

Development of Cost Planning Standard for Mechanical and Miscellaneous Work on Stadium Field of Play Works in Integrated Contracts of State Building Design Based on Indonesian Minister of Public Works Regulation No 22 of 2018 To Improve Cost Accuracy

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Abstract

A building has its own complexity characteristics. There are many public facilities buildings that have a fairly high level of complexity, for example, the stadium. Public facilities buildings that have high complexity certainly require efficient contract methods because conventional work contract methods are considered not qualified to accommodate those who are influenced by the complexity of the building work. One suitable and better method is the Integrated Design and Build contract, this contract involves the contractor from planning to implementing the construction work completed properly, but in the event of failure, the contractor bears all the risks caused. This type of contract is considered necessary to be applied because some examples of public facilities work projects, especially sports facilities, are problematic in the implementation process. One example is the renovation of Helsinki Olympic Stadium experiencing an over-budget of up to €38 million. Another example refers to Indonesia, the 2018 XVIII Asian Games project, the initial cost of the project is Rp 7.4 trillion, then the cost rises drastically to Rp 12.7 trillion. Due to the frequent similar cases, we aim to develop specific cost planning standards for the mechanical work section, and Miscellaneous in the field of play area of the stadium with an integrated contract based on PUPR Ministerial Decree No.22 of 2018 to improve cost accuracy. The expected outcome of the entire study is to develop new Cost Planning Standards for stadium projects to improve the accuracy of project costs.

Keywords— Integrated Design And Build Contract, Improve Cost Accuracy, Stadium, Public Facilities.

Introduction

Design and Build is a work construction contract related to the construction of a building where the provider has a unity of responsibility for designing and implementing construction. This design is different from conventional methods where service users do not need to prepare detail engineering design (DED), but only prepare basic design. (Inspectorate General of the Ministry of PUPR, 2020). But in its implementation, there are still many obstacles in the field. Here are some examples of

problems with obstacles in using design and build contracts. The audit process of the inspection team is not separated into a problem. The examiner asks for details of the quantity and price of the unit of work which of course causes differences so that disputes or claim disputes occur between service users, service providers and auditors. The construction of the stadium building, can not be separated from the basic needs for lighting, fire extinguishers, air conditioning or other electronic equipment. ME's work is one of the largest budget

contributors in project cost estimates. Often in the midst of the implementation of the project, there is less work added to mechanical and electrical work which sometimes makes a difference in documenting that is not well recorded or changes in the use of materials from the predetermined. As was the case with the stadium construction project at U.S. Bank Stadium, it is known that 90 percent of the \$15.4 million in unpaid work was caused by construction companies working on power projects, drywall and other projects. This is due to changes made by the Minnesota Sports Facilities Authority and the hks architects have added costs beyond what has been agreed. Aligned with U.S. Bank Stadium, the total cost of the new Mercedes-Benz Atlanta Falcons Stadium has reached \$1.5 billion after an additional \$9.1 million in change orders for ME jobs in June, according to the Atlanta Journal-Constitution. The additional cost in May was largely due to an accelerated schedule to complete construction in June 2017—in time for the 2017-2018 NFL season.

Literature Review

Based on the Regulation of the Minister of Public Works No. 22 of 2018, the state building is one of the state-owned assets that has strategic value as a place for the implementation process of the state that is regulated and managed so that it is functional, reliable, effective, efficient and organized in an orderly manner. In preparing the financing of the construction of this State Building must get recommendations from technical agencies, so that the financing is prepared in accordance with existing provisions, both from the amount of price, standard and non-standar, classification of State Buildings, and the implementation of its construction. Design and Build can be described as a procurement method in which one entity or consortium is contractually responsible for the design and construction of a project (Ndekugri & Turner, 1994; Akintoye, 1994; Akintoye & Fitzgerald, 1995; Griffith, Knight & King, 2003). According to Hale & Shrestha, (2009), "Design

and Build can be described as a project delivery method in which the owner provides the requirements for a particular project and gives a contract to one company that will design and build the project".

According to Minister of Youth and Sports Regulation No. 400 of 2013, a stadium is a piece of sports infrastructure that must be predominantly used for sporting activities/practices. The stadium is prioritized as a center for athletics and football. However, because the stadium is equipped with stands with sufficient seats for spectators and a reasonably wide arena, it can be used for a variety of non-sports activities, such as music concerts, religious activities, social activities, and other activities that involve visitors. In general, stadium work is separated into three parts: the main stadium building, field of play, and regional work. The field of play zone's scope of work comprises a football field and an athletic track.

