ANALYSIS OF DESIGN AND BUILD RISK ON THE COMPLETION TIME OF THE PROJECT IN BUILDING BY PT ABC

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Central Agency on Statistics (BPS) stated that the value of building construction increases every year, even in the last 10 years it has increased to 201% and 61% in the last five years. The high demand for building construction must be followed by the right time and a good quality in its implementation. A procurement with design and build system is supposed to be a solution for establishing a construction project done in time but still stick to technical specifications.

This thesis aims to determine the risks of the design and build methods that can affect the implementation time and building quality. This thesis was conducted on building projects constructed by PT ABC. Tests completed in this thesis were carried out through several stages such as comparative analysis of statistical data, validity and reliability testing, data normality test, risk level analysis, correlation analysis, factor analysis, multiple regression analysis (T test and F test), and final step expert validation as the final stage of the tests.

This thesis indicated that, out of the 35 design and build risks, 5 variables have been factored into two factors which have a significant negative effect on the project's implementation time, they are internal invoicing and external factors. The internal factor was determined by the contractor's ability to manage capacity and to control the quality of design and build work results along with the ability of the Project Managers to lead, to organize, and to motivate their team. While external factor was specified in negligence and retardation of subcontractors and their work that is not in accordance with what was agreed upon. Another factor that has a significant negative impact is the authority of the Project Managers in making decisions on a day to day activities, financial decisions, decisions in selecting key team members (determinants).

Keywords: Design and Build, Risk, Time.

1. Introduction

Design and build system is a method of development that is considered better both in terms of time, cost, and quality when compared with the method of design bid build (Satterfiled, 2009), (Chen et al, 2016), (Hale et al, 2009), (Goddess and Diputra, 2017). But in fact there are still some projects that have been using design and build system with the time of not working on time as design and build done by PT ABC in EPC Security and Marine Facility LNG project Donggi-Senoro and Project Transmart Cilegon. The late time to make the project cost more enlarged (Kerzner, 2001), in addition, delays triggered dissatisfaction for the owner so that the quality of the

project is considered less good (Gasperz, 2003).

Nature (2011) shows that the risk is what makes the design and build methods have weaknesses, the risk arises because there are several factors, namely the risk in terms of time and the quality of the project. Ogunsanmi, Salako, and Ajayi (2011) argue that clients and contractors who use the design and build approach should be wary of using this method as it may pose some risk. This research is using a building project conducted by PT ABC because PT ABC in the use of design and build methods is not always successful, but some projects also managed to finish with a faster time.

Based on the background there are several problems that will be the discussion in this research that is, (1) What are the risks arising from the selection of design and build methods in terms of work time? (2) What are the dominant and or significant risks in terms of their impact and the frequency of the design and build methods of work time? (3) How are the actions and possible responses to the risks incurred?

Research Objectives: (1) Knowing what are the risks arising from the selection of design and build methods in terms of work time, (2) Knowing the risks of the dominant and or significant impacts and their frequency due to selection of methods Design and build against the time of the project, (3) Take action and/or respond to any risks and impacts arising in the future so as to minimize those risks.

2. Literature Study

2.1 Design and build

Design and build is an example of collaboration of design and construction which gradually become a procurement system. The design and build system can be defined as a procurement system with a contract between the owner and a construction team responsible for implementing the design and construction process Efficient (Molenaar et al., 1998).

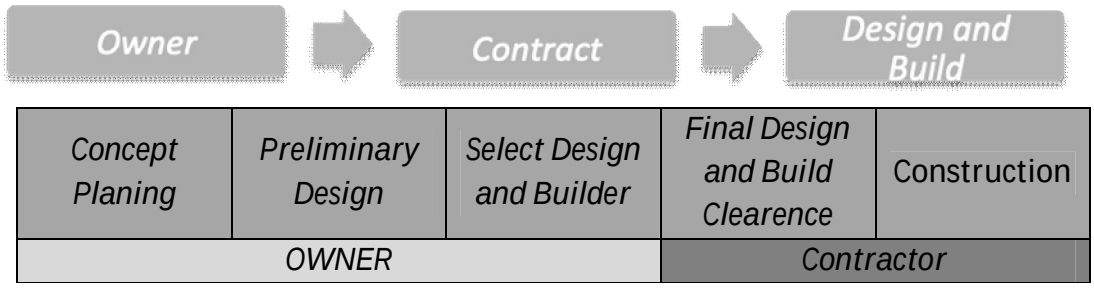

Figure 1.1 Early stages of the Design and Build process

From the picture 1.1 it can be seen that the employer (Owner) pointed directly to the implementation of design and build work, where they overall do the design work while carrying out the physical work.

