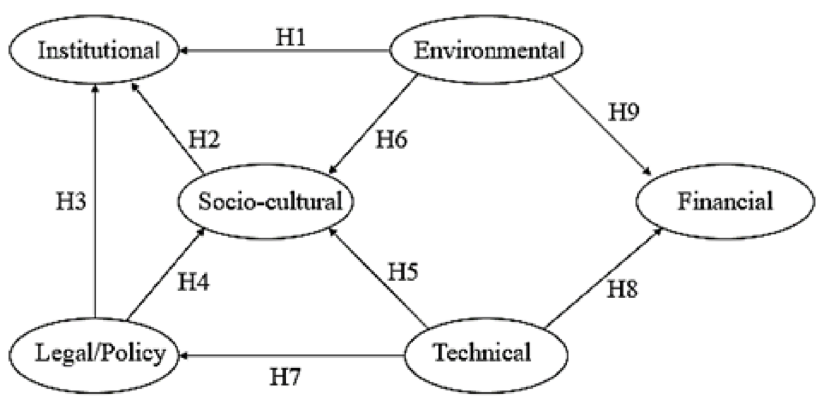

Fig. 1. Hypothetical framework of aspects

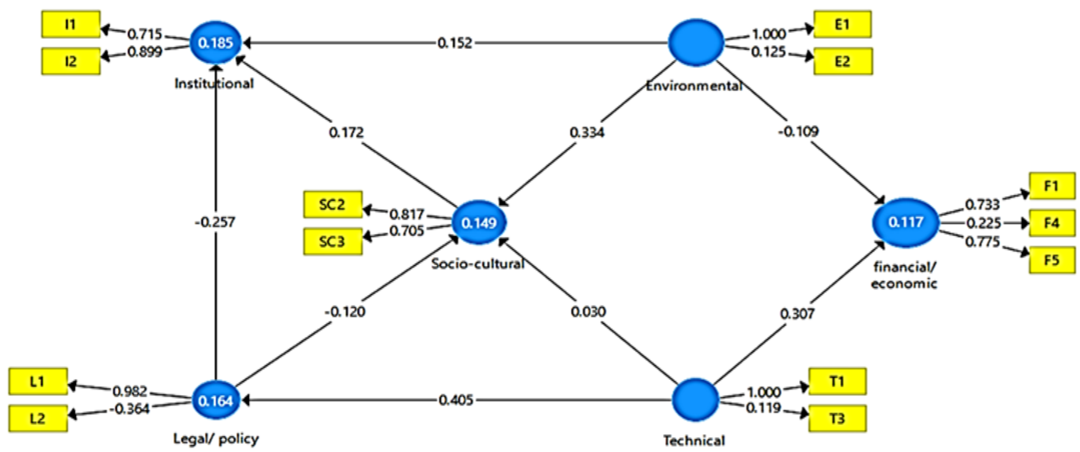

Fig.2. Measurement model

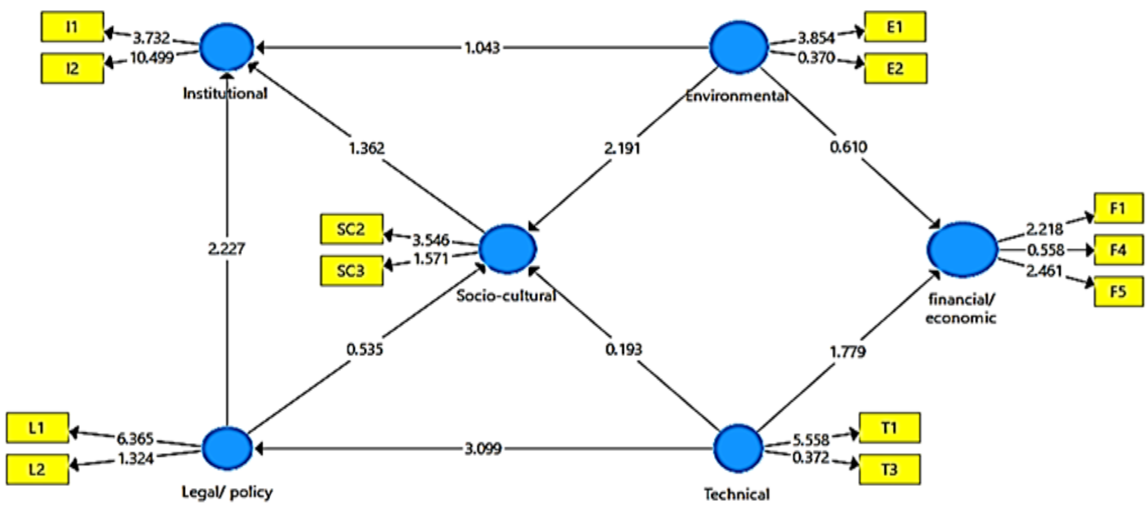

Fig. 3. Structural mode

Table 1 Barriers identified in implementing on site construction waste management

Aspects	Factors		Literature
	Notation	*Barriers identified in implementing on site construction waste management*	
Financial/ economical	F1	Lack of a well-developed waste recycling market	[4]
	F2	Construction waste management results in higher project costs	[4]
	F3	Lacking economic penalizing methods for waste management	[4]
	F4	Reluctance to segregate for recycling and re-using materials	[4]
	F5	Financial benefits from waste reduction are providing little incentive	[4],[12]
	F6	First priority is financial profit and not environmental issues	[7]
Institutional	I1	Consumes additional time (records, efforts, man power)	[2]
	I2	Unavailable waste management procedures and technological support within the organization	[3]
	I3	Lack of managerial commitment and support for the issue of waste	[2]
	I4	Lack of expertise and experience in waste management process	[2],[3]
Environmental	E1	Inadequate training of construction workers on waste handling issues	[7]
	E2	Insufficient environmental concern by the industry, political decision makers, and clients	[7]
Technical	T1	Insufficient knowledge on how to implement eco-technologies	[15]
	T2	Construction waste management cannot be effectively carried out due to limited space	[3]
	T3	Difficulty in acquiring and documenting waste data	[13]
