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Contractor Role on the Increase of Constructability in Highway Project

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ABSTRACT: The construction service industry is one industry that has intense competition. Construction services work is complex, unique, and at the same time has business risks at the same time, in this case the service provider competes as cheaply as possible in terms of price but the company must also have profit opportunities. Indonesia as a developing country that continues to build infrastructure certainly has a high intensity of infrastructure work, especially in the field of roads, the high intensity of road works also occurs in Banten, DKI Jakarta and West Java Provinces which make service providers often find obstacles to the implementation of road improvement work. This can occur because of various factors such as long-standing planning so that it is less relevant, the traffic on the road that is being carried out is very dense, the road to be worked on is the only road so that it cannot be closed for long periods of time, up to social problems related to the impact on local residents. These obstacles make service providers must be swift in dealing with it, and play an active role in finding solutions to solve the problem. The purpose of this research is to find out the role of service providers in improving constructability, especially for Banten, DKI Jakarta and West Java which will be the object of research. The data collection technique used is the survey method by distributing questionnaires to all stake holders involved in road works projects in Banten, DKI Jakarta and West Java, the method of analysis used is correlation and linear regression to determine the variables that most influence the increase in constructability in roadworks. The results obtained are the role of service providers, especially in constructability improvement is adequate through correlation analysis found 19 independent variables that have a strong correlation with the dependent variable, with four variables that have the strongest influence which shows that the concept of constructability is familiar in the construction world that makes Respondents' perceptions of service providers in improving constructability are sufficient, so that service providers are considered able to carry out constructability on road improvement work properly.

KEYWORDS: Constructability, improvement of roads, national roads.

I. INTRODUCTION

The construction service industry is one industry that has intense competition. Construction services work is complex, unique, and at the same time has business risks, in this case the service provider competes to be as cheap as possible in terms of price but the company must also have profits. The stages of construction projects are divided into several stages, namely: concept planning and feasibility studies, engineering and detailed design, procurement, and implementation of construction. The project approach itself is divided into a conventional contract system and engineering design.

The development of the construction service industry in Indonesia began around the 1970s, at the beginning of the PJP I, the existing construction services companies of the former Dutch company changed their status from the State Company (PN) to the state-owned company PT. As a State-Owned Enterprise (BUMN/ SOE) (Yasin, 2003) [4] such as NV HollandscheBetonMaatschappij / HBM (Now PT HutamaKarya), NV Associate (now PT Adhi Karya), NederlandscheAanemingMaatschappij / NEDAM (Now PT NindyaKarya), Volker AannemingMaatschappij (now PT WaskitaKarya) and others. At this time projects have begun to be tendered which fosters competition not only among

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fellow BUMN/ SOE but also the private sector, BUMN/ SOE service providers can no longer rely on their big names but are also required to compete professionally.

Indonesia as a developing country that continues to build infrastructure certainly has a high intensity of infrastructure work, especially in the field of roads, the high intensity of road works also occurs in Banten, DKI Jakarta and West Java provinces which make service providers often find obstacles to the implementation of road improvement work. This can happen because of various factors such as long-standing planning so that it is less relevant, the traffic on the road that is being carried out is very dense, the road to be worked on is the only road so that it cannot be closed for long periods of time, up to social problems related to the impact on local residents.

These obstacles make service providers must able to swiftly dealt with it, and play an active role in finding solutions to solve the problem. Constructability, also known as buildability in the UK, is a program that emerged in the late 1970s in America that bridged the gap between architects / designers and service providers. "Constructability" is defined by the Construction Industry Institute (CII) of Austin, USA as "the optimal use of construction knowledge and experience at the planning, design, procurement and implementation stages of the field so that buildings can be built effectively, efficiently and of good quality" (Sulistio, 2013) [2].

Constructability basically is a bridge between planners and implementers, constructability can be applied by service providers during work execution, because designs that do not take into account the technical aspects and field factors will greatly slow its implementation, this can be done if service providers have criteria such as experience and the knowledge and support of various related parties, the success of a construction implementation is the responsibility of the service provider.

II.LITERATURE REVIEW

Construction Project

A construction project is a series of activities which are only one-time implemented generally (relatively) short term, and there are restrictions on the start and end times (Erviyanto, 2003) [1]. The definition of a project is simply a series of activities that are planned and carried out sequentially using a lot of resources and are limited by costs, quality and time (Sultan Syah M, 2004) [3].

