CONSTRUCTION COST ESTIMATION MODEL OF THE BUILDING PROJECTS

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ABSTRACT: This investigation aims to establish a construction cost estimation model for building projects. Due to various factors, the cost estimation for the building's construction cannot be enhanced. The cost estimation in the Indonesian construction industry is unreliable for completing projects at contract costs. Less emphasis on the variable factor decreases the accuracy of the estimated cost. This study gathered construction sector management data to contribute empirical evidence to the literature. According to this study, cost estimators can considerably enhance cost estimation in the Indonesian construction industry, estimating methodology, project information, current data, and historical data. Since the explored factors for estimating building construction costs were not considered in previous studies, the model devised by this research is a significant contribution. The practical implications of this research are reliable for cost estimation in the building and other sectors to increase the accuracy of the estimated cost about the actual project cost. This research also provides prospective directions for incorporating new knowledge into the cost estimation model by determining the impact of other significant factors.

Keywords: Cost estimation, project costing, building construction, estimating model, costing model

1. Introduction

Before the commencement of any undertaking, it is necessary to estimate the associated costs. The government sector institutes are diligently developing new public infrastructure. Nonetheless, the proper methodology for this infrastructure is required (Yildiz et al., 2014). The stockholders' decision is the premise for any project, and that decision is based on the project's cost. Forecasting is important when estimating the cost of a project because different organizations and governments adopt different strategic actions based on forecasting to determine the cost of the project (Johnson & Babu, 2020). Numerous initiatives fail when the government does not provide an accurate cost estimate. A reasonable cost estimate can facilitate improved cost management and decision-making. In the Indonesian construction industry, the lack of a well-developed fundamental cost estimation model is the cause of rising project costs (Love & Ahiaga-Dagbui, 2018).

A reasonable cost is required for the initiatives, and various factors influence cost concerns. When decisions regarding these variables have already been made, the cost factors can be modified to have less influence on the estimated cost (Xu, 2021). The construction industry's projects improve over time, and appropriate decision-making opportunities are created for these projects. The estimation of costs for these projects must be enhanced so that there is no significant difference between the estimated cost and the project's actual cost (Dharwadkar & Arage, 2018). The government institute must have enhanced cost estimation capabilities, and a model that incorporates all cost estimation factors should be developed. Moreover, cost estimation can provide an excellent opportunity to develop project costs (Chan, Olawumi, & Ho, 2019).

In modern times, the construction industry and the service industry estimate the costs of various initiatives. Diverse types of megaprojects are initiated following the development of accurate cost estimates, which are essential for achieving the desired benefit simultaneously (Gupta & Debnath, 2022). The lower the variance in cost estimation, the better the working conditions, which can enhance cost quality and other factors. The projects with the smallest variance between the estimated cost and the actual cost of the contract begin with accurate cost estimation (Olanrewaju, Panesar, & Saxe, 2022). This method is superior for developing a cost-related model to ensure that the appropriate budget is used fairly for the project's market performance. Furthermore, institutions that have failed to better the cost management system in this sector face significant implementation challenges with accurate estimation (Ahmed, 2018).

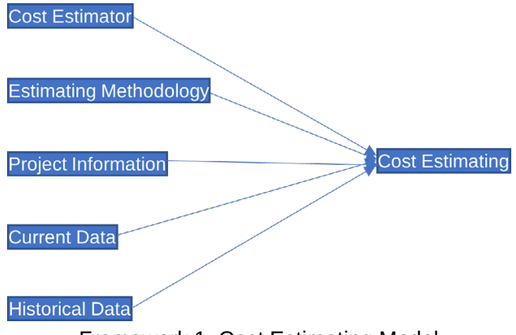
This investigation aims to establish a construction cost estimation model for building projects. Due to various factors, the cost estimation for the building's construction

cannot be enhanced. Less emphasis on the variable factor decreases the accuracy of the estimated cost. This study gathered construction sector management data to contribute empirical evidence to the literature. Since the investigated factor for cost estimation in building construction was not considered in earlier studies, the model devised by this research is a significant contribution. The practical implications of this research are reliable for cost estimation in the building and other sectors to increase the accuracy of the estimated cost about the actual project cost. This research also provides prospective directions for incorporating new knowledge into the cost estimation model by determining the impact of other significant factors.