Satterfiled (2009) also argues that the advantage of using the design and build method is the sole responsibility (when an error occurs, the owner can directly ask for a direct accountability to the construction executor), Minimize the occurrence of design changes so that there will be cost

savings, good quality (because the sole responsibility is certainly the executive will be very attentive to the quality), the speed of execution time (when compared to The bid design method build is certainly faster because the tender process is quite done once and the executor also does not have to wait for the design because it is still within the same scope), and the price certainty (the process of design done by the contractor makes Price offered to be a whole so that the price certainty can already be determined since the beginning of the contract occurred).

2.2 Comparison of Design and build and Design bid build

Design and Build is basically considered to have many advantages over the bid design method Build, this can be seen in the image 1.2 where there is a big difference between the two methods.

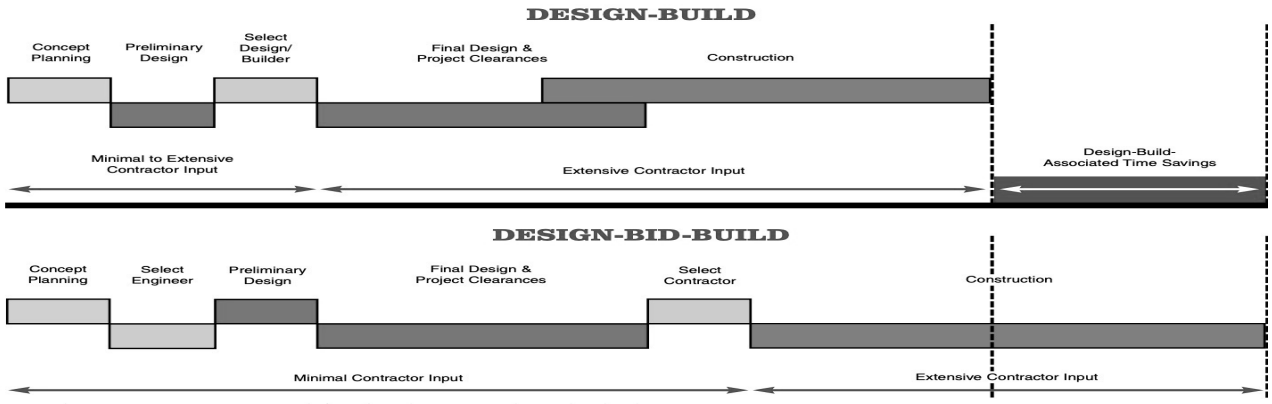

Figure 1.2 Different of process of design-and-build and design-bid-build

From this explanation can be concluded that the process of design bid build has a long time compared with the design and build method because it involves several parties and do double the selection in the tender made by the owner so small Possible project workmanship can be completed with a faster time, therefore the design and build method is considered much better in terms of time if the method of bid design build. There could be a potential conflict between Desingner and implementing contractor, where the consultant planners and contractors do not agree with the aspects contained in the contract. Different from design and build where the sole responsibility can minimize conflict. But in achieving success is certainly a lot of risks that will be encountered because in the implementation there are still some projects that have been using design and build methods but not timely in the process even the benefits of The method is not felt in the final process

2.3 Risk Management

Risk can be said to be an unexpected result, even if an activity has been planned as best as possible, but still contains uncertainty that it will run completely according to plan (Labombang, 2011). Krezner (2001) argues under the risk of construction projects are activities or factors that, in the event, will increase the likelihood of achieving the objectives of the project according to the cost, time and quality. The risk on construction projects is however not eliminated but may be

reduced or transferred from one party to another (Kangari, 1995). Minimizing risk in a project must necessarily begin with good risk management, project risk management is a systematic process ranging from the planning, identification, analysis, response and risk control phases Potentially adverse impacts (nature, 2011).

2.4 Risk on Design and Build Methods

Although design and build projects are expected to be faster and less expensive than projects with bid and build methods, not all design and build projects can really solve it. The single source of design and build consists of a professional team of architects, engineers, and contractors that are at risk for cost, time, quality, and project management. Therefore, the study of the risks must be identified, examined and analyzed to ensure the success of the project procurement methods. The risks and uncertainties will always accompany the project, contractors should be able to make better decisions with better risk understanding in design and build projects. Design and build contractors must be thoroughly competent to ensure that the risks involved do not at all times exceed the benefits that will be gained because contracts on design and build transfer more risk to the contractor.