Constructability

Constructability is a term that attracts the attention of the construction industry, practitioners and academics. "Constructability" is defined by Construction Industry Institute (CII) Austin, USA as "the optimum use of knowledge and construction experience at the planning, design, procurement and implementation stages of the field so that buildings can be built effectively, efficiently and of good quality" (Sulistio, 2013) [2]. Constructability is a construction project management technique from beginning to end during the pre-construction phase, this technique serves to identify obstacles before the project is built to reduce or prevent errors, delays, and costs that exceed the budget (IPENZ, 2008). From this definition, the definition conveyed by CII has provided clear boundaries and scope and gives the understanding that the need to consider aspects of implementation at the design stage and vice versa at the implementation stage must stick to the design principles that have been applied to design solutions.

Constructability is important for service providers because design that does not take into account technical aspects and field factors will be very detrimental during the implementation period, while if the design drawings have arrived at the service provider then successful implementation is the responsibility of the service provider. There are 7 (seven) basic concepts produced namely (Sulistio, 2013) [2]:

1. Controllable design schedule and procurement
2. Controllable chosen design and procurement
3. Must use unsure design standard
4. Use of design module to ease installation investigation and handling
5. Design must promote accessibility from all resources
6. Design must ease construction and environment friendly
7. Used material must be as specified in contract

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Concept of Constructability

In the United States (USA) CII (Construction Industry Institute, 1987) developed the concept of "constructability" into 17 concepts, grouped into 3 phases of project life circle, namely: project conceptual planning, design and procurement, and field operations. The concept is based on the experience of project owners, contractors and the CII Constructability team and researchers who are conducting research on constructability. The main purpose of this concept is to stimulate thinking about Constructability and how to apply constructability (Sulistio, 2013) [2]. As seen on Fig 1. (a) and (b) below are the principles and effect of cost curve of constructability.

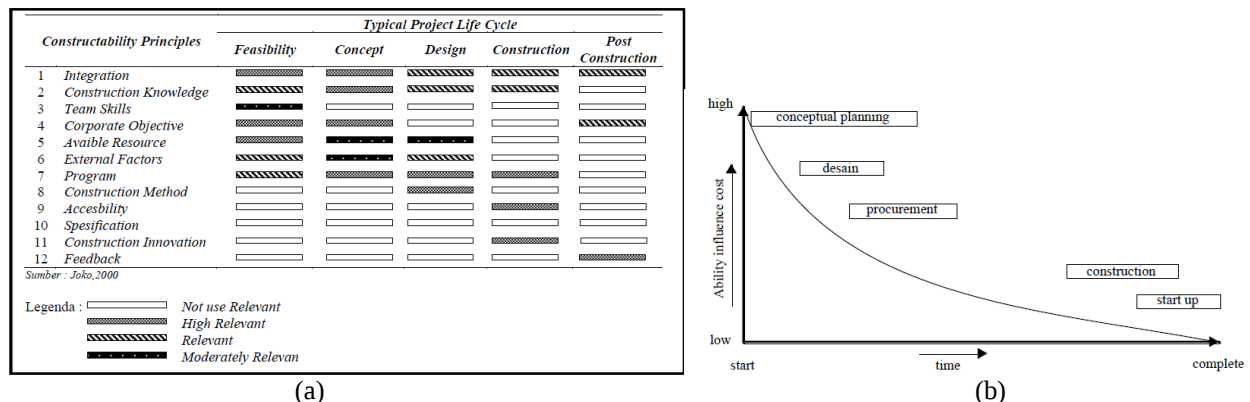


Fig. 1 (a) Principles of constructability (Sulistio, 2013) (b) Effect of cost curve

III. RESEARCH METHODOLOGY

The research methods for this research was determined by using the selective method by Yin (2009) [5] which can be seen on the table 1 below:

Table. 1 Research Methods (Yin, 2009)

Strategy	Form of Question	Researcher has Control Over the Events	Degree of Focus from Similar Past Research
Experiment	How, Why	Yes	Yes
Survey	Who, what, where, how many	No	Yes
Archive Analysis	Who, what, where, how many	No	No
Historical	How, why	No	No
Case Study	How, why	No	Yes

Location

The research sites that will be reviewed are road construction work in the area of the National Road Implementation Centre VI, namely Banten, DKI Jakarta and West Java. Distribution of questionnaires and interviews will be carried out to respondents who are carrying out construction activities or respondents who have completed construction activities in the area. Fig 2 shows that road section for DKI Jakarta, Banten, and West Java.