2. Review of Literature

Cost estimation aims to determine the potential cost of any future undertaking. This estimate improves the quality of the work through cost-effective planning. The cost estimator is entrusted with producing more accurate cost estimates. The most effective method for estimating costs is to enhance the comprehension and knowledge of the cost estimator. The process of cost estimation depends on various methodologies required to increase the productivity of cost estimation. The project information is required for cost estimation because it would be simple to estimate the cost more accurately if sufficient information were available.

Moreover, the current data is required for cost estimation because the data must be analyzed to determine the relevant results. Indeed, the importance of historical data is also required for cost estimation, as these historical data provide relevant information that can be used for project forecasting. Figure 1 depicts the cost estimation model based on these variables.



Framework 1. Cost Estimating Model

According to Johnson and Babu (2020) research, the estimation of project costs can be enhanced by the caliber of the individuals involved. Appropriate cost estimation is required for making various decisions, but reasonable and qualified individuals are required to enhance cost estimation. In addition, the research conducted by Dharwadkar and Arage (2018) revealed that the estimation quality of the cost estimation procedure could be improved by taking reasonable actions. Cost estimation refers to the process of gathering evidence to estimate the cost of an undertaking. Accurate cost estimation is only feasible when qualified individuals are involved. The failure of cost estimation is also attributable to fewer innovative individuals contributing to it.

Moreover, according to Xu (2021) study, the cost estimation process must be enhanced with digital tools over time, but the individual in charge of this process must have advanced-level experience. When there is no integration in the cost of the products, the inefficiency of cost estimation can become problematic. Cost estimation is a reliable method for determining the appropriate project budget and contract.

H1: Cost estimator has a direct and positive impact on cost estimating.

Cost estimation employs a variety of distinct methodologies. The research conducted by Dharwadkar and Arage (2018) revealed that the modern method for cost estimation is to enhance estimation using digital tools. When the appropriate measures are implemented during cost estimation, the forecasting of cast estimation can be enhanced. The research conducted by Chan et al. (2019) concluded that external factors must be considered to enhance project cost estimation. Indeed, the accuracy of the cost estimate and its estimation can be enhanced by taking the necessary steps.

Moreover, the study by Gupta and Debnath (2022) concluded that the output of the cost estimation process could be improved by incorporating digital and contemporary technologies. In addition, when these digital tools are utilized more effectively, the accuracy of cost estimates can be enhanced. Nonetheless, every cost estimation methodology must be designed to incorporate both internal and external factors. The study by Jo and Yun (2021) found that fair practices in the cost estimation model can increase the cost's reliability and facilitate a better comprehension of its workings.

H2: Estimating methodology has a direct and positive impact on cost estimating.

According to Liu et al. (2020) research, the development of the mission should be the most important factor for cost estimation. Estimating a project's cost relies heavily on information regarding the project's nature, duration, and level of complexity. According to the research conducted by Poh, Ubeynarayana, and Goh (2018), cost estimation is used for forecasting the future. Still, effective strategies should be developed for its productive output to improve performance. All external and internal factors must be considered realistically to ensure accurate estimation. By educating their employees, reputable businesses strive to improve their cost projections. Access to all information is the best way to improve the estimated cost of any given undertaking. In addition, Wang, Lin, and Zhang (2020) contributed to the literature by demonstrating that the cost estimation process can be influenced if reasonable actions are taken, and dependable strategies are developed. To improve the method of cost estimation, it is necessary to take into account information regarding all potential factors and delays in the project's complexity.

H3: Project information has a direct and positive impact on cost estimating.

