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Article

Confirmatory Factor Analysis of the Life Cycle Costing Sub-Cost Distribution for Industrialised Building System using SEM-PLS

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Abstract. Industrialised Building System (IBS) contributes a great shift in sustainable construction, however previous studies have proven that one of the hindrances in promoting sustainable in IBS, is a high cost for pre-cast material components, thus effected the overall cost. In addition, the introduction of Life Cycle Costing (LCC) leads in providing a better and comprehensive cost estimation; as well as provides a significant advantage in the preparation of cost estimates, hence it provides a better baseline for decision making. The lacking application of LCC in IBS is still in trivial impact, where Malaysia experiences a slower progress of IBS construction, even though robust steps has been taken by the Government to influence construction players to accommodate LCC in projecting a comprehensive cost estimates, especially for IBS projects. This paper highlights an outcome of study that simulate the causal effect relationship between IBS Cost Factors and LCC Cost Distribution. A questionnaire survey was used to associate the IBS cost factors and LCC cost distribution and followed by Structural Equation Modelling (SEM) analysis which validate the relationships between the factors. The result of analysis was developed based on findings from 102 responded questionnaires which were distributed to Quantity Surveyors from various agencies. There were 5 LCC cost distribution factors used in this research and 43 IBS Cost Factors to get associated with. SEM-PLS was used to eliminate the cost association by eliminating factors recorded a loading value less than 0.70. From 43 IBS Cost Factors used earlier, only 15 cost factors were retain for further analysis and the development of a cost estimates using LCC approach. The outcome of this analysis is expected to guide the construction players to achieve more practical cost estimates and feasible alternatives for decision making in IBS construction, by focusing on the critical cost contributed to the overall cost of IBS project in Malaysia.

Keywords: Industrialised building system, life cycle costing, cost parameters, factor loading.

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1. Introduction

Basically, Industrialized Building System (IBS) in development industry has positives results in improving the exhibition of in general development work. Through the exertion of CIDB, advancing the utilization of IBS in Malaysian Construction Industry since 1998, it has demonstrated that IBS gives positives impact on that. The Government had demonstrated before that any development which receives 70% or more parts of the IBS can be considered as one that has applied the methodology of IBS. Nonetheless, Khalil et al. (2016) found that the use of IBS in development industry in Malaysia is less a result of the hesitance of the partners since they are not convinced with the IBS system.

The government means to make it mandatory for the authoritative specialists to execute IBS persistently 2020. In any case, the move faces various troubles. An investigation drove by CIDB shows that the use of IBS by the private section is yet deficient around 15% and the organization directs it toward be higher about 70% [1]. Throughout the long term, the selection of IBS in the Malaysian development segment has been slower than anticipated. The traditional development technique is the more favoured strategy when contrasted with the others. As of now, the Malaysian development industry utilizes either the ordinary development strategy, halfway IBS technique or a full IBS selection in a task. Until this point, IKEA Penang, a private development venture, has the most elevated IBS Score with a 92.3 IBS Score.

In Industrialised Building System (IBS), organizing viable design segments into exercises during undertaking improvement and setup stages can limit building cost. Conversely, if sustainable design elements are considered late in the design process and designers must redesign the entire project overall cost can increase significantly [2].

2. Cost Estimation in IBS Project

It was found that even IBS was firstly introduced to Malaysia in 1964, the projects have been facing problem of project cost overrun. The cost overrun was mainly the cause of slow adoption of IBS in Malaysia ever since [3]. Seconded by [4] that pre-cast concrete and steel structures construction that are mainly used in Malaysia, cost was the main factors influenced the decision of method adoption. [3] further highlighted it is vital to identify the major factors that influence the cost over budget and find out effective technique to improve cost estimation for IBS projects in Malaysia. The IBS cost factors grouped according to the stage of construction namely design, production, transportation, installation, and the whole process. [5] suggested that cost of prefabrication, modular construction and IBS highly influenced by the duration of construction. It was found that a significant amount was reduced when prefabrication, modular construction or IBS method being adopted. Other than that, building size or project magnitude also plays an important role in determining the cost of the project.

