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RISK ANALYSIS OF FOUNDATION WORK IN CONSTRUCTION PROJECTS OF 6 (SIX) TOLL ROADS IN THE CITY TO IMPROVE TIME PERFORMANCE

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ABSTRACT

The Jakarta inner ring toll road is a toll road that surrounds the inner city of Jakarta. Due to the dense number of vehicles and traffic congestion on the existing inner-city toll roads, the DKI Jakarta Provincial Government plans to increase the number of inner-city toll roads to 6 sections. The project development begins with Section 1A, namely from Kelapa Gading - Pulo Gebang. At present development is still at the stage of foundation work where progress in October 2019 only reached 80.97% of the target of 100%. The work has been delayed and has been extended 2 times. From these problems, this study was conducted to analyze the high risks that affect the time performance of foundation work and corrective and preventive actions. In this study data collection was carried out by distributing 4-step questionnaires, namely expert validation, pilot survey, respondents and final expert validation. Risk ranking is analyzed using MS. Excel is based on a probability and impact matrix table that aims to determine variables that have a high level of risk. From the results of data analysis, there are 4 variables that fall into the high risk category, namely the problem of land acquisition, work location is not ready, work drawings are not ready, and the core staff of the project are less competent. The results of expert recommendations for the four variables can be stated in preventive and corrective actions.

Keywords *: Risk, time performance, toll road, foundation*

INTRODUCTION

Roads are a means for the mobility of goods and people. In big cities such as Jakarta, many highways have already exceeded the planned capacity, causing congestion to occur. The increased production of motor vehicles and the ease of the buying process are the main factors increasing the number of motorized vehicles on the road. From these problems, the Government built a toll road that aims to reduce the burden of traffic and congestion that occurs on public roads and reduce air pollution due to slow or stagnant motorized vehicles. And the Jakarta Inner Ring Road (JIRR) was built, which is a toll road that circles the inner city of Jakarta. This toll road is divided into 3 parts namely Cawang - Pluit Toll Road (Jakarta Intra Urban Tollroad), Port Toll Road (Pluit - Tanjung Priok toll road) and Ir. Wiyoto Wiyono (Cawang - Tanjung Priok section). Due to the high number of vehicles and traffic congestion on the toll road, the DKI Jakarta Provincial Government plans to increase the inner-city toll road to 6 (Six) sections, namely Kampung Melayu - Kemayoran (9.6 km), Semanan - Sunter through Rawa Buaya Duri Pulo (22.8 km), Kampung Melayu - Duri Pulo via Tomang (11.4 km), Sunter - Pulo Gebang via Kelapa Gading (10.8 km), Ulujami - Tanah Abang (8.3 km), and Pasar Minggu - Casablanca (9.5 km). The construction of 6 (six) toll roads is mostly elevated, along the river and railroad lines (Project Document, 2017). In the first section, the development is divided into 3 sections, namely Section A from Kelapa Gading to Pulo Gebang, Section B from Semanan to Grogol and Section C from Grogol to Kelapa Gading. The project development starts from section A, from Kelapa Gading to Pulo Gebang.

This project uses a type of bored pile foundation with a diameter of 1200 mm where the volume of drilling reaches 96,596.22 m with a planned time to carry out the foundation work from September 1, 2017 to April 1, 2018. But the reality on the ground with the schedule is the work the foundation has not been completed and has completed an extension of the time for completion 2 (two) times, namely until 31 October 2019 where the work must reach 100% progress. Until the end of October 2019 the work progress only reached 80.79% from 100%. As a result of the delay in completion, the foundation contractor lost ± 5 billion. This is a serious concern because other projects did not occur. Therefore, researchers want to identify and analyze high risks that affect the time performance of foundation work along with preventive and remedial actions.

Project risk management aims to identify and manage risks that are not handled by other project management processes. When not managed, this risk has the potential to cause the project to deviate from the plan and fail to achieve the stated project goals. As a result, the effectiveness of project risk management is directly related to project success (PMBOK Guide Sixth Edition, 2017).

Risk level analysis is based on the Risk Level Index equation, where the magnitudes of the Risk Level Index are a picture of the level of risk that occurs. In accordance with (PMBOK Guide Sixth Edition, 2017), evaluation of risks in a project depends on:

1. The probability of occurrence of risk and frequency of occurrence.
2. Impact of these risks.
3. Risk level index with the following equation:

$$R = I \times P \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

with:

R = Risk Level Index
I = Frequency/Probability
P = Impact

RESEARCH METHODOLOGY

The thinking framework used in this study is a scientific approach that shows the relationship between independent variables and dependent variables in the process of analysis. The thinking framework can be outlined in the following scheme:

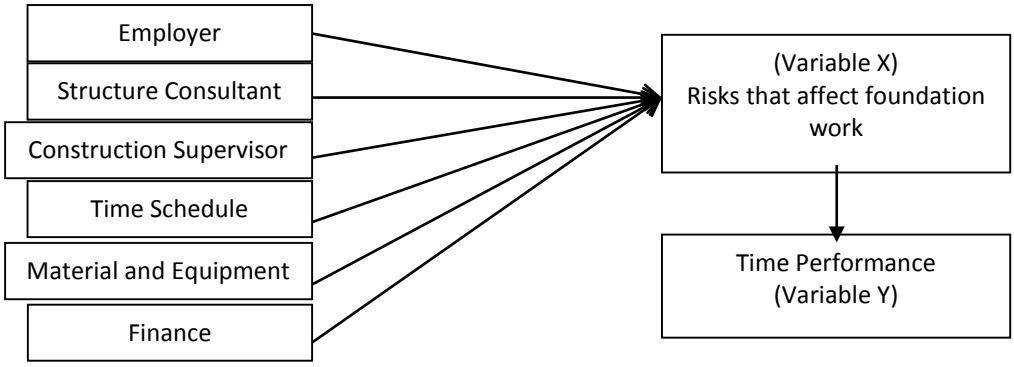

Figure 1. Scheme of Thinking Framework
*(*Source: Processed by the author, 2019*)*

As for the research flow chart, see figure at the below:

