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Risk Analysis of Project Timeliness and Quality Defectson the Construction of Overpass Mengger DK 140+500 Bandung, Indonesia

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ABSTRACT: Identifying risks in the Mengger DK 140 + 500 Overpass Development Project in the city of Bandung on time and quality needs to be done, this is a form of construction project that has a number of risks in its implementation. The data analysis methodology uses Factor analysis and Path analysis of answers from questionnaires distributed to 30 respondents from contractors, owners and planning consultants involved in the construction work of the Mengger DK 140+500 Overpass in Bandung City which was built in the 2020 fiscal year. Based on the results of the F test study, it was found that all factors have a direct or indirect effect together on the non-achievement of the time and quality target with Fcount = 6,880 > Ftable = 2,420 and Fcount = 18,137 > Ftable = 2,393. However, individually, the factors that directly influence significantly on the non-achievement of the time target are Financial Factor Fcount =2,514 > Ftable = 2,080, Human Resources Fcount = 2,638 > Ftable = 2,080, Material Fcount = 2,277 > Ftable = 2,080, and Equipment Fcount = 2,438 > Ftable = 2,080. Meanwhile, factors that have a significant direct effect on the non-achievement of the quality target are Financial Factor Fcount = 2,773 > Ftable = 2,086, Human Resources Fcount = 2,825 > Ftable = 2,086, and Work Environment Fcount = 3,584 > Ftable = 2,086 against the Quality Target either directly or indirectly through the Target Time. The dominant factor directly or indirectly affects the non-achievement of the time target and the quality target is the Equipment Factor with a standardized β coefficient value of 0,198. The strategy to address this is that the contractor must provide equipment that has the appropriate capabilities and capacity to serve the required volume of work.

KEYWORDS: Bandung City, Risk Analysis, Overpass, Failure on the Construction, Construction Project.

I. INTRODUCTION

In this era of globalization, the development of construction in Indonesia has increased significantly. This is inseparable from the community's need for facilities and infrastructure. An overpass/bridge is a building that allows a road to cross a river or water channel, valley or cross other roads that are not the same surface height [9].

Bandung is one of the National Strategic Project cities in the China Indonesia High-Speed Train Project. This high- speed rail project stretches along the Purbaleunyi toll road and in the implementation of this project resulted in many old bridges having to be relocated, one of which is the Mengger Overpass because this overpass operates on high-speed trains so it must be freed up and allocated elsewhere. The new Mengger Overpass is located between Bandung City and Bandung Regency which crosses the Purbaleunyi DK 140 + 500 Toll Road.

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II. LITERATURE REVIEW

PROJECT MANAGEMENT

According to Siswanto Agus and Salim M Alif, Project management is a science about the art of leading an organization consisting of planning, implementing and controlling limited resources in an effort to achieve goals and objectives effectively and efficiently [5].

PROJECT OBJECTIVES

Project objectives can be measured by performance indicators of cost, quality, time, and work safety by planning carefully, carefully, and integrated the entire allocation of human resources, equipment, materials, and costs in accordance with the required needs. All this is aligned with the goals and objectives of the project [5].

PROJECT RISK MANAGEMENT

An organized approach to identifying potential risks with the aim of minimizing the occurrence of unforeseen events is known as risk management. In addition, unexpected negative outcomes can be identified, and appropriate response strategies can be developed to mitigate these potential risks [2].

TYPE OF RISK

Knowing the different types of risks and how they are categorized according to theory is essential for risk identification. Since projects under construction services companies are also areas of business organization whose purpose is to obtain financing.

Business risk, also known as speculative risk, and pure risk are two broad categories of risk categorized by their nature. The risks that if taken can result in losses or gains are known as speculative risks [6].

TIME (SCHEDULE)

Schedule is the elaboration of project planning into a sequence of steps for the implementation of work to achieve goals. On the schedule has been included the time factor. The schedule shows the estimated time it takes to complete each work package and the relationships between the work packages (which ever work package must be completed before the other package starts). The arrangement of these relationships is referred to as a network. Projects must be carried out within the limits of a predetermined period and end date [6].

QUALITY

The definition of quality according to ISO 8402 (1886) is the nature and characteristics of a product or service that make it meet the needs of customers or users [6]. Subjectively quality is fitness for use, that is, something that suits taste. Objectively Joseph M. Juran defines quality as a special standard by which its capabilities, performance, reliability, ease of maintenance and characteristics can be measured [3].