According to the research conducted by Ingle and Mahesh (2022), the availability of current information is essential for the project costing procedure. However, initiatives that have not yet begun but for which information is available should be modified and used for improved forecasting. Large organizations are utilizing various cost estimation factors to improve the development of initiatives and services. Similarly, the construction industry must utilize an innovative approach to project estimation and costing because this method is beneficial over the long term. According to Nishi and Minagawa (2020) study, new information about projects is a beneficial method for estimating the cost of any project. In addition, when all information is available, the estimators will have access to it to estimate the projected cast size. This cost estimate based on current data is required to enhance the performance of the project's contract cost complexity. The research conducted by Lee et al. (2021) revealed that the estimated cost could be a superior method when it is identical to the project's complexity cost. Cost management ensures that realistic factors are considered before the ultimate cost estimate.

H4: Current data has a direct and positive impact on cost estimating.

The most accurate pricing can be determined when historical data are available for any factor. In his study, Ahmed (2018) concluded that the casting process could be improved when historical evidence for each factor is available for data analysis and improved costing. Moreover, when the appropriate actions for sustainable costing are taken, historical data can be a better source of projections. As reported by Love and Ahiaga-Dagbui, comparing and constructing historical data is necessary to increase the ability to estimate costs (2018). In addition, historical data is regarded as the best source for casting, as it can provide a more efficient working strategy. When the appropriate information is utilized, the accuracy of cost estimates for any given endeavor can be improved. Over time, reasonable actions are taken to enhance the strategic cost estimation, but historical data should not be overlooked. Olanrewaju et al. (2022) found that cost estimation is more effective when data from multiple initiatives are available for systematic comparison and contrast. The estimated cost is a method for improving the construction of any project. Still, a more realistic approach based on historical evidence can provide a more reliable basis for standard casting.

H5: Historical data has a direct and positive impact on cost estimating.

3. Methodology

This study obtained information from cost estimators in the Indonesian construction industry. This research's "population" is the department's costing and budget allocation management. The participants' responses are collected using a Likert scale questionnaire. This investigation employs a scale adapted from previous research. The cost estimator items were adapted from Akintoye and Fitzgerald (2000) to ascertain their direct impact on cost estimation. The items for estimating methodology are then adapted from Tarka (2017) to ascertain its direct impact on cost estimation. In addition, the project information items are adapted from Yildiz et al. (2014) to ascertain their direct impact on cost estimation. In addition, the current data items have been adapted from Chan and Park (2005) to ascertain their direct impact on cost estimation. The historical data items are derived from Sridarran, Keraminiyage, and Herszon (2017) to ascertain their direct impact on cost estimation. In addition, the cost estimation measurements are derived from Probst et al. (2020). The research employed a "cross-sectional" approach to data acquisition, and "Smart PLS" was utilized for data analysis. This study's findings are derived from "PLS Algorithm calculations" and "PLS Bootstrapping calculations." In addition, this research's "sample size" is 114, and the "unit of analysis" is the individual.

4. Findings

For the data normality test, kurtosis and skewness values were employed. According to Bai and Ng (2005), "skewness is a measure of symmetry, or more precisely the absence of symmetry, and kurtosis is a measure of whether the data have heavy or light tails relative to a normal distribution." Moreover, according to Mardia (1974), "a general guideline for skewness is that if the number is greater than+1 or less than–1, this indicates a significantly skewed distribution, and for kurtosis if the number is greater than+1, the distribution is excessively peaked." The data in Table 1 demonstrate the study's "data normality."