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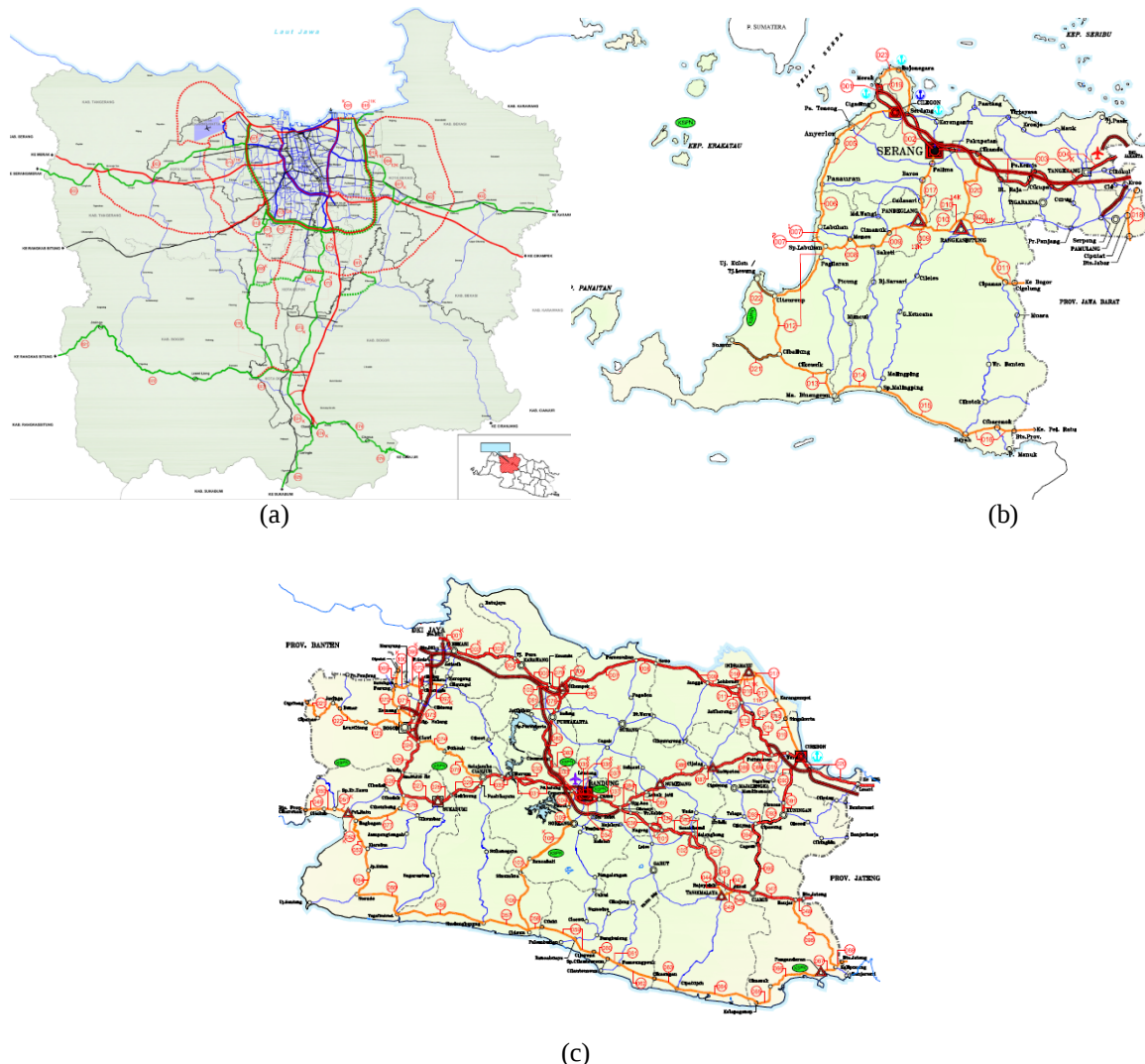


Fig. 2 (a) DKI Jakarta provincial road section (BBPJV VI, 2018) (b) Banten provincial road section (BBPJV, 2018) (c) West Java provincial road section (BBPJV, 2018)

Respondents Criteria

In this study, data will be collected and processed from respondents, namely service users and service providers regarding constructability on road improvement work, research will be conducted in the working area of the VI National Road Implementation Centre (“Balai Besar Pelaksanaan Jalan Nasional/VI (BBPJV VI)”) in Jakarta. The respondents who will be met are:

1. Commitment Making Officials on Road improvement projects in the area of BBPJV VI Jakarta;
2. Work Unit at BBPJV VI Jakarta;
3. Relevant employees at BBPJV VI Jakarta;
4. Provider of service for carrying out road improvement work in the working area of BBPJV VI Jakarta.