POPULATION AND SAMPLE

A population is a collection of all individuals with predetermined qualities, those qualities or traits are called variables. A sample on the other hand is a collection of randomly selected sampling units that are part of the population. People who are considered experienced in the field and know the development process, including the initial planning, tender process, and physical development process in the field, are used to determine the number of populations. Where these individuals are located in each of the agencies. During this time, samples were taken from the population that was considered to represent all these agencies or companies [8].

VALIDITY TEST

An index known as reliability indicates the extent to which a measuring instrument is reliable or trusted. In other words, reliability shows the consistency of a measuring instrument in detecting the same symptoms [4]. The Alpha Cronbanch method was used for reliability tests in this study. If the Alpha Cronbanch value is greater than 0.6 then the instrument is considered reliable.

FACTOR ANALYSIS

Conceptually, a factor is an uncertain condition but has a certain chance of occurrence and, if it occurs it will cause negative effects. Independent variables (X1, X2, X3, etc.) define the concept of factors. According to Sugiyono, independent variables refer to the variables responsible for the emergence or change of dependent variables [8].

The purpose of factor analysis is to find a way to summarize the data in the initial variable into a new set of dimensions or variables (factors). This is done by reducing or summarizing the data to determine the structure. By looking at the correlation between variables or respondents, factor

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analysis determines the structure of relationships between variables or respondents.

PATH ANALYSIS

Path analysis is a technique developed from double linear regression. This technique is used to test the magnitude of the contribution (contribution) indicated by the path coefficient on each path diagram of the causal relationship between the variables X1 X2 and X3 to Y and its impact on Z.

"Path analysis is a technique for analysing causal relationships that occur in multiple regressions if the independent variable affects the dependent variable not only directly but also indirectly" [7].

III. METHOD

This research was conducted by taking the location of the Mengger DK 140 + 500 Overpass Construction in the City of Bandung, West Java which was built in the fiscal year of September 16, 2020.

Location Map of Mengger Overpass Construction Work in Bandung Kidul City

The research variables to obtain what factors affect the risk of failure to achieve project targets on time and quality in the Construction of the Mengger DK 140 + 500 Overpass in the City of Bandung used are as follows:

1. Independent variables (X) consist of: Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Methods (X5), Production (X6), Design Changes (X7) and Work Environment (X8).
2. Bound Variables (Y) consist of: Timely (Y1) and Right Quality (Y2).

The items on the questionnaire used to collect data on the effect on the risk of failure to achieve project goals on time and quality on the Construction of the Mengger DK 140 + 500 Overpass in Bandung City and to determine the most dominant factor affecting it using a likert scale with a range of 1 to 5 (Very No Effect-Very Influential), so that the first number represents a very negative response to one of the question items and the fifth number represents a very positive response to one of the question items.

The information obtained from the survey results (questionnaire) will be processed to produce data in the form of a table. In the formulation of the problem, the results of data processing are used to answer questions. The type of data collected must be taken into account when processing it, and this should be done taking into account the purpose. The accuracy of the analysis method has a significant impact on the accuracy of the research findings. Path and factor analysis is a method of data analysis used. The questionnaire data from each of these variables were then scored, resulting in a single score for each variable with multiple indicators, which were then analysed using factor analysis and path analysis. The Statistical Package and Service Solution (SPSS) 15 for Windows program is used for data processing.

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IV. RESULT AND DISCUSSION

VALIDITY TEST RESULT

The validity test results obtained the results that the statement items of variables Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Methods (X5), Production (X6), Design Changes (X7), Work Environment (X8), Target Time (Y1), and Quality Targets (Y2) met the validity test requirements, namely the value of rcount more than rtable (rhit > rtable) and significance values less than 0.05 (sig < 0.05) so that it can be concluded that the items in the instrument on the variable Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Methods (X5), Production (X6), Design Changes (X7), Work Environment (X8), Target Time (Y1), and Quality Targets (Y2) stated each item of statement in this study is valid.

READABILITY TEST RESULT

Cronbach's Alpha coefficient for each variable is carefully calculated from the results of the reliability test. From the test results, it can be concluded that the instruments used in this study already have the reliability to measure Financial Variables (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Methods (X5), Production (X6), Design Changes (X7), Work Environment (X8), Time Targets (Y1), and Quality Targets (Y2) used in this study already have reliability (reliability). So that these factors can be represented in every question.