IBS contributes a great shift in sustainable construction, however previous studies have proven that one of the hindrances in promoting sustainable in IBS, is a high cost for pre-cast material components, thus effected the overall cost. With the introduction of Life Cycle Costing (LCC) leads in providing a better and comprehensive cost estimation; as well as provides a significant advantage in the preparation of cost estimates, hence it provides a better baseline for decision making. The lacking application of LCC in IBS is still in trivial impact, where Malaysia experiences a slower progress of IBS construction, even though robust steps has been taken by the Government to influence construction players to accommodate LCC in projecting a comprehensive cost estimates, especially for IBS projects [2].

3. Life Cycle Cost Parameters and Sub-Cost Distribution

IBS building can be evaluated as financially savvy through the life cycle cost technique, a method for surveying aggregate building expense after some time. LCC can possibly bolster the trade-off between some ecological targets and general reasonableness focuses by including every single money related stream along the item lifecycle (integrating so as to go past the understood expenses of proprietorship long term utilize and end- of-life expense) [6] The LCC process may also provide information, for example, in the appraisal of the monetary feasibility of items and activities, in the recognizable proof of the expense drivers and expense productivity upgrades, in assessments of diverse procedures for item operation, upkeep, examination and others [7]. Classically, LCC is used at the design stage to compare a series of options that can range from a single building component right to a complete building.

In conjunction with that, there are several factors or parameters that have to be considered when calculating LCC, includes investment life span, building life span, component life span, interest rate, changes in money value and, obsolescence. The main element in LCC evaluations is to determine the investment life span. In general, the investment life span is the period over which the organisation using the building expects returns for the use of it. At the end of the investment life span, the building and land will have a residual value. The project life spans lie within the range of three to sixty years depending on the nature of the project. In addition, the nature of client organisation, the type of project proposed, and the risk level of the project will also determine the investment life span [8]. While for IBS, the cost establishment for a project highly depends on the type of the IBS system chose as well as the other factors such as suitability of IBS system, mock-up system cost and accuracy of tender document [9, 10].

In their Guideline for Life Cycle Cost Analysis stated that to execute the LCC analysis in construction project, arrangements of information are required to be set up so as to set up the parameters and technique for figuring of

LCC [11]. Table 1 delineates the information required to execute LCC investigation for development venture. Information are isolated into three noteworthy segments, speculation information, activity and support information, and task explicit information. Proficient judgment dependent on recorded information, comparative undertaking type and experience can be presented in defence of information required cannot be acquired. A few information, for example, capital cost, energy utilization cost, life cycle can be procured from recorded information from the common building type. Thought should be made for geographical factors as it will give tremendous effect on LCC [12]. For instance, fees and local authority taxes can be modified by the area of the undertaking.

Table 1. The Input Data Required to Execute LCC Analysis for Construction

Investment Cost Data	Operation and Maintenance Data	Project Specific Data
Building Cost	Administration	Type of Building
Site Cost	Energy	Type of Design
Design Fees	Water	Type of Building Material
Salvage Value	Waste Water	Location
Demolition Cost	Cleaning	Lifetime Period
Other	Material	Other Data
	Maintenance	
	Insurance Cost	
	Rates	
	Taxes	
	Other Data	

Source: Standford University Land and Building (2005).

There are several factors that must be considered when calculating LCC, includes investment life span, building life span, component life span, interest rate, changes in money value and, obsolescence. The main element in LCC evaluations is to determine the investment life span. In general, the investment life span is the period over which the organisation using the building expects returns for the use of it. At the end of the investment life span, the building and land will have a residual value. The project life spans lie within the range of three to sixty years depending on the nature of the project. In addition, the nature of client organisation, the type of project proposed, and the risk level of the project will also determine the investment life span [8].

The building use life span is determined by several factors, which include the methods of construction and the amount of maintenance on the building during its life span. However, building can be differentiated by two life spans which are physical or structural life span and economic life span [13]. Component life span specifically discussed on the tight selection process of suitable component to be used in the project. Some components if chosen properly, installed, and carefully maintained might have long life span. IBS projects known to have problem on its components' joint and installation. Therefor by practising LCC in the early planning stage helps the clients in controlling the maintenance cost of the building.