Table 1. Data Normality

Items	Mean	Standard Deviation	Excess Kurtosis	Skewness
CER1	3.257	1.538	-0.543	0.088
CER2	3.275	1.796	-0.589	0.432
CER3	3.532	1.911	-0.853	0.302
CER4	3.532	1.928	-0.848	0.372
CER5	3.560	1.748	-0.513	0.294
EM1	3.523	1.818	-0.733	0.219
EM2	3.523	1.855	-0.929	0.137
EM3	3.706	1.881	-0.820	0.185
EM4	3.748	1.888	-0.816	0.286
EM5	3.679	1.976	-0.858	0.356
PI1	3.587	1.917	-0.789	0.366
PI2	3.606	1.889	-0.689	0.351
PI3	3.670	1.870	-0.753	0.302
PI4	3.514	1.798	-0.507	0.438
PI5	3.564	1.941	-0.968	0.194
CD1	3.482	1.833	-0.683	0.302
CD2	3.656	1.804	-0.700	0.241
CD3	3.050	1.466	-0.174	0.554
CD4	3.174	1.517	0.431	0.901
HD1	3.220	1.439	0.852	0.911
HD2	3.142	1.463	0.451	0.760
HD3	3.106	1.409	0.456	0.674
HD4	3.183	1.534	0.236	0.710
HD5	3.128	1.481	0.480	0.834
CEG1	3.028	1.449	-0.328	0.416
CEG2	3.128	1.348	0.304	0.601
CEG3	3.092	1.424	0.140	0.614
CEG4	3.115	1.475	0.255	0.708
CEG5	3.193	1.411	-0.292	0.444

In addition, the study's "convergent validity" is determined. Li et al. (2020) state that "factor loading demonstrates how accurately an item represents the underlying construct and must be greater than 0.70." According to Taber (2018), "Cronbach's alpha (α>0.70) is a measure of internal consistency, i.e., how closely related a group of items is. It is considered a measure of the reliability of scales." In addition, Moonen-van Loon et al. (2013) demonstrated that "composite reliability (CR>0.70) is a measure of internal consistency among scale items, similar to Cronbach's alpha." In addition, Alarcón, Sánchez, and De Olavide (2015) emphasized that "average variance extracted (AVE>0.50) is a measure of the amount of variance captured by a construct regarding the amount of variance due to measurement error." Table 2 details the significant results of "convergent validity."

Table 2. Convergent Validity

Constructs	Items	Factor Loading	Cronbach's Alpha	CR	AVE
Current Data	CD1	0.839	0.930	0.947	0.782
	CD2	0.825			
	CD3	0.871			
	CD4	0.875			
Cost Estimating	CEG1	0.859	0.942	0.956	0.812
	CEG2	0.894			
	CEG3	0.895			
	CEG4	0.873			
	CEG5	0.899			
Cost Estimator	CER1	0.905	0.877	0.914	0.727
	CER2	0.909			
	CER3	0.915			
	CER4	0.896			
	CER5	0.880			
Estimating Methodology	EM1	0.927	0.947	0.960	0.826
	EM2	0.911			
	EM3	0.891			
	EM4	0.902			
	EM5	0.915			
Historical Data	HD1	0.903	0.953	0.964	0.841
	HD2	0.902			
	HD3	0.909			
	HD4	0.936			
	HD5	0.935			
Project Information	PI1	0.912	0.944	0.957	0.818
	PI2	0.889			
	PI3	0.924			
	PI4	0.900			
	PI5	0.898			

According to Henseler, Ringle, and Sarstedt (2015), "discriminant validity examines whether or not concepts or measurements that are not expected to be related are, in fact, unrelated." For this study, the findings of the "Fornell and Larcker" model were utilized, which stipulates that "the values of the constructs must be greater than the correlated values of the other constructs." In addition, this investigation utilized the cross-loading technique for the discriminant validity test. Cross-loading to establish discriminant validity at the item level, according to Li et al. (2020), implies a strong correlation between items of the same construct and a very weak correlation between items of a distinct construct. The results of "Fornell and Larcker" are shown in Table 3, and the results of "cross-loadings" are shown in Table 4.