Socio-cultural	S1	Low demand by clients for sustainable buildings	[12]
	S2	Difficulties in changing work practices of workforce	[13]
	S3	A belief that waste reduction efforts will never be sufficient to completely eliminate waste	[15]
Legal/ policy	L1	Existing regulations are difficult to operate in practice	[14]
	L2	Lack of awareness of law regarding illegal dumping and construction waste management	[14]

Table 2 Demographic Analysis

Category	Frequency	Percentage
Respondent		
Client	13	12
Contractor	24	22.2
Consultant	22	20.4
Manager/Engineer	48	45.4
Year of experience		
<1	3	1
1-3	21	19.1
3-5	24	21.3
5-10	29	27.7
>10	30	27.7

Table 3 Descriptive statistics such as kurtosis, and skewness

Aspects	Excess kurtosis	Skewness
Financial	-0.198	0.501
Institutional	-0.259	-0.818
Environmental	-0.318	-0.557
Technical	-0.557	-0.282
Socio-cultural	-0.203	-0.145
Legal/ policy	-0.435	0.761

Table 4 Cross - loadings

	Environmental	Institutional	Legal/policy	Socio-cultural	Technical	Financial
E1	1.000	0.306	-0.346	-0.371	-0.157	-0.156
E2	0.125	0.085	0.200	-0.031	0.133	0.103
F1	-0.135	-0.223	0.246	-0.049	0.226	0.733
F4	-0.008	0.207	0.020	0.039	-0.002	0.225
F5	-0.104	-0.369	0.370	-0.055	0.263	0.775
I1	0.291	0.715	-0.128	0.160	-0.103	-0.282
I2	0.229	0.899	-0.389	0.285	-0.093	-0.355
L1	-0.358	-0.346	0.982	-0.225	0.418	0.428
L2	0.045	0.107	-0.364	0.058	-0.046	-0.029
SC2	0.369	0.263	-0.069	0.817	-0.045	-0.029
SC3	0.182	0.167	-0.300	0.705	-0.068	-0.083
T1	-0.154	-0.109	0.402	-0.071	1.000	0.324
T3	0.112	0.214	-0.040	0.017	0.119	0.027