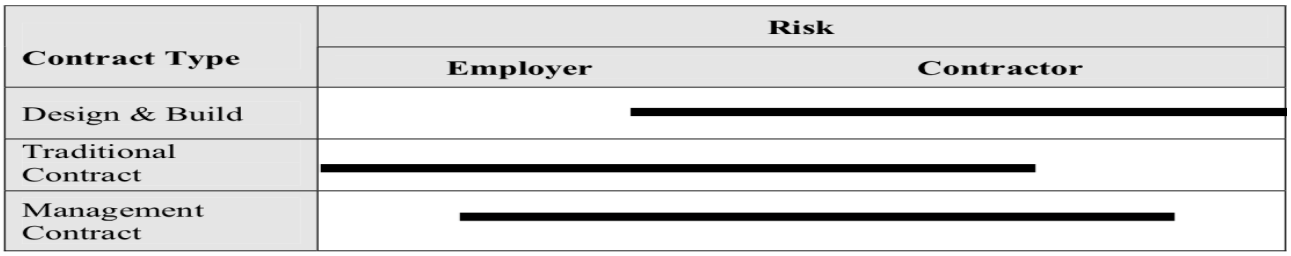

Figure 2.5. Allocation of risk for each type of contract procurement

The existing literature states that the use of design and build systems is better than the traditional system or the bid design method build, but in fact there are still some projects that already use design and build methods but still occur Delays in workmanship. Some studies have stated that project delays occur due to constraints in implementation where this is called risk. Risk is inevitable but can be minimized, this will be realized if the project risk management goes well. With the phenomenon occurring as well as the literature that researchers want to know more about the risks that can cause delays in project time on the use of design and build methods and how much impact And to find out what action is appropriate and must be done to minimize risk.

3. Research Methodology

This research aims to determine what risk is arising and is dominant or significant as a result of the selection of design and build methods in terms of job time as well as how actions should be taken from those risks. This research Model is quantitative research with survey research used in this research through the questionnaire data given to the respondents from PT ABC and also experts in design and build method. The research methods used are multiple regression analyses by

conducting several tests in advance namely, validity and reliability tests, risk analysis, correlation analysis, and factor analysis. Double regression analysis aims to obtain a statistical model of variable dimension that has been obtained from factor analysis, which is the risk factors that affect the performance of the work execution time of design and build. Multiple regression analyses are performed when the number of predictor variables is at least two. Multiple regression equations as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_i + \beta_3 X_i + \beta_4 X_i + \beta_5 X_i + \beta_6 X_i + \beta_i X_i + \varepsilon$$

Info:

Y	= Project Completion time
β_0	= Constant
X1	= Risk Design and Build Methods
Xi	= Risk Design and Build Methods
$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$	= Regression coefficient

4. Finding and Discussion

4.1 Validity and reliability tests

The validity and reliability test aims to test the data collection instruments. Valid means that the instrument can be used to measure what should be measured. The reliability test is used to determine the consistency of the measuring instrument, whether the measuring instrument is used reliably and remains consistent if the measurement is repeated.

The value corrected the item-total correlation compared to the value R table product moment, where the value n is the number of samples (respondents) = 79. So acquired value R Table Product moment = 0220. Then done decision making if the value of corrected item-Total correlation (R count) is positive (+) and greater than R table product moment, then the variable is valid. In order to test the reliability of variables is carried out the decision by calculating the final value of Cronbach's alpha from each instrument which is a latent variable indicator. Cronbach's alpha value is said to be good if its value is ≥ 0.7, nevertheless the value of Cronbach's alpha ≥ 0.6 acceptable in explanatory research.