Table 3. Discriminant Validity–Fornell & Larcker

	Cost Estimating	Cost Estimator	Current Data	Estimating Methodology	Historical Data	Project Information
Cost Estimating	0.884					
Cost Estimator	0.706	0.981				
Current Data	0.862	0.847	0.873			
Estimating Methodology	0.673	0.937	0.831	0.969		
Historical Data	0.735	0.722	0.867	0.688	0.917	
Project Information	0.653	0.921	0.815	0.934	0.656	0.905

Table 4. Discriminant Validity–Cross-loadings

Items	Cost Estimating	Cost Estimator	Current Data	Estimating Methodology	Historical Data	Project Information
CD1	0.607	0.825	**0.839**	0.836	0.623	0.828
CD2	0.604	0.815	**0.825**	0.816	0.610	0.817
CD3	0.823	0.651	**0.871**	0.621	0.809	0.605
CD4	0.842	0.660	**0.875**	0.635	0.856	0.609
CEG1	**0.859**	0.659	0.785	0.605	0.828	0.584
CEG2	**0.894**	0.632	0.764	0.621	0.837	0.599
CEG3	**0.895**	0.593	0.722	0.569	0.798	0.564
CEG4	**0.873**	0.633	0.757	0.596	0.832	0.593
CEG5	**0.899**	0.601	0.779	0.585	0.837	0.548
CER1	0.687	**0.905**	0.776	0.838	0.711	0.829
CER2	0.610	**0.909**	0.744	0.848	0.614	0.813
CER3	0.594	**0.915**	0.735	0.834	0.598	0.838
CER4	0.645	**0.896**	0.767	0.824	0.663	0.839
CER5	0.634	**0.880**	0.790	0.876	0.655	0.827
EM1	0.655	0.860	0.757	**0.927**	0.663	0.82
EM2	0.612	0.853	0.760	**0.911**	0.630	0.809
EM3	0.572	0.840	0.745	**0.891**	0.603	0.845
EM4	0.616	0.839	0.760	**0.902**	0.627	0.886
EM5	0.600	0.869	0.759	**0.915**	0.604	0.889
HD1	0.834	0.645	0.799	0.620	**0.903**	0.593
HD2	0.862	0.647	0.797	0.608	**0.902**	0.580
HD3	0.852	0.674	0.791	0.651	**0.909**	0.632
HD4	0.881	0.650	0.781	0.622	**0.936**	0.593
HD5	0.860	0.695	0.807	0.655	**0.935**	0.613
PI1	0.613	0.847	0.751	0.868	0.619	**0.912**
PI2	0.589	0.821	0.717	0.809	0.605	**0.889**
PI3	0.572	0.819	0.722	0.828	0.572	**0.924**
PI4	0.552	0.822	0.722	0.817	0.545	**0.900**
PI5	0.622	0.852	0.770	0.895	0.620	**0.898**

The first finding of this study confirmed that the cost estimator positively impacts cost estimation (H1). The positive and confirmed influence of the estimating methodology on cost estimation was the second finding of this study (H2). In addition, the third finding of this study asserts that the cost project information regarding cost estimation is positive and confirmed (H3). In addition, this study's fourth finding confirmed that the current data's influence on cost estimation is positive (H4). Accordingly, this study concludes that the influence of historical data on cost estimation is positive and confirmed (H5). Table 5 summarizes the significant findings.

Table 5. Paths Testing

Paths	Original Sample	Standard Deviation	t	p
Cost Estimator->Cost Estimating	0.622	0.087	7.149	0
Estimating methodology->Cost Estimating	0.508	0.084	6.047	0
Project Information->Cost Estimating	0.343	0.079	4.341	0
Current Data->Cost Estimating	0.257	0.070	3.680	0
Historical Data->Cost Estimating	0.755	0.049	15.377	0
Significant “t>1.96 and p<0.50”				