Table 5 Construct Reliability and Convergent Validity

	Environmental	Institutional	Legal/policy	Socio-cultural	Technical	Financial
Composite Reliability	0.563	0.793	0.297	0.735	0.559	0.624
Average Variance Extract (AVE)	0.508	0.66	0.549	0.582	0.507	0.396

Table 6 Discriminant validity (Fornell and Larcker criterion)

	Environmental	Institutional	Legal/policy	Socio-cultural	Technical	Financial
Environmental	0.713					
Institutional	0.305	0.812				
Legal/policy	-0.347	0.349	0.741			
Socio-cultural	0.372	0.287	-0.225	0.763		
Technical	-0.158	-0.117	0.405	-0.072	0.712	
Financial	-0.157	-0.395	0.411	-0.069	0.324	0.629

Table 7 Hetrtrait monotrait (HTMT) ration

	Environmental	Institutional	Legal/policy	Socio-cultural	Technical	Financial
Environmental						
Institutional	0.814					
Legal/policy	1.162	0.67				
Socio-cultural	1.435	0.699	0.789			
Technical	0.922	0.649	0.824	0.433		
Financial	0.712	0.942	0.868	0.303	0.789	

Table 8 Value of R^2 and Q^2

	R square	Q Square
Institutional	0.185	0.080
Legal/policy	0.164	0.074
Socio-cultural	0.149	0.023
Financial	0.117	0.021

Table 9 The latent variable correlation coefficient

	Environmental	Institutional	Legal/policy	Socio-cultural	Technical	Financial
Environmental	1.000	0.305	-0.347	0.372	-0.158	-0.157
Institutional	0.305	1.000	-0.349	0.287	-0.117	-0.395
Legal/policy	-0.347	-0.349	1.000	-0.225	0.405	0.411
Socio-cultural	0.372	0.287	-0.225	1.000	-0.072	-0.069
Technical	-0.158	-0.117	0.405	-0.072	1.000	0.324
Financial	-0.157	-0.395	0.411	-0.069	0.324	1.000

Table 10 The path coefficient and T-statistics values, p- value (constructs)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Value
Environmental -> Institutional	0.144	0.152	0.138	1.043	0.297
Environmental -> Socio- cultural	0.349	0.345	0.159	2.191	0.029
Environmental -> financial	-0.106	-0.102	0.175	0.610	0.542
Legal /policy -> Institutional	-0.267	-0.289	0.120	2.227	0.026
Legal /policy -> Socio-cultural	-0.097	-0.094	0.182	0.535	0.593
Socio-cultural -> Institutional	0.182	0.169	0.133	1.362	0.174
Technical -> Legal/ policy	0.405	0.398	0.131	3.099	0.002
Technical -> Socio-cultural	0.023	0.023	0.120	0.193	0.847
Technical -> Financial	0.309	0.294	0.174	1.779	0.076

Table 11 The path coefficient and T-statistics values, p- value (measured variables)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Value
E1 <- Environmental	1.000	0.905	0.207	4.821	0.000
E1 <- Environmental	0.153	0.160	0.410	0.372	0.710
F1 <- Financial	0.726	0.616	0.323	2.248	0.025
F1 <- Financial	0.220	0.254	0.377	0.583	0.560
F1 <- Financial	0.781	0.662	0.273	2.866	0.004
I1 <- Institutional	0.694	0.675	0.180	3.849	0.000
I1 <- Institutional	0.912	0.892	0.117	7.792	0.000
L1 <- Legal/policy	0.983	0.956	0.114	8.599	0.000
L1 <- Legal/policy	0.361	-0.333	0.269	1.339	0.181
SC2 <- Socio-cultural	0.864	0.792	0.214	4.032	0.000
SC2 <- Socio-cultural	0.641	0.562	0.386	1.659	0.098
T1 <- Technical	1.000	0.944	0.161	6.217	0.000
T1 <- Technical	0.123	0.115	0.330	0.373	0.710

REFERENCES

Ajayi S O and Oyedele L, "Waste-efficient materials procurement for construction projects: a structural equation modelling of critical success factors." Waste Management, Vol.75: pp. 60–69, 2018