On the other hand, interest rate is one of the factors that crucial in performing an LCC calculation. Nature of the interest rates which changes over time and depends much on the current economy situation. In construction project investment, where the main product is constructed to be used for in long period of time, interest rates is one the biggest hurdles to be incorporated in the LCC calculation. Hence, the right choice of interest rates practically influenced the final output from the LCC calculation [14]. Further suggested by [14] another factors to be considered is disused or obsolescence. Obsolescence means that which is no longer practices or used, discarded, out of date, worn out, affected through wearing down, atrophy or degeneration. It is related to the changes in requirements which will cause an object not to be able to function fully. Whole Life Cycle Cost generally require the improvement of the calculation model for the categories of distinctive cost elements in different stages. [15] stated that there are two types of development cost: Initial Cost/Capital Cost and Maintenance and operation cost. While [14] highlighted that in a construction project, the cost of a building can be separated into five components which are pre-development cost, construction cost, operation cost [16], maintenance cost and disposal cost.

Construction costs according to [17], construction cost is divided into labour cost, material cost and equipment operation cost. While [18] and [14] stated that construction costs divided into building and infrastructure cost, plant and machinery cost, mobilization and demobilization cost, transportation cost, labour cost, preliminaries, and contingencies cost. Operation and maintenance cost as according to [19] consists of Land Rent (if any), operating staff, labour and material for maintenance and repairs, periodic renovations, insurances (for renewal of insurances) and taxes, utilities as well as owner's other expenses. [15] included repair and replace cost, cleaning cost, depreciation o fixed asset cost and administration and managing cost. Besides, ICT and IT facilities, security cost, furniture, fitting and equipment and stationaries and reprographic cost also being included in operation cost.

Maintenance cost incorporates the expense of works, planned maintenance costs, preventive maintenance expenses, and restorative maintenance expenses to guarantee that the benefit is consistently worked. In the nutshell, reviews expenses and cost to fix the components are taken in thought [20]. To guarantee that the advantage isn't physically fall apart and out of date quality, repair and redesign expenses are likewise included. As of late, maintenance costs are emerged because of monetary importance of keep up the benefits. [21] directs that non-fuel Operating Costs and Maintenance and Repair (OM and R) costs are regularly hard to evaluate than other structure consumptions. Working timetables and standard of support fluctuate from structure to building, thus, there is incredible variety in these expenses notwithstanding for structures of a similar kind and age. [21] dictates that non-fuel Operating Costs and Maintenance and Repair (OM & R) costs are often difficult to estimate than other building expenditures. Operating schedules and standard of maintenance vary from building to building, hence, there is great variation in these costs even for buildings of the same type and age.

Besides than the pre-development cost, physical construction, operation cost, maintenance cost and demolition cost, [22] highlighted that the integration of energy cost together with cost associated to environmental element would give an LCC a conclusive advantage. Currently, these two costs are calculated using Life Cycle Analysis.

Another significant segment to be remembered for LCC is salvage value. Salvage value is the assessed value when the benefit arrived at the consummation of purpose of its life expectancy. The definition in bookkeeping terms is the rest of the incentive after deterioration costs were determined. For a construction project, after demolition, the land worth may raise however the wastage of building materials may deteriorate. Salvage value is significant and must be assessed in executing LCC examination of a benefit [23]. Salvage value is remembered for removal cost alongside removal reviews cost, physical destruction cost, reestablishment cost and customer determinable expense.

Other than segments described above, there are different variables should be incorporated while getting ready LCC. Loan cost is characterized as financial factors which affected by the monetary pattern of the country. It is a fundamental instrument for LCC as it decides the estimation of cash in future time. [24] referenced that, financing cost is varied and dependent upon development, blast, downturn and despondency of monetary conditions. The information of loan cost can be acquired from money institutional. [14] expressed that picking a reasonable intrigue without a doubt is a troublesome errand in LCC. Loan costs may change after some time and it varies over extensive stretch. LCC considers realities that venture toward sturdy resources, for example, structures parts submit the proprietor of the structure to both current and future expense. Thus, picking a reasonable loan fee in LCC relies upon the money related status of the proprietor and expectation of the financing cost development in long haul.