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
X1	375.4557	3681.867	.395	.749	.818
X2	371.8101	3689.566	.359	.837	.820
X3	373.2405	3685.877	.350	.884	.820
X4	373.8228	3816.199	.243	.683	.824
X5	373.5063	3807.997	.224	.751	.825
X6	373.9114	3826.107	.236	.506	.824
X7	375.8228	3759.686	.376	.861	.820
X8	374.8228	3729.609	.363	.779	.820
X9	376.4684	3792.252	.335	.925	.821
X10	370.7089	3782.004	.299	.557	.822
X11	373.7215	3689.639	.442	.864	.817
X12	373.9114	3759.466	.395	.808	.819
X13	377.6835	3850.475	.291	.875	.822
X14	376.4937	3820.125	.330	.873	.821
X15	376.0759	3750.379	.368	.909	.820
X16	374.7342	3707.864	.430	.897	.818
X17	372.2785	3744.768	.334	.672	.821
X18	377.5316	3830.586	.284	.842	.822
X19	373.3291	3774.685	.335	.882	.821
X20	372.6835	3736.322	.380	.787	.819
X21	374.3797	3867.726	.250	.652	.823
X22	371.7215	3845.691	.237	.680	.824
X23	374.7215	3776.229	.340	.912	.821
X24	373.8228	3833.096	.244	.557	.823
X25	372.6076	3845.600	.263	.580	.823
X26	375.8987	3851.041	.283	.824	.822
X27	375.9367	3738.291	.429	.872	.818
X28	373.8734	3856.907	.258	.795	.823
X29	376.5316	3784.842	.295	.767	.822
X30	373.8734	3860.958	.249	.589	.823
X31	372.7848	3775.222	.315	.817	.821
X32	373.2278	3787.486	.251	.708	.824
X33	371.1646	3733.626	.359	.785	.820
X34	373.0633	3790.111	.223	.834	.825
X35	375.2658	3850.608	.254	.885	.823

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.826	.828	35

Table 4.1 Validity and reliability test results

Output result of the above SPSS program shows that corrected item-Total correlation (R count) is positive (+) and greater than r table so it can be said that the used is valid and the final value of Cronbach's alpha ie Designer Builder Factors of 0828. Result partial calculation of Cronbach's alpha end value greater than 0.7, so that the data results are highly reliable.

4.2 Risk analysis and correlation analysis

Nr.	Risk Factors	Mean	Risk Level
Designer Team			
X1	Design team experience in designing design and build work	9.75	L
X2	Understanding the design team to the requested design needs of the owner	13.39	H
X3	Understanding the design team to the prevailing regulatory standards	11.96	M
X5	Understanding of design team to estimate the cost of implementation of design and build work	11.70	M
X6	Communication between personnel involved in the implementation of design and build work, both among personnel own design team and with the physical implementing team of the work	11.29	M
X7	Understanding design team To change the design requested by the owner during development design	9.38	L
X8	Delay in reaching a design agreement when developing design caused differences perception Owner and design team	10.38	M
X9	Put contractors to the building knowledge during development design	8.73	L
Builder Team			
X10	Contractor experience in performing design and build work	14.49	H
X11	Competence of contractors in carrying out design and build work	11.48	M
X13	Understanding contractors to develop design that has been agreed together between the design team and the owner	7.52	L
X14	Quality working relationship contractor with owner	8.71	L
X15	Equipment and machinery availability for contractors to perform design and build work	9.13	L

Nr.	Risk Factors	Mean	Risk Level
X16	Ability of Contractor in Project Management (HR, financial, K3 etc)	10.47	M
X17	Contractor ability to capacity management and quality control of design and build work	12.92	H
X18	Coordination and communication between parts of the contractor's working organization	7.67	L
X20	Negligence and delays of sub-contractors	12.52	H
X21	The ability of contractors to create innovations in technical work and materials to accelerate the execution of work	10.82	M
X22	Realization of work that does not comply with what has been agreed	13.48	H
Project Manager			
X23	PM experience in performing design and build work	10.48	M
X24	Competence of PM in carrying out design and build work	11.38	M
X28	PM experience in scheduling all work activities	11.33	M
X29	Ability of PM to communicate and coordinate with owner during design and build work	8.67	L
X30	The ability of PM to communicate and coordinate with its team including SUB contractors during the work of design and build	11.33	M
X31	Ability of PM in Leadership (leadership), organizing (orginizing), as well as motivating his team (motivated)	12.42	H
X32	The ability of PM to push the whole team is committed to the quality, cost and time of design and build work	11.97	M
X33	PM involvement from the beginning of the project and is continually involved in the design and build project	14.04	H

Nr.	Risk Factors	Mean	Risk Level
X34	Capability of PM in meeting monitoring and control meetings during the direct design and build work	12.14	M

Table 4.2 Risk Level Calculation result

Table 4.2 shows that there are 7 variables that have a high level of risk, from this result the researcher conducts a correlation test between variables that have high levels of risk with the project execution time.