FACTOR ANALYSIS RESULT

A variable set is feasible to use factor analysis if it has a high enough degree of interconnectedness (dependency). Indications of this degree of association are determined by KMO (Keiser Meyer Olkin) and MSA (Measures Sampling Adequacy) values. The following are the results of the selection of indicators (items) that affect the Target Time and Quality of the construction of the Mengger DK 140 + 500 overpass project as follows:

1. Financial Variables (X1) are formed with manifest variables consisting of: Use of contract advances (X1.1), Late payment by owner to contractor (X1.2), Delay in payment by contractor to worker (X1.3), Delay in payment by contractor to supplier (X1.4), Delay in payment by contractor to subcontractor (X1.5) and financial capability of contractor (X1.6).
2. The Human Resources Variable (X2) is formed with manifest variables consisting of: Availability of human resources (X2.1), HR does not have good skills (X2.2), HR does not have large responsibilities (X2.3), working human resources cannot coordinate properly (X2.4), HR productivity is quite low (X2.5) and Estimator behaviour is less experienced (X2.6).
3. Material Variables (X3) are formed with manifest variables consisting of: Material shortage (X3.1), Late material delivery (X3.2), Material Usage Deviations from specifications (X3.3), Material damage and changes (X3.4), Material scarcity (X3.5) and Absence of material tests in the laboratory (X3.6).
4. Equipment Variables (X4) are formed with manifest variables consisting of: Limited number of equipment (X4.1), Existing equipment is often damaged (X4.2), Ability of unsuitable tools to serve the volume of work (X4.3), Delays in equipment delivery (X4.4), and Inadequate operator power (X4.5).
5. Variables The Method of Execution of Work (X5) is formed with manifest variables consisting of: Work is not carried out in the order and stages of work (X5.1), The execution of the work is not up to specification (X5.2), and the work is not done properly and correctly (X5.3).
6. Production Variables (X6) are formed with manifest variables consisting of: Workers do not meet the target volume of work (X6.1), Lack of communication between field implementers and workers (X6.2), and Inadequate construction material production sites (X6.3).
7. The Design Change Variable (X7) is formed with manifest variables consisting of: non-fulfillment of initial planning (X7.1), Frequent design changes by owner (X7.2), and Delay in the process of changing from planning (X7.3).
8. The Work Environment Variable (X8) is formed with manifest variables consisting of: Frequent rain (X8.1), Bridge Surroundings (X8.2), and Topographic State (X8.3).
9. The Target Time variable (Y1) is formed with manifest variables consisting of: Time is not proportional to volume (Y1.1), and Retreat of work execution (Y1.2).
10. The Quality Target Variable (Y2) is formed with manifest variables consisting of: The quality of the material is not good (Y2.1), and the Bridge Life does not reach the life of the plan (Y2.2).

PATH ANALYSIS RESULT

In this study, path analysis consisted of two equations. The first equation examines the influence of Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Methods (X5), Production (X6), Design Changes

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(X7), and Work Environment (X8) on Target Time (Y1). The second equation examines the effect of Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Method (X5), Production (X6), Design Change (X7), Work Environment (X8), and Time Target (Y1) on Quality Target (Y2).

PATH ANALYSIS OF THE FIRST EQUATION (X1-X8 to Y1)

Before the path analysis of the first equation is carried out, a classical assumption test is first carried out. The classical assumptions tested are residual normality, heteroskedasticity, multicollinearity, and linearity.

a. Residual Normality Test

The results of the residual normality test in equation 1 obtained a significance value of 0,200, which showed more than 0,05 (sig > 0,05) so that it was stated that the residual in equation 1 was normally distributed so that the assumption of residual normality was met.

b. Heteroskedasticity Test

The results of the heteroskedasticity test in equation 1 obtained the significance value of each independent variable more than 0.05 (sig > 0.05) so that it was stated that equation 1 did not have a heteroskedasticity problem.

c. Multicollinearity Test

The results of the multicollinearity test on equation 1 obtained the VIF value of each independent variable less than 10 (VIF < 10) so that it was stated that equation 1 did not have a multicollinearity problem.

d. Linearity Test

The results of the linearity test in equation 1 obtained the significance value of each independent variable more than 0.05 (sig > 0.05) so that it is stated that the relationship between the independent variable and the bound variable of equation 1 is linear so that the assumption of linearity is met.