Interest rates to be sure is a precarious business. On the off chance that it is excessively low, it will be as an afterthought or be one-sided towards the momentary choice with low capital expense. If it is excessively high, it will be one-sided towards future cost investment funds to the detriment of higher starting use. To utilize the most current loan costs, it must mirror the idea of the undertaking, customer, and current economic situations. Henceforth, as an answer, the loan cost picked ought to be with regards to moral and the best proficient practice. Notwithstanding that, the loan fee picked ordinarily shows the expense of acquiring which must be balanced by the normal swelling rate or over a period when the undertaking is being utilized. [25].

The last part in LCC cost is the building life span. The standard life expectancy of a benefit particularly fabricating start from the underlying phase of development, operational and support stage until it arrived at the removal stage. Generally, the life expectancy of a structure will long go on until 60 years. It is central to consider different sorts of life patterns of components that will be remembered for LCC. [26] sorted the items into three general classes of items as indicated by its life cycles. The division of kinds of life cycles is basic in the point of view of LCC in light of the fact that the life expectancy of the items and expository models are sent for enormous scope may not equivalent to the little scope advancement venture [15] and [19] again proposed that the structure life length is dictated by a few variables, which incorporate the techniques for development and the measure of support on the structure during its life expectancy. Further proposed by [15] that the structure life length can be separated by two life expectancy: physical or auxiliary life expectancy and financial life expectancy.

4. Research Methodology

This research was carried out by disseminating a set of questionnaires. For this questionnaire, 200 set of questionnaire forms were distributed using emails, online using www.kwiksurvey.com and self-delivered to the respondents. Respondents were carefully selected and from one group of background which is Quantity Surveyor. Since the questions are only focus on the LCC components and its sub-components, selecting only the Quantity Surveyors was accurate where my objective was solely to determine the cost success factors relationship between LCC cost distribution and IBS project cost activities and to obtain weightage of each sub-components in LCC costing activities to further development of a computerized programming application. 102 questionnaires or 51% responds were successful collected and analysed. The relationships between the cost parameters were analysed using the SEM-PLS to form the Structural Modelling presenting the relationship between factors. Based on the data collected through survey distribution, all the inputs received from respondents were analysed by employed a software program called Statistical Package for Social Science (SPSS) V23, Structural Equation Modelling (SEM) using Smart-PLS 3.0 and Microsoft Excel 2010. Since this research is a Confirmatory Factor Analysis, SEM-PLS is suitable to be used rather than using the normal Exploratory Factor Analysis which can be perform using SPSS. In this research, the analysis used a single approach suggested by [27] which focus on the assessment of measurement model only. Generally, the objective for evaluating the research model is to examine whether both measurement and structural meet the underlying quality criteria for empirical work [27, 28, 29].

The respondents contact was obtained from the official website of Board of Quantity Surveyors Malaysia (BQSM) and selected from Consultant Quantity Surveyors (CQS) directory and Professional Quantity Surveyors (PQS) only. Since a slow response was predicted earlier, respondents selected were came from consultants in Klang Valley (Selangor and Kuala Lumpur), Negeri Sembilan and Melaka only. The reason of this selection was made due to the travelling time and expenses. Location selected is accessible by car and has shorter travelling time as compared to the North, East and Sabah and Sarawak. The response rate of the overall respondents is 52%. Table 2 below presents the summary of LCC parameters and its sub-components found in this research.

Table 2. Summary of LCC Parameters and its sub-components.

LCC Parameters (Components)	Sub-Components	LCC Parameters (Components)	Sub-Components	LCC Parameters (Components)	Sub-Components
Pre-Development Cost /Initial Cost/Capital Cost	• Land Cost • Legal Fees • Agent Fees • Stamp Duty • Site Investigation Cost • Soil Investigation Cost • Migration Cost • Promotions and marketing • Financing Cost • Contribution to Local Authority • Environmental Management Cost • Staff Training • Land acquisition and compensation cost • Decommissioning Cost • Land Rent • Insurances • Texas	Construction Cost	• Building material cost • Plant and Machinery Cost • Mobilization and Demobilization • Safety Management Cost • Preliminary Cost • Transportation Cost • Labour Cost • Fuel Cost	Operation Cost /Annual Running Cost	• Cleaning Cost • Utilities Cost • Administration Cost (incl. Salary) • Security Cost • ICT & IT Cost • Furniture, Fittings and Equipment Cost • Stationeries and Reprographic Cost
Maintenance Cost	• Major Replacement Cost • Subsequent Refurbishment and Adaptation Cost • Redecoration • Minor Replacement and Repair Cost • Unscheduled Repairs, Replacement and Maintenance Cost	Disposal Cost/End of life Cost	• Disposal Inspection Cost • Physical Demolition Cost • Reinstatement Cost • Salvage Cost		
Interest Rate			Inflation Rate		
Salvage Cost			Building Life Span		