5. Discussion and Conclusion

This study has contributed an important model to the body of knowledge. This study’s first conclusion is that the cost estimator’s influence on cost estimation is positive and confirmed. Nonetheless, a comparison is made between these findings and the outcomes of previously published studies. The failure of cost estimation can also be ascribed to the participation of uncreative individuals. Moreover, according to the research conducted by Dharwadkar and Arage (2018), the cost estimation method must be enhanced with digital technologies over time. Still, the individual in charge of this process must have advanced knowledge. When there is no integration of product costs, estimating costs with less precision can be problematic. Cost estimation is a reliable method for selecting an appropriate budget and project contract. According to the research of Xu (2021), the caliber of the individuals involved in an undertaking may increase its estimated cost. An accurate cost estimate is required for various judgments, but reasonable and qualified individuals are also required to improve the cost estimation. In addition, Johnson and Babu (2020) study demonstrated how the quality of the cost estimation process could be enhanced by taking the appropriate steps. Cost estimation is the process of gathering multiple pieces of evidence to estimate the cost of an undertaking. It can be enhanced only when the appropriate individuals are involved in cost estimation. Existing studies substantiate and support the relationship established by this study, as indicated by the comparison.

The second finding of this study was that the estimation methodology has a positive and substantiated effect on cost estimation. However, a comparison is made between these findings and the outcomes of previously published studies. In the cost estimation procedure, numerous methodologies are utilized. The study by Olanrewaju et al. (2022) demonstrated that utilizing digital technologies to improve cost estimation is the contemporary approach. When the appropriate steps are taken during cost estimation, cast estimation forecasting can be improved. According to the research of Gupta and Debnath (2022), enhancing the estimation of project costs necessitates taking external factors into account. Cost estimation and dependability can be improved when the appropriate actions are required. In addition, according to Ahmed (2018) research, using digital and modern technology can increase the accuracy of the cost estimation procedure. Since these digital technologies are utilized more efficiently, the estimation of costs can also be refined.

Nevertheless, each methodology must be designed to integrate both internal and external cost estimation components. According to the research by Love and Ahiaga-Dagbui (2018), equitable practices in the cost-estimating model can improve the cost’s precision and comprehension through a more efficient working process. Existing studies substantiate and support the relationship established by this study, as indicated by the comparison.

In addition, the third finding of this study indicated that the cost project information on cost estimation is positive and validated. Nonetheless, a comparative analysis is conducted between these findings and the outcomes of previously published studies. According to Jo and Yun (2021), the task’s development data should take precedence over all other factors when estimating costs. Information regarding the project’s nature and degree of complexity is essential for cost estimation. According to research by Yildiz et al. (2014), cost estimation is used for future forecasting; however, effective methodologies should be developed to increase its output and performance. The estimation can be considered reliable when all external and internal factors are realistically considered. By calculating costs, reputable businesses are preparing their employees to project costs. The availability of all information is the greatest way to increase the projected cost of a project. In addition, the Poh et al. (2018) study contributed to the body of knowledge by demonstrating that the cost estimation process can be influenced when sensible measures are taken, and reliable techniques are developed. To enhance cost estimation, accounting for all potential causes and delays in project complexity is necessary. Existing studies substantiate and support the relationship established by this study, as indicated by the comparison.

In addition, this study’s fourth finding indicated that current data’s influence on cost estimation is positive and supported. Nonetheless, a comparison is made between these findings and the outcomes of previously published studies. According to the research conducted by Chan and Park (2005), it is crucial to have access to the most recent data when estimating the cost of a project. However, initiatives for which information is already available but which have not yet begun should be modified and utilized to improve projections. Major businesses utilize various cost estimation components to comprehend projects and services.

Similarly, because this strategy is viable over the long term, the construction industry must employ innovative methods for project estimating and costing. According to Liu et al. (2020)’s study, new project-related information can assist in estimating a project’s cost. In addition, the approximations would have access to this data to calculate the expected cast once all the information is available. Based on the most recent data, this cost projection is required to increase the performance of the project’s complexity with the contract cost. The study by Chan et al. (2019) revealed that an estimate’s accuracy depends on how closely it follows the complexity costs of the project. Before developing a final cost estimate, it is the responsibility of cost management to ensure that realistic factors are considered. Indeed, the comparison revealed that the relationship established by this study is supported and confirmed by previous research.