First Equation Residual Normality Test Results

	UnstandardizedResidual 1
Test statistic	.100
Asymp Sig. (2-tailed)	.200

First Equation Heteroskedasticity TestResults

No	**Independent Variables**	**Sig.**	**Information**
1	Finance	0.900	Hetero Free
2	Human resource	0.677	Hetero Free
3	Materials	0.956	Hetero Free
4	Equipment	0.822	Hetero Free
5	Methods of carrying out work	0.215	Hetero Free
6	Production	0.540	Hetero Free
7	Design changes	0.308	Hetero Free
8	Work environment	0.170	Hetero Free

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Result of the First Equation Multicollinearity Test

No	Independent Variables	VIF	Information
1	Finance	2.285	Multicol Free
2	Human resource	2.311	Multicol Free
3	Materials	2.053	Multicol Free
4	Equipment	4.721	Multicol Free
5	Methods of carrying out work	2.603	Multicol Free
6	Production	2.656	Multicol Free
7	Design changes	1.895	Multicol Free
8	Work environment	1.159	Multicol Free

Linearity Test Results of the First Equation

No	Independent Variables	Sig.	Information
1	Finance	0.907	Multicol Free
2	Human resource	0.990	Multicol Free
3	Materials	0.305	Multicol Free
4	Equipment	0.602	Multicol Free
5	Methods of carrying out work	0.793	Multicol Free
6	Production	0.708	Multicol Free
7	Design changes	0.601	Multicol Free
8	Work environment	0.454	Multicol Free

Results of the First Equation Path Analysis

No	Independent Variables	Path Coefficient	Tcount	Sig.	Information
1	Finance	0.436	2.514	0.020	Significant
2	Human resource	0.460	2.638	0.015	Significant

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3	Materials	0.374	2.277	0.033	Significant
4	Equipment	0.607	2.438	0.024	Significant
5	Methods of carrying out work	- 0.373	- 2.015	0.057	Insignificant
6	Production	0.030	0.163	0.872	Insignificant
7	Design changes	- 0.198	- 1.254	0.224	Insignificant
8	Work environment	- 0.055	- 0.445	0.661	Insignificant
R_{square}= 0.724 T_{table}= 2.080 Bound Variable: Target Time					

PATH ANALYSIS OF THE SECOND EQUATION (X1-X8 Y1 TO Y2)

Before analysing the path of the second equation, a classical assumption test is first carried out. The classical assumptions tested are residual normality, heteroskedasticity, multicollinearity, and linearity.

a. Residual Normality Test

The results of the residual normality test in equation 2 obtained a significance value of 0.200, which showed more than 0,05 (sig > 0,05) so that it was stated that the residual in equation 2 was normally distributed so that the assumption of residual normality was met.

b. Hereroskedascity Test

The results of the heteroskedasticity test in equation 2 obtained the significance value of each independent variable more than 0.05 (sig > 0.05) so that it was stated that equation 1 did not have a heteroskedasticity problem

c. Multicollinearity Test

The results of the multicollinearity test on equation 2 obtained the VIF value of each independent variable less than 10 (VIF < 10) so that it was stated that equation 2 did not have a multicollinearity problem

The results of the linearity test in equation 2 obtained the significance value of each independent variable more than 0,05 (sig > 0,05) so that it is stated that the relationship between the independent variable and the bound variable of equation 1 is linear so that

d. Linearity Test

The results of the linearity test in equation 2 obtained the significance value of each independent variable more than 0,05 (sig > 0,05) so that it is stated that the relationship between the independent variable and the bound variable of equation 1 is linear so that the assumption of linearity is metAfter all the classical assumptions of equation 2 are performed and the result is obtained that the assumptions are met, then it can proceed to the path analysis equation presented as follows.

Second Equation Residual Normality Test Results

	Unstandardized Residual 1
Test statistic	.109
Asymp Sig. (2-tailed)	.200

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Second Equation Heteroskedasticity Test Results

No	Independent Variables	Sig.	Information
1	Finance	0.549	Hetero free
2	Human resource	0.406	Hetero free
3	Materials	0.114	Hetero free
4	Equipment	0.688	Hetero free
5	Methods of carrying out work	0.162	Hetero free
6	Production	0.343	Hetero free
7	Design changes	0.661	Hetero free
8	Work environment	0.263	Hetero free
9	Target time	0.960	Hetero free

Results of the Second Equation Multicollinearity Test

No	Independent Variables	VIF	Information
1	Finance	2.973	Multicol Free
2	Human resource	3.077	Multicol Free
3	Materials	2.561	Multicol Free
4	Equipment	6.057	Multicol Free
5	Methods of carrying out work	3.106	Multicol Free
6	Production	2.659	Multicol Free
7	Design changes	2.037	Multicol Free
8	Work environment	1.170	Multicol Free
9	Target time	3.621	Multicol Free