According to Permen PU No. 28 of 2016 there are 7 categories for the scope of work, namely: Design Development, Sitework, Structural Work, Architectural Work, Mechanical Work, Electrical Work, Exterior Facilities and Miscellaneous Work. Mechanical work is work related to large tools and machinery, such as elevators and escalators for large buildings, air conditioners, as well as the installation of water pumps, and other supporting installations. Types of mechanical work according to Permen PU No. 28 of 2016 include Plumbing, heating, ventilation and air conditioning, fire prevention. Mechanical work activities in the field of play to be studied include the procurement and Installation of HDPE Pipes, installation of Saddle Clamp and installation of GIP Pipes, Gate Valve, Quick Coupling, etc. Miscellaneous work is another job. Miscellaneous work types according to Permen PU No. 28 of 2016 include equipment, special construction, communication systems, lightning prevention. Miscellaneous work activities in the field of play that will be studied include Soil Breeding, Grass Planting, Fertilizing and Watering, etc. Standard costs are used for the implementation

of standard physical construction which includes architectural work, structures, utilities that include plumbing work, and lighting installation networks, and finishing. Standard costs include construction overhead, insurance, occupational safety, inflation, and taxes in accordance with the provisions of the standard cost in addition to standard construction implementation work, including construction implementation overhead, insurance, occupational safety, inflation, and taxes in accordance with the provisions of the laws and regulations.

Table Error! No text of specified style in document..1 Indicators and Variables of Standard Cost

No	Variable	Indicator	Reference
1	Standard Cost	Work component	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree (2017)
			Fisk, E.R (1992) Public Works Ministerial Decree (2018); Public Works Ministerial Decree 22 Tahun 2018; Ghallab and Hosain (2020);
		Technical specifications	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree

No	Variable	Indicator	Reference
			(2017); Public Works Ministerial Decree (2018)
		Number of seats	UEFA Guide to Quality Stadiums (2011); Permen Menpora No.0400 Tahun 2013;
		The highest unit price for state buildings	Jauzy A. (2012); BPSDM PUPR (2016); Public Works Ministerial Decree (2017)
		Construction cost index	Hikmah J. dan Idris (2019)

According to Presidential Decree No. 73 of 2011, non-standard costs are costs used for the implementation of non-standard physical construction (for which there is no standard), such as: licensing other than IMB, and utility splicing. Non-standard costs for the implementation of non-standard physical construction work: preparation and maturation of land, increase in building architecture work, increased building structure work, special construction completeness consisting of mechanical and electrical work, and special buildings are environmentally friendly.

Table Error! No text of specified style in document..2 Indicators and Variables of Non-Standard Cost

No	Variable	Indicator	Reference
1	Non-Standard Cost	Volume details	Jauzy A. (2012); BPSDM PUPR

	(2016)
Buildings and environment	Public Works Ministerial Decree (2017)
Significant function	Public Works Ministerial Decree (2017); Permen PU (2018)
Other works	Public Works Ministerial Decree (2017)

Additional costs are not included in standard or non-standard costs. Examples include the issue of an IMB (Building Permit), internet connection fees, soil investigation testing, and costs of safety.

Table Error! No text of specified style in document..3 Indicators and Variables of Additional Costs

No	Variable	Indicator	Reference
1	Additional Costs	IMB or PBG	Governor Regulation No. 147 of 2018; Herea and Ungureanu (2018); PP No. 16 of 2021
		Internet Connection Fee environment	Rusniati (2020); KOMINFO Decree Candy No. 14 of 2017
		Soil Investigation Test	SNI 8460:2017; Rena. M (2011)
		Cost of Safety	Public Works Ministerial Decree No. 10 of 2021

Based on the literature and previous studies that discussed the Cost Planning Standard followed

by regulations or policies from Permen PU No. 22 of 2018 and previous studies that discussed cost accuracy, in this study there was a variable X (Free Variable) which is a standard cost and non-standard cost that can affect variable Y (Bound Variable) namely cost accuracy.