Correlations

		X2	X10	X17	X20	X22	X31	X33
Y	Pearson Correlation	-.415	-.319	-.224	-.327	-.205	-.202	-.299
	Sig. (2-tailed)	.000	.004	.047	.003	.070	.074	.007
	N	79	79	79	79	79	79	79

Table 4.3 Pearson correlation test results

From table 4.3 obtained that the whole variable indicates a correlation-(negative). This indicates that the entire risk variable (X) has a directional relationship that is opposite to the Y variable (timing performance). The entire variable has a significant correlation (according to the output of SPSS is that has a (*) and (*) Marking of time performance as much as 7 variables, namely: X2, X10, X17, X20, X22, X31, and X33.

4.3 Factor analysis

Factor analysis is to define the structure of a matrix data and analyze interrelated structures (correlation) between a number of variables by defining a set of similarity variables or dimensions and often referred to by factors. With the analysis factor can be identified the dimension of a structure and then determine until how far each variable can be explained by each dimension.

Because the main principle of factor analysis is the correlation then the assumptions associated with the correlation should be used (1) large correlation or correlation between independent variables must be significant, e.g. > 0.5 or in SPSS outputs which have a sign (*) or (* *), (2) Large partial correlation is the correlation between two variables by assuming fixed other variables should be smaller. In SPSS partial correlation is given through the option of Anti Image Correlation, (3) In certain cases, assuming the normality of variables or factors that occur should be fulfilled

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.467
Bartlett's Test of Sphericity	Approx. Chi-Square	130.943
	df	21
	Sig.	.000

Table 4.4 KMO and Bartlett's Test Scratch

The KMO Test & Bartlett's is to test whether there is a correlation between variables. From table 5.14. Above can be seen that the number & KMO Bartlett's test is 0467 < 0.5, as well as the significance of 0.000 < 0.05. This means the factor analysis process cannot be continued because the value of KMO & Bartlett's test is less than 0.5. To solve the problem it is necessary to remove variables that have Anti-image matrices that are less than 0.5. Based on the results of the research in the appendix, eliminated variables X2, X10, and X33 so that the test results obtained KMO & Bartlett's (table 4.5).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.527
Bartlett's Test of Sphericity	Approx. Chi-Square	22.070
	df	6
	Sig.	.001

Tabel 4.5 KMO and Bartlett's final Test

The KMO Test & Bartlett's is to test whether there is a correlation between variables. From table 4.5 above can be seen that the number of KMO & Bartlett's test is 0527 > 0.5, as well as the significance 0.001 < 0.05. This means that the factor analysis process can be resumed. It will then be analyzed in the overall correlation matrix with the measures of sampling adequacy (MSA). MSA is measured from the output of anti-image matrices to the correlation result as much as 4 variables. Here is the result of the output of Anti-0.5 image.

Anti-image Matrices

		X17	X20	X22	X31
Anti-image Correlation	X17	.535[a]	-.164	-.075	-.321
	X20	-.164	.542[a]	-.338	.009
	X22	-.075	-.338	.532[a]	.071
	X31	-.321	.009	.071	.587[a]

a. Measures of Sampling Adequacy(MSA)

Tabel 4.6 Matrice Anti Image Output table

Furthermore, the core process of factor analysis is to perform an extraction of the existing variable, so that it will form one or more new factors. This process is called Factoring. The extraction results can be seen from the table of total variance explained the following:

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.518	37.956	37.956	1.518	37.956	37.956	1.397	34.928	34.928
2	1.201	30.027	67.983	1.201	30.027	67.983	1.322	33.056	67.983
3	.651	16.275	84.258						
4	.630	15.742	100.000						

Extraction Method: Principal Component Analysis.

Tabel 4.7 Table Total Variance Explained

Of the 4 variables analyzed the extraction result into two new dimensions (where Eigen value > 1 is a factor). Dimension 1 is able to account for 37.96% variation, while the dimension of two is able to explain 12.684% variation. Both factors are able to explain 30.03% of variations.

Rotated Component Matrix [a]

	Component	
	1	2
X17	.252	**.772**
X20	**.800**	.134
X22	**.822**	-.043
X31	-.134	**.840**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 3 iterations.