In this case there are criteria for respondents who must be determined so that the results of data collection and processing become more accurate include:

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1. Respondents have a working period of 3 years or more in their current position;
2. Respondents must be at least D IV or college graduates;
3. Respondents must be involved as service users and service providers on road improvement work;
4. Respondents from the service provider must be at least a supervisors or above.

Steps used in this research are:

1. Data Collecting. In this step, all relevant data and past literature concerning constructability was collected.
2. Finding the factor about contractors' role that increase constructability.
3. Making those factors into variables.
4. Turning those variables into questionnaire. Meaning creating the questionnaire based on the variables and the purpose of this research
5. Spread the questionnaire. Spreading the questionnaire to the correct people, such as the qualified worker (with enough experience and education) who worked directly inside the project, very familiar about the subject, or experts within the project or construction field.
6. Run correlation analysis to find the factor which correlate the most with this research's dependent variable (variable which represent the topic of this research which is change order that influence time performance of construction)
7. Run Multicollinearity analysis
8. Run Multiple Regression analysis to find the correct equation to find the variables, in this case the variables are the factors that influenced a contractors' role that increased in constructability in highway project.

IV. ANALYSIS AND RESULTS

Result of Validity Test

This test is conducted to see whether or not an instrument is valid for research, in this case the instrument in question is the variables of the distributed questionnaire. The test is done using the Spearman-Brown equation using the help of a data processing program. Validity test was conducted on the results of the questionnaire obtained from 62 respondents, based on the Spearman table, then the variable is valid if the value of the correlation coefficient (r_i) is greater than 0.211 which is the coefficient obtained from the Spearman Upper Critical Values table with $n = 62$ with significance level of 0.05. The coefficient value that does not reach 0.188 is declared invalid.

Validity test is performed on independent variables (X) and dependent variables (Y). The results of the analysis of the validity of stages 1 and 2 indicate that there are several variables below the coefficient of 0.211, with the test in stage 3 showing no variables below 0.211.

Result of Reliability Test

This test is carried out to see how reliable a questionnaire can be used. In this study the reliability test results were 0.968 (in the Cronbach's Alpha column) at the final stage, which indicates that the reliability of the data has entered the Excellent or special category.

Result of Correlation Test

Pearson correlation analysis is used to measure whether or not there is a close relationship between variables, whether it's a relationship between the independent variable (X) or the relationship between the independent variable (X) and the dependent variable (Y). The results of the questionnaire survey gave results in the form of ordinal scale data while the Pearson correlation analysis could not analyse ordinal scale data but is able to analyse interval scale data. Ordinal scale data needs to be converted into interval scale data using the method of successive interval. This change with the method of successive interval is done in MS. Excel uses Add-ins that are in the MS Excel program.

Based on the correlation test, there is a significant relationship between the independent variable (X) on the dependent variable (Y) at the level of 0.01, which is the variable that greatly influences the role of service providers in improving constructability. Below are the variables with high correlation to the independent variable. Table 2 are the results of correlation test where the independent variables have high correlation to the dependent variable.

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Table. 2 Result of Correlation Test

Va r	Notes
X6	Constructability is a bridge between planners and project implementers
X8	Constructability is important for service providers because designs that do not take into account technical aspects and field factors will greatly hamper project implementation
X9	Constructability is part of Total Quality Management (TQM)
X1 0	Constructability can run along with Value Engineering (VE)
X1 1	The term constructability is familiar in the world of Indonesian construction
X1 2	Constructability of service providers arises due to errors in planning and design
X1 8	Project manager's support for constructability
X1 9	Support for initiators for service providers regarding constructability
X2 0	Authority of the service provider team in implementing constructability
X2 1	Reward the service provider team for the results of constructability
X2 2	Service user's support
X2 3	Support in planning
X2 6	Knowledge of prices
X2 7	Knowledge of work methods
X2 8	Ability to identify work at unnatural costs
X3 0	Competence of management, employees and workers
X3 1	Active team members
X3 2	The ability to communicate and cooperate between team members
X3 3	Mastery of work methods / implementation

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Linear Regression Test

Table. 3 Linear Regression Result

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.660 ^a	.436	.427	.70860
2	.749 ^b	.561	.546	.63071
3	.774 ^c	.599	.579	.60751
4	.797 ^d	.636	.610	.58436

a. Predictors: (Constant), X11

b. Predictors: (Constant), X11, X21

c. Predictors: (Constant), X11, X21, X31

d. Predictors: (Constant), X11, X21, X31, X17

Table 3 above shows the most suitable model describing the relationship between the independent variable and the dependent variable, that is, the model that has the largest R square value, in this case the model 4. This model shows that the results of the respondents indicate the role of the service provider to constructability meets the specified criteria with the level of influence as much as 63.6% by variable X11 (The term constructability is familiar in the world of Indonesian construction), X21 (Reward for the service provider team for constructability results), X31 (Activity of team members) and X17 (Support of top management service provider companies towards constructability).