Linearity Test Results of the Second Equation

No	Independent Variables	Sig.	Information
1	Finance	0.985	Multicol Free
2	Human resource	0.904	Multicol Free
3	Materials	0.053	Multicol Free
4	Equipment	0.630	Multicol Free

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5	Methods of carrying out work	0.662	Multicol Free
6	Production	0.656	Multicol Free
7	Design changes	0.339	Multicol Free
8	Work environment	0.228	Multicol Free
9	Target time	0.078	Multicol Free

OVERALL, PATH ANALYSIS

Based on the results of the overall Path analysis, a model validity test was then carried out. In the analysis of the indicative path the validity of the model is the coefficient of total determination obtained as follows.

R^2_{total}= 1–$Pe1^2$x $Pe2^2$

R^2_{total}= 1– (1-0,724)x (1-0,891)

R^2_{total}= 1– 0,276x 0,109

R^2_{total}= 1– 0,030

R^2_{total}= 0,970

Results of the Second Equation Path Analysis

No	Independent Variables	Path Coefficient	T count	Sig.	Information
1	Finance	0.353	2.773	0.012	Significant
2	Human Resource	0.366	2.825	0.010	Significant
3	Materials	0.007	0.062	0.952	Insignificant
4	Equipment	-0.066	-0.362	0.721	Insignificant
5	Methods of Carrying Out Work	0.100	0.767	0.452	Insignificant
6	Production	-0.074	-0.617	0.544	Insignificant
7	Design Changes	0.004	0.042	0.967	Significant
8	Work Environment	0.286	3.584	0.002	Significant
R_{square} = 0.891 T_{table}= 2.086 Bound Variable: Quality Target					

INDIRECT INFLUENCE TESTING

In path analysis, it is known indirect influence. There were eight indirect influences tested in this study as follows.

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Results of Indirect Influence Testing Results in Path

No	Independent Variables	Pers 1 Coefficient	Pers 2 Coefficient	Indirect Coefficient	T Count	Sig.	Information
1	Finance	0.436	0.326	0.142	2.497	0.021	Significant
2	Human resource	0.460	0.326	0.150	2.517	0.020	Significant
3	Materials	0.374	0.326	0.122	2.510	0.020	Significant
4	Equipment	0.607	0.326	0.198	2.126	0.046	Significant
5	Methods of carrying out work	-0.373	0.326	-0.122	-1.445	0.163	Insignificant
6	Production	0.030	0.326	0.010	0.147	0.885	Insignificant
7	Design changes	-0.198	0.326	-0.065	-1.030	0.315	Insignificant
8	Work environment	-0.055	0.326	-0.018	-0.404	0.690	Insignificant

V. CONCLUSION

Based on the results of the study, the following conclusions can be described:

1. From Test F, it was found that the factors of Finance (X1), Human Resources (X2), Materials (X3), Equipment (X4), Work Implementation Method (X5), Production (X6), Design Change (X7), and Work Environment (X8) have a direct or indirect effect together on the non-achievement of time and quality targets, with Fcount = 6,880 > Ftable = 2,420 and Fcount = 18,137 > Ftable = 2,393. However, individually, the factors that directly influence significantly on the non-achievement of the time target are Financial Factor Fcount = 2,514 > Ftable = 2,080, Human Resources Fcount = 2,638 > Ftable = 2,080, Material Fcount = 2,277 > Ftable = 2,080, and Equipment Fcount = 2,438 > Ftable = 2,080. Meanwhile, factors that have a significant direct effect on the non-achievement of the quality target are Financial Factor Fcount = 2,773 > Ftable = 2,086, Human Resources Fcount = 2,825 > Ftable = 2,086, and Work Environment Fcount = 3,584 > Ftable = 2,086 against the Quality Target either directly or indirectly through the Target Time.
2. The most dominant factor that directly or indirectly affects the non-achievement of time targets and quality targets is the Equipment Factor with a standardized β coefficient value of 0,198.
3. Strategies to overcome the risk of failure to achieve project goals on time and quality in the construction of the Mengger DK 140+500 overpass:

a. The contractor must timely make payments to the worker in the execution of work.
b. Contractors must choose human resources that can coordinate well at the time of work.
c. The contractor must enter into a cooperation or contractual agreement with another provider regarding the arrival of materials from outside.
d. The contractor must provide equipment that has the appropriate capabilities and capacity to serve the required volume of work.

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