Tabel 4.8 Output table Rotated Component Matrix

From table 4.8, it can be seen that the variables form two new dimensions as follows:

- Dimension 1 (X. A) consists of A collection of variables X20 (negligence and delay of sub-contractors), and X22 (realization of job execution that does not correspond to what has been agreed) is a variable that has the value of loading factor Highest (0822). For the next Dimension 1 is named: "Risk arising from external parties".
- The 2nd dimension (X. B) consists of a collection of X17 variables (the contractor's ability to management capacity and quality control of design and build work), and X31 (the ability of PM in leadership, organizing (orginizing), as well as Motivated his team (motivating)) is a variable that has the highest loading value factor (0840). For the next Dimension 1 is named "Risk arising from internal parties".

4.4 Regression analysis

Regression analysis aims to measure the strength of a linear association (relation) between two variables. In regression analysis in addition to measuring the relationship strength between two or more variables as well as correlation analysis, it also shows the direction of the relationship between dependent variables and independent variables. Related to this research, regression analysis aims to obtain a statistical model of variable dimensions that have been made from factor analysis, which are the risk factors that affect the performance of the execution time Design and build work on PT ABC. Regression analysis In this study conducted with output in the form of model summary and test result T and F test.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.924[a]	.854	.850	.42310	.854	198.727	2	68	.000	2.113

a. Predictors: (Constant), XB, XA

b. Dependent Variable: Y

Table 4.9 Output Table Model Summary

The Model summary table illustrates the model confidence level and the number of models that may be modifiable. The Adjusted value of R2 is the level of confidence model indicating the trust level of the created model. The results obtained with the Adjusted R2 value are 85.4%, indicating that the 85.4% time performance variation can be described by the X. A and X. B dimension functions, while the remainder of 14.6% is described by other causes outside the model.

Variabel	t test	t table	Decision
X.A	-9.234	-1.996	Ho rejected and Hi accepted
X.B	-16.328	-1.996	Ho rejected and Hi accepted
X35	-2.374	-1.996	Ho rejected and Hi accepted

Tabel 4.10 Test t result

Based on the table above it can be seen that the Ho hypothesis is rejected and Hi is acceptable, which means variables X. A, X. B and X35 individually there is a linear relationship and affect the timing of performance. Overall all variables both X. A, X. B and X35 also have an influence on project time performance.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	72.095	3	24.032	143.393	.000[a]
	Residual	11.229	67	.168		
	Total	83.324	70			

a. Predictors: (Constant), X35, XB, XA

b. Dependent Variable: Y

Tabel 4.11 F test Result

From the results of the study gained that the figure F count of 143,393 > F table of 2,742 and this means that P-value 0.000 < 0.05 is significant. This means Ho is rejected and Hi accepted. This

means that the dominant risk factor in the implementation of design and build work jointly affects time performance.

5. Conclusion & Recommendation

Results of the questionnaire showed that the understanding of the design team to the needs of the design of the owner, contractor experience in carrying out the design and build work, the ability of the contractor to the capacity management and quality control work design and Build, omission and delay of Subcontractor, realization of job execution that is not in accordance with what has been agreed, the ability of PM in leadership, organizing (organizing), as well as motivating the team (motivated), and PM involvement from the beginning of the project and are continuously involved in the design and build project is a risk that has a high category based on the impact and frequency of risk occurrence in the use of design and build methods against time Project work.

The results of the risks that are considered to be impact and high frequencies are then analyzed further and produce that there are two factors that have a significant negative influence on the project execution time of the internal factors and external factors. External factors consist of omissions and delays of subcontractors and the realization of the execution of work that does not conform to what has been agreed. The internal factor consists of the contractor's ability to management capacity and quality control of the design and build work and the ability of the PM in leadership, organizing (orginizing), as well as motivating the team and other is the authority of the PM in making day-by-day activity decisions, financial decisions, decisions in the selection of key team members (determinants).

Recommendation of the results of this research is that the main contractor should choose subcontractors based on the track record or experience of the subcontractor. The use of design and build has a single responsibility so that negligence and delay of the subcontractor can be a high risk to the contractor's main party. The ability of the contractor to the capacity of management and quality control of the design and build work and the ability of PM in leadership, organizing (orginizing), as well as motivating the team is an important factor in this matter Researchers recommend that Contracting Parties involved in design and build project work must have sufficient experience, both in terms of project management, job control and of course all parties involved especially the leader Project or project manager must have the ability in organizing all elements involved in a project other than that the leader must also be able to make the right decisions especially when there are problems with both internal and external.

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