5. Results and Findings

5.1. Construct Reliability and Average Variance Extracted test

With the 52% response rate, 104 questionnaires answers were run into Construct Reliability analysis. As referred to Table 3 below shows the value of composite reliability is more than 0.708, therefore the constructs tested are valid. Even though the Cronbach Alpha value are all less than 0.700, in PLS as described by [30], value in AVE and Composite Reliability (CR) are more reliable. Hence, all five constructs are at least more than 0.500. The highest AVE value is from maintenance cost while the least is from construction cost. AVE means a grand value of the squared loading equivalent to communality of the construct. A value of AVE within 0.708 to 0.900 shows the variation in the item measured is explained in the construct.

Table 3. Construct Reliability and Average Variance Extracted test.

Construct	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Construction Cost	0.561	0.774	0.533
Disposal Cost	0.462	0.782	0.644
Pre-Development Cost	0.723	0.828	0.546
Maintenance cost	0.474	0.789	0.653
Operational cost	0.712	0.822	0.536

Table 4 below shows all the LCC Cost Distribution parameters analysed in this research. Initially there are 43 sub-components calculated to obtain the factor loading. All the indicators have a loading value >0.70 and accepted for further test.

For pre-development cost (refer coding INC), there were 17 cost distribution factors tested and only 4 indicators were valid and accepted as shown in Table 5 on the next page. The highest cost factor is Land Acquisition and Compensation Cost (INC13) with a loading value of 0.775 and followed by Environmental Management Cost (0.730) (INC11). The other validated cost distribution factor for pre-development cost is Land Rent (INC15) with a loading value of 0.729 and Site Investigation Cost (INC5).

Table 4. Factor Loading of LCC Cost Distribution.

Indicator	Factor Loading	Indicator	Factor Loading
INC1	0.467	CC5	0.665
INC2	0.436		
INC3	0.526	CC6	0.54
INC4	0.453	CC7	0.49
INC5	0.529	CC8	0.648
INC6	0.541	OPC1	0.547
INC7	0.504	OPC2	0.565
INC8	0.568	OPC3	0.636
INC9	0.518	OPC4	0.716
INC10	0.472	OPC5	0.543
INC11	0.6	OPC6	0.692
INC12	0.529	OPC7	0.638
INC13	0.706	MTC1	0.52
INC14	0.506	MTC2	0.587
INC15	0.59	MTC3	0.616
INC16	0.497	MTC4	0.592
INC17	0.485	MTC5	0.514
CC1	0.328	ELC1	0.609
CC2	0.53	ELC2	0.687
CC3	0.564	ELC3	0.573
CC4	0.559	ELC4	0.724

Table 5. Details of LCC Cost Distribution

Construct	Coding	Indicator	Loading
Pre-Development Cost/Initial Cost	INC11	Environmental Management Cost	0.730
	INC13	Land Acquisition and Compensation Cost	0.775
	INC15	Land rent	0.729
	INC5	Site Investigation Cost	0.720
Construction Cost	CC4	Safety Management Cost	0.711
	CC5	Preliminary Cost	0.781
	CC8	Fuel Cost	0.696
Operational Cost	OPC3	Administration Cost	0.708
	OPC4	Security Cost	0.718
	OPC6	Furniture, fittings, and equipment cost	0.772
	OPC7	Stationaries and reprographic cost	0.731
Maintenance Cost	MTC2	Subsequent Refurbishment and Adaptation Cost	0.757
	MTC3	Redecoration (internal and external cost)	0.856
Disposal Cost	ELC2	Physical Demolition Cost	0.881
	ELC4	Salvage Cost	0.716