Accordingly, this study concludes that the influence of historical data on cost estimation is positive and confirmed. To confirm this relationship, a comparison is made between these findings and the outcomes of previously published studies. When readily accessible historical data for any factor is available, optimal costing can be performed. According to the study by Probst et al. (2020), casting procedures can be enhanced when historical data for each factor is available for data analysis and more precise costing. When the appropriate steps are taken to ensure cost-effectiveness, historical data can be an excellent source for casting. According to Tarka (2017), historical data is necessary for comparing and developing models that can improve cost estimation accuracy. In addition, historical data is regarded as a viable source for forecasting that can provide a more efficient working method. It is possible to improve cost estimation accuracy for any undertaking by using the appropriate data. Even though significant improvements have been made over time to the strategic cost estimation process, it is essential to consider the value of historical data. According to Sridarran et al. (2017), a thorough comparison and contrast of existing data from numerous projects can make the cost estimation procedure more accurate. Cost estimation can enhance project construction, but a realistic approach supported by historical data can provide a stronger foundation for standard casting. Existing studies substantiate and support the relationship established by this study, as indicated by the comparison.

6. Theoretical and Practical Implications

Since the explored factors for estimating building construction costs were not considered in previous studies, the model devised by this research is a significant contribution. The relationship examined by this study is also the subject of new research. The study contributed to the understanding that the cost estimator significantly and positively influences cost estimation. This relationship was not previously examined in the literature-reviewed studies. Secondly, the study contributed to the knowledge that the estimating methodology significantly and positively influences cost estimating. The literature-reviewed studies did not previously examine this relationship. Thirdly, the study contributed to the understanding that project information significantly and positively influences cost estimation. The literature-researched studies did not previously examine this relationship. In addition, the study contributed to the knowledge that current data has a significant and positive impact on cost estimation. The literature-reviewed studies did not evaluate this relationship. Lastly, the study contributed to the knowledge that historical data significantly and positively affects cost estimation. The literature-reviewed studies did not previously examine this relationship. These connections constitute a new contribution to the body of knowledge.

Consequently, the practical implications of this research are reliable for cost estimation in the building and other sectors to increase the accuracy of the estimated cost of the project’s contract cost. According to the study, the qualifications and experience of the cost estimator must be taken into account because they influence the cost estimation procedure. When the cost estimator is qualified, he creates an appropriate model more efficiently. The study emphasized that the cost estimation methodology should be enhanced over time and that new technologies should be utilized. The data can be stored in the new database, and systematic calculations can be performed.

Similarly, the information about the project is crucial to the cost estimation process, as it can provide a better working environment and enhance the estimation experience. Consequently, the data is required for the estimation of the cast size. For accurate cost estimation in the construction industry, the cost estimator must utilize historical and new data. In this manner, the Indonesian construction industry can improve the casting process, which must be improved over time.

7. Future Directions

Despite this, the findings of this study indicate that cost estimation in the Indonesian construction industry can be enhanced by cost estimators, estimating methodologies, project information, current data, and historical data. In addition, the model developed by this research is an important contribution, as previous studies did not consider the examined factors for estimating building construction costs. Thus, the practical implications of this research are reliable for cost estimation in the building and other sectors, enhancing the accuracy of the estimated cost of the project's contract cost. This research also provides prospective directions for incorporating new knowledge into the cost estimation model by determining the impact of other significant factors. This study recommends that future research investigate the role of internal factors as mediators between cost estimation and the factors discussed in the model of the current study. In addition, this study recommended that future research investigate the role of environmental factors as a moderator between cost estimation and the factors discussed in the model of this study. By pursuing these directions, the cost estimation model would be improved.

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