Table Error! No text of specified style in document..4 Research Synthesis – Relation Between Variables

No	Relation Between Variables	Reference
1	Standard Cost → Cost Accuracy	Permen PU No. 22 (2018); Perpres No. 73 (2011)
2	Non Standard Cost → Cost Accuracy	Muhammad T. H (2017); Pradana & Miftahul (2019)
3	Other Cost → Cost Accuracy	Muhammad T. H (2017); Alfredo F. (2005)

Based on the background of the problem and the study of literature, it can be concluded the hypothesis of this study, namely:

1. Standard Cost Variables affect the accuracy of costs significantly.
2. Non-Standard Cost variables affect cost accuracy significantly.
3. Other Cost affect cost accuracy significantly.

METHOD

Material, to determine variables and indicators, this research begins with the collection of secondary data, including literature reviews and archive analysis. Then collect primary data, which includes expert confirmation of the literature study's findings and distribution of questionnaires to respondents.

Samples, Secondary data are collected through literature studies, namely in journals that discuss cost planning standards and how to improve cost accuracy, in order to get the

variables and indicators indicated in sub chapter 2.5. The first stage of data collecting was to solicit expert advice on cost accuracy. There are five professionals with more than ten years of expertise and the most recent education is a Master of Engineering. After obtaining agreement and input from experts, move to the second stage of data collection in order to validate the language used in the questionnaire that will be disseminated to the primary respondents in the third stage of data collection. After obtaining the findings of the second stage of data collection, move to the third step of data collection, which involved the distribution of questionnaires to respondents based on the respondent criteria.

1. Minimum education of three years
2. Minimum education S1 (Bachelor) majoring in Civil Engineering / Architecture / Mechanical or Electrical Engineering.
3. Have or are currently in construction work

Procedure, the procedure selected for this research is archive analysis, questionnaire-based surveys, statistical analysis using SPSS and SmartPLS tools, and expert validation. The questionnaire that will be used in this study as a research tool. The Research Question (RQ) data collection process is divided into many stages. Prior to performing a pilot survey for the first questionnaire, a review of the archives of prior literature research was conducted to gather material for questionnaire development. The first stage of data collection is to ascertain the elements of standard costs, non-standard costs, and other costs that may affect the accuracy of costs on cost planning standards for the scope of design development work, sitework, and stadium structures by validating content and constructs through interviews and discussions with experts.

Research Process, several research methods were used in this study to address the problem formulation, including archive analysis, questionnaires, and expert validation. The study

used a questionnaire to collect data from respondents, and then analysed the association between standard cost variables, non-standard costs, and cost accuracy using SEM-PLS and subsequent validation with experts or experts. The data collected will be analysed to create a standard form of cost planning that will be transformed into cost planning standards in accordance with Minister of Public Works Regulation No. 22 of 2018 in order to increase cost accuracy.

Data Analysis, following the collection of all data, data analysis is performed. Data analysis was used to ascertain whether the independent factors influenced the dependent variable. The obtained data will be analyzed using the SPSS and SmartPLS tools. Before analyzing the respondent data, a test was undertaken to ensure that the obtained data was usable and met the requirements. The following tests are performed on the respondent's data: data adequacy, homogeneity, validity, reliability, and KMO data adequacy. After the data was validated and found to meet the requirements, the authors analyzed the respondent's data. SmartPLS software was used to conduct the analysis. To ascertain the effect of planning standards on cost accuracy in state buildings, this research is extended by evaluating respondent questionnaire data using the SmartPLS tool after it has been analyzed using the SPSS tool.

Test Validity with SPSS, the product moment Pearson correlation test results in a correlation coefficient which is used to measure the strength of the linear relationship between two variables. The result to be analysed in this test is the Pearson correlation value "r" which can be said to be valid if "r" is greater than the significance where the significance value obtained in the distribution table of the "r" table is 0.24. It was found that the Pearson value on each indicator was greater than the "r" table = 0.24 where it can be concluded that all data are valid.

Reliability Test (Cronbach's Alpha) with SPSS, in this study, the reliability test (Cronbach's Alpha) was used to determine the reliability and consistency of the measuring device by measuring the consistency and stability of the responses or data. The researchers used the SPSS tool to conduct a reliability test using the Cronbach's Alpha method under the following conditions:

- Cronbach's Alpha value > 0.06 then reliable
- Cronbach's Alpha value < 0.06 then not reliable

The result test as follow :

Table 3.1 Results of Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
0.712	19

The reliability test results in Table 4.9 showed that the 19 indicators in the study had Cronbach alpha's values of $0.712 > 0.6$ which means all indicators are reliable and the study is reliable.