Table. 4 ANOVA Test Results

Model		Sum ofSquares	df	MeanSquare	F	Sig.
1	Regression	23,308	1	23,308	46,420	.000 ^b
	Residual	30,127	60	,502		
	Total	53,435	61			
2	Regression	29,966	2	14,983	37,665	.000 ^c
	Residual	23,470	59	,398		
	Total	53,435	61			
3	Regression	32,029	3	10,676	28,928	.000 ^d
	Residual	21,406	58	,369		
	Total	53,435	61			

Table. 4 ANOVA Test Results (cont.)

Model		Sum of Squares	df	Mean Square	F	Sig.
4	Regression	33,971	4	8,493	24,871	.000 ^e
	Residual	19,464	57	,341		
	Total	53,435	61			

a. Dependent Variable: Y

b. Predictors: (Constant), X11

c. Predictors: (Constant), X11, X21

d. Predictors: (Constant), X11, X21, X31

e. Predictors: (Constant), X11, X21, X31, X17

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Table 4 above shows the results of the ANOVA test which shows for each model the p-value (sig. column) is less than 0.05 which indicates the significance of the independent variables with the dependent variable for all models. Total df (degree of freedom) value is 61 (n-1) which means that all 60 respondents' data are used entirely for linear regression analysis.

Table. 5 Linear Regression Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,578	,292		5,411	,000
	X11	,640	,094	,660	6,813	,000
2	(Constant)	,627	,348		1,798	,077
	X11	,529	,088	,546	6,018	,000
	X21	,354	,087	,371	4,091	,000
3	(Constant)	-,092	,453		-,203	,840
	X11	,479	,087	,494	5,484	,000
	X21	,322	,084	,337	3,809	,000
	X31	,242	,102	,209	2,365	,021
4	(Constant)	,089	,442		,202	,841
	X11	,469	,084	,483	5,571	,000
	X21	,430	,093	,450	4,620	,000
	X31	,383	,115	,330	3,336	,002
	X17	-,260	,109	-,263	-,2385	,020

Table 5 above shows the results of the linear regression coefficient that will be formed into the equation below. Equations are formed based on Model 4, the equation is:

$$Y = 0.89 + 0.469X_{11} + 0.430X_{21} + 0.383X_{31} - 0.260X_{17}$$

This test is used to determine whether the independent variable (X) has a significant effect on the dependent variable (Y).

1. Constant value 0.89; meaning if (X₁) to (X₃₈) has the value is 0, then the value (Y) is 0.89.
2. Variable regression of coefficient X₁₁ (the term constructability is familiar in the world of Indonesian construction) 0.469; states that these variables have a positive effect.
3. Variable X₂₁ regression coefficient (reward for service provider team for constructability results) 0.430; states that these variables have a positive effect.
4. X₃₁ variable regression coefficient (activity of team members) 0.383; states that these variables have a positive effect.
5. Variable regression coefficient X₁₇ (support from top management service provider companies for constructability) (-0,260); stated that respondents' perceptions of top management support were not good.

Based on these equations it can be concluded that the biggest influence that makes respondents feel the role of service providers in improving constructability is adequate X₁₁, X₂₁, X₃₁, and X₁₇.

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V. CONCLUSION

The conclusion of the analysis is the role of service providers, especially in constructability improvement is sufficient based on the results of literature studies and questionnaire analysis, through correlation analysis obtained 19 independent variables (X) that have a strong correlation with the dependent variable (Y), with the strongest variable is variable X11 (The term constructability is familiar in the world of Indonesian construction), which shows that the concept of constructability is familiar in the construction world, which makes respondents' perceptions of service providers in constructability improvements sufficient, so that service providers are able to carry out constructability on road improvement work properly

Based on the results of the regression test, there were 4 variables which had the strongest influence on the Y variable, namely X11 (The terms constructability are familiar in the world of Indonesian construction), X21 (Reward for the service provider team for constructability results), X31 (Activity of team members) and X17 (Support top management service provider companies towards constructability).

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