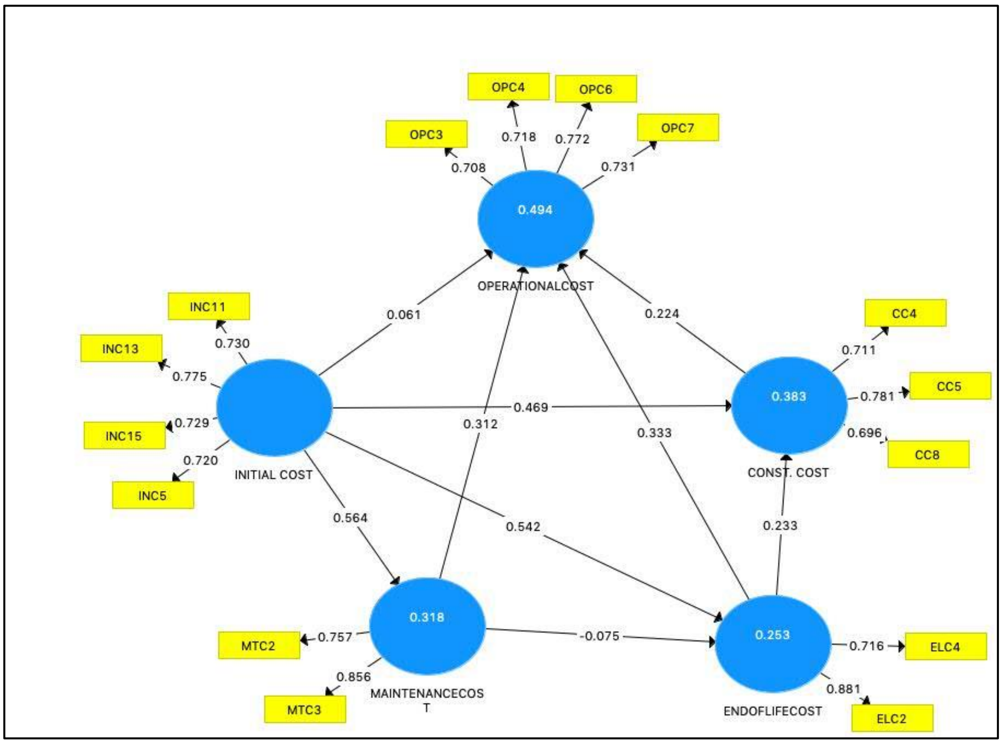

Fig. 1. Construct Path Loading for LCC Cost Distribution Parameters.

As shown in Table 5 and Fig. 1 above, for Construction Cost, initially there were 8 constructs tested, and only 3 constructs are valid and accepted. The valid constructs are Preliminary Cost (CC5) with a loading value of 0.781, followed by Safety Management Cost (CC4) with a loading value of 0.711 and Fuel Cost (CC8) with a loading value of 0.696.

For Operational Cost, initially there were 7 cost distribution factors tested and only 4 factors were valid and accepted. Furniture, fittings, and equipment cost (OPC6) has the highest loading value of 0.772, followed by with a value of Stationaries and reprographic cost (OPC7) with a value of 0.731. The third highest loading value is security cost (OPC4) with a loading value of 0.718 and the last cost factors accepted is administration cost (OPC3) which has a loading value of 0.708.

For Maintenance Cost, initially there were 5 distribution cost factors considered for validation for reliability. Only 2 indicators were valid and accepted. The indicators are Subsequent Refurbishment and Adaptation Cost (MTC2) with a loading of 0.757 and Redecoration (internal and external cost) (MTC3) with a loading value of 0.856.

For Disposal Cost, there were 4 initial indicators tested and only two indicators were valid and accepted. The highest loading value is from physical demolition cost (ELC2) with a loading value of 0.881 and followed by the salvage cost (ELC4) which recorded a loading value of 0.716.

5.2. Discriminant Validity

As summarised in Table 6, there are five constructs being measured. Pre-Development Cost constructs has seventeen indicators before being eliminated because of low loading, lower than 0.600. Out of seventeen indicators, only four indicators remain which are Environmental Management Cost, Land Acquisition and Compensation Cost, Land Rent and Site Investigation Cost. AVE for these constructs shows a greater value than 0.50 and can be summarised as the convergent reliability between constructs is adequate. The value of HTMT value shows less than 1 which means the ratio of correlations within the constructs to correlation between the construct is acceptable.