Data Sufficiency Test – KMO (Kaiser Meyer Olkin) with SPSS, the KMO & Bartlett test was used to determine the data adequacy in this study, which was conducted using the SPSS program tool. After calculating the KMO and Bartlett, the following findings are obtained:

Table 3.2 Calculation Result of KMO dan Bartlett's Test

Kaiser-Meyer-Olkin	Measure of	0.761
Bartlett's Test of Sphericity	Approx. Chi-Square	507.369
	df	171
	Sig.	0.000

Kmo & Bartlett's Test results in Table 4.11 showed that the study had a KMO value of $0.761 > 0.5$, so the sample of this study has been sufficiently used. Bartlett's Test of Sphericity value has a significance value of $0.000 < 0.05$ which means there is a significant correlation relationship between research variables so that it can be continued to the next stage of analysis.

RESULT

Because each indicator has a T-statistic more than 1.96 or a P-Value < 0.05 , they all have a significant effect on the latent variable. Additionally, the following table contains the path coefficient obtained results using bootstrapping to determine the significance of the relationship between variables. Table 4.1 Bootstrapping Results by Path Coefficient.

Table 4.1 T-Statistic Results (Boot Stramping)

Relation	Original Sample (O)	T Statistics (O/S TDEV)	P Values	Description
Non-standard Cost -> Cost Accuracy	0.399	5.019	0.000	Significant Impact
Standard Cost -> Cost Accuracy	-0.296	2.973	0.003	Significant Impact
Other Cost -> Cost Accuracy	0.300	3.703	0.000	Significant Impact

The Path Coefficient result in Table 4.19 shows variable X1. Standard Cost, X2. Non-Standard And X3 Costs. Other costs have a significant effect on Y1. Cost Accuracy due to T-Statistic value > 1.96 or P-Value value < 0.05 . Standard costs (0.399) and other costs (0.300) have a positive path coefficient value which means standard costs and miscellaneous costs have a positive and significant effect on increased cost accuracy. While non-standard costs (-0.296) have a negative path coefficient value which means non-standard costs negatively and significantly affect the decrease in cost accuracy. If sorted from the smallest p-value to the largest coefficient, then the variables that most affect cost accuracy are standard costs, other costs and the last is non-standard costs.

R Square, is the coefficient of determination that explains how far the dependent data can be explained by independent data. R Square is worth between 0 – 1 with the provision that the closer to 1 (one), the better. R Square is owned by variable Y (dependent variable).

Table 4.2 R Square Table, Result of Bootstrapping

	R Square	R Square Adjusted
Y1 - Cost Accuracy	0.597	0.579

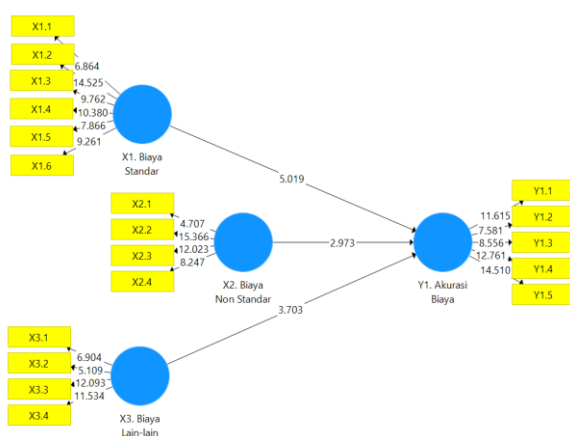
Table 4.2 shows the variable R-square value of cost accuracy is 0.597 which indicates that cost accuracy can be explained by standard fees, non-standard costs and other costs of 59.7% which fall into the moderate category. (Joe F Hair et al., 2011). The remaining 40.3% can be explained by variables other than those used in the study.

Model Fit, shows how good the model is.

Table 4.3 Result of Fit Model

	Saturated Model	Estimated Model
SRMR	0.100	0.100
d_ULS	1.902	1.902
d_G	0.701	0.701
Chi-Square	2478.195	248.195
NFI	0.562	0.562

the model in this study was able to represent the actual state of the field by 56.2%.



Picture 4.1 Structural Equation Modelling Overview on Inner Model

T-Statistics (Boot Stramping) results are also obtained from Table 4.1 for the mathematical model of the research findings based on the Original Sample (O), namely $Y = 0.399 X1 - 0.296 X2 + 0.300 X3$. Additionally, the level of accuracy increases if the variable X1 Standard Cost and X3 Additional Cost is increased, and the accuracy rate is also increased if the X2 variable is increased. Non-Standard Fees reduced.

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