Amaratunga D and Kulatunga U, "Attitudes and perceptions of construction workforce on construction waste in Sri Lanka". Management of Environmental Quality, Vol. 17(1): pp.57–72, 2006

Bakshan A, Chehab G, El-Fadel M, Karaziwan J and Srour I, "Behavioural determinants towards enhancing construction waste management: a Bayesian Network analysis. Resources", Conservation and Recycling, vol.117(Part B): pp.274–284, 2016

Bakr GA, “Identifying crucial factors affecting accuracy of cost estimates at the tendering phase of public construction projects in Jordan.” International Journal of Civil Engineering and Technology Vol. 10(1): pp.1335–1348, 2019

CepedaCarrión, G., Cegarra-Navarro, J.-G., &Cillo, V. (2019). Tips to use partial least squares structural equation modelling (PLS-SEM) in knowledge management. Journal of Knowledge Management, 23(1), 67–89.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), Modern methods for business research (pp. 295–358). Mahwah, NJ: Erlbaum.

Coughlan J and Hooper D, “Structural equation modelling : Guidelines for determining model fit. Electronic Journal of Business Research Methods” Vol. 6(1): pp.53–60, 2008

Dawes J, “Do Data Characteristics Change According to the Number of Scale Points Used? An Experiment Using 5-Point, 7-Point and 10-Point Scales”. International Journal of Market Research Vol. 50(1): pp. 61–104.2008

Hair, J. F., Howard, M. C., &Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. Journal of Business Research, 109, 101–110.

Kabirifar K, Mojtahedi M, Wang C and Tam V W Y, “Construction and demolition waste management contributing factors coupled with reduce, reuse, and recycle strategies for effective waste management: a review”. Journal of Cleaner Production, Vol.263(1), 2020

Kalidindi S N, Kishore K C and Ram V G,” Environmental benefits of construction and demolition debris recycling: evidence from an Indian case study using life cycle assessment”. Journal of Cleaner Production, Vol.255:2020

Kolaventi S S, Momand H, Sivakumar M V N and Tadepalli T, “An assessment of construction waste management in India: a statistical approach”. Waste Management & Research, Vol. 37(1): pp.1–16, 2019

Mak T M W, Wang L, Yu I K M, et al.,” Extended theory of planned behaviour for promoting construction wastes recycling in Hong Kong”. Waste Management, Vol.83(1): pp.161–170, 2019

Marin G, Nicolli F and ZoboliR,”Catching-up in waste management. Evidence from the EU”. Journal of Environmental Planning and Management, Vol.61(1): pp.1861–1882, 2018

Manowong E, “Investigating factors influencing construction waste management efforts in developing countries: An experience from Thailand”. Waste Management and Research Vol. 30(1): pp. 56–71. 2012

Maryono N and Hirofumi S, “Identification of factors affecting stakeholder’s intentions to promote preparedness in disaster waste management: A structural equation modelling approach”. Memoirs of the Faculty of Engineering, Kyushu University Vol.74 (3):pp.79–98.2015

Nagpure AS, “Assessment of quantity and composition of illegal dumped municipal solid waste (MSW) in Delhi”. Resources, Conservation and Recycling Vol. 141(1): pp. 54–60, 2019

Sarstedt, M., Bengart, P., Shaltoni, A. M., & Lehmann, S. (2018). The use of sampling methods in advertising research: A gap between theory and practice. International Journal of Advertising, 37(4), 650–663.

Schuberth, F., Henseler, J., &Dijkstra, T. K. (2018). Confirmatory composite analysis. Frontiers in Psychology, 9, 2541.

Willaby, H., Costa, D., Burns, B., MacCann, C., & Roberts, R. (2015). Testing complex models with small sample sizes: A historical overview and empirical demonstration of what partial least squares (PLS) can offer differential psychology. Personality and Individual Differences, 84, 73–78.

Yuan H, “Barriers and countermeasures for managing construction and demolition waste: a case of Shenzhen in China”. Journal of Cleaner Production, Vol.157: pp.84–93

Zeng, N., Liu, Y., Gong, P., Hertogh, M., &König, M. (2021). Do right PLS and do PLS right: A critical review of the application on PLS in construction management research. Frontiers of Engineering Management, 8(3), 356–369.

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