For construction cost, out of eight indicators, only three indicators are valid. There are Safety Management Cost, Preliminary Cost and Fuel Cost. [28] explains on the lower than 0.700 of Composite Reliability. According to him, a value between 0.60 to 0.70 shows an acceptable internal consistency, where [31] stated a value between 0.70 to 0.90 shows a satisfactory consistency between constructs. Composite reliability of the construct shows 0.774 with AVE 0.553. The HTMT less than 1, hence, it can be concluded that the construct measured is acceptable.

For operation cost, out of seven indicators measured initially, only three indicators remains, which are Administration Cost (including salary), Security Cost, Furniture, Furnishing and Equipment Cost and Stationaries and Reprographic Cost. The Composite Reliability for this construct is 0.822 with AVE of 0.536. The HTMT is less than 1 (HTMT=0.902). Therefore, it can be concluded that the construct is valid.

Maintenance cost has five indicators initially and after calculating the algorithm, three indicators which have a loading lower than 0.70 have been eliminated. The remaining indicators are Subsequent Refurbishment and Adaptation Cost and Redecoration (internal and external cost). The CR value is 0.789 with AVE of 0.653. The HTMT shows less than 1 which is 0.941; therefore, it can be concluded that the construct is valid for structural model.

The last components measured is Disposal Cost. This construct has 4 indicators initially and after calculated only two indicators remain, which are physical demolition cost and salvage cost. The CR of the construct is 0.822 while the AVE is 0.644. The HTMT shows a value lower than 1, so it can be concluded that the construct is valid for further measurement model.

From the analysis presented above and 43 initial parameters being analysed, only 15 parameters recorded a value more than 0.70. With that, it can be concluded that these 15 parameters are crucial to be accounted as dominant factors in performing cost estimation for IBS project using LCC approach.

Table 6. Discriminant Validity of LCC Cost Distribution.

Constructs	Coding	Indicators	Indicator reliability	CR	AVE	Discriminant validity		
			Loadings			Cross Loading	Fornell Larcker	HTMT CI Does not include 1
			>0.600	>0.708	>0.501			
Construction Cost	CC4	Safety Management Cost	0.711	0.774	0.553	0.717	0.703	YES
	CC5	Preliminary Cost	0.781			0.782		YES
	CC8	Fuel Cost	0.696			0.689		YES
Disposal Cost	ELC2	Physical Demolition Cost	0.881	0.782	0.644	0.833	0.803	YES
	ELC4	Salvage Cost	0.716			0.713		YES
Pre-development Cost	INC11	Environmental Management Cost	0.730	0.828	0.546	0.669	0.739	YES
	INC13	Land Acquisition and Compensation Cost	0.775			0.748		YES
	INC15	Land rent	0.729			0.736		YES
	INC5	Site Investigation Cost	0.720			0.742		YES
Maintenance Cost	MTC2	Subsequent Refurbishment and Adaptation Cost	0.757	0.789	0.653	0.744	0.808	YES
	MTC3	Redecoration (internal and external cost)	0.856			0.866		YES
Operational Cost	OPC3	Administration Cost	0.708	0.822	0.536	0.707	0.732	YES
	OPC4	Security Cost	0.718			0.718		YES
	OPC6	Furniture, fittings and equipment cost	0.772			0.772		YES
	OPC7	Stationaries and reprographic cost	0.731			0.732		YES

6. Conclusion

This paper identifies that the IBS promotes good collaboration between participants hence it successfully eliminates a conventional construction communication between participants problem. While the main hindrance of IBS was identified as monopoly of market price resulting in price manipulation by the supplier. Main cost factors of IBS were the mock-up or prototype system price. Therefore, focus to reduce with concern to educate the stakeholders on the real cost occurred in selecting an appropriate construction method generally, IBS particularly.

From the analysis performed, it shows that Initial cost is directly related to construction cost, Maintenance cost, and Disposal (End of Life) Cost. While Maintenance Cost, Operation Cost, Disposal Cost and Construction Cost are related to each other. Therefore, it can be concluded that the initial cost indeed is crucial to be estimated as accurate as possible because it performs as benchmark to proceed with the project or to halt it. The decision will directly affect construction, maintenance, and disposal cost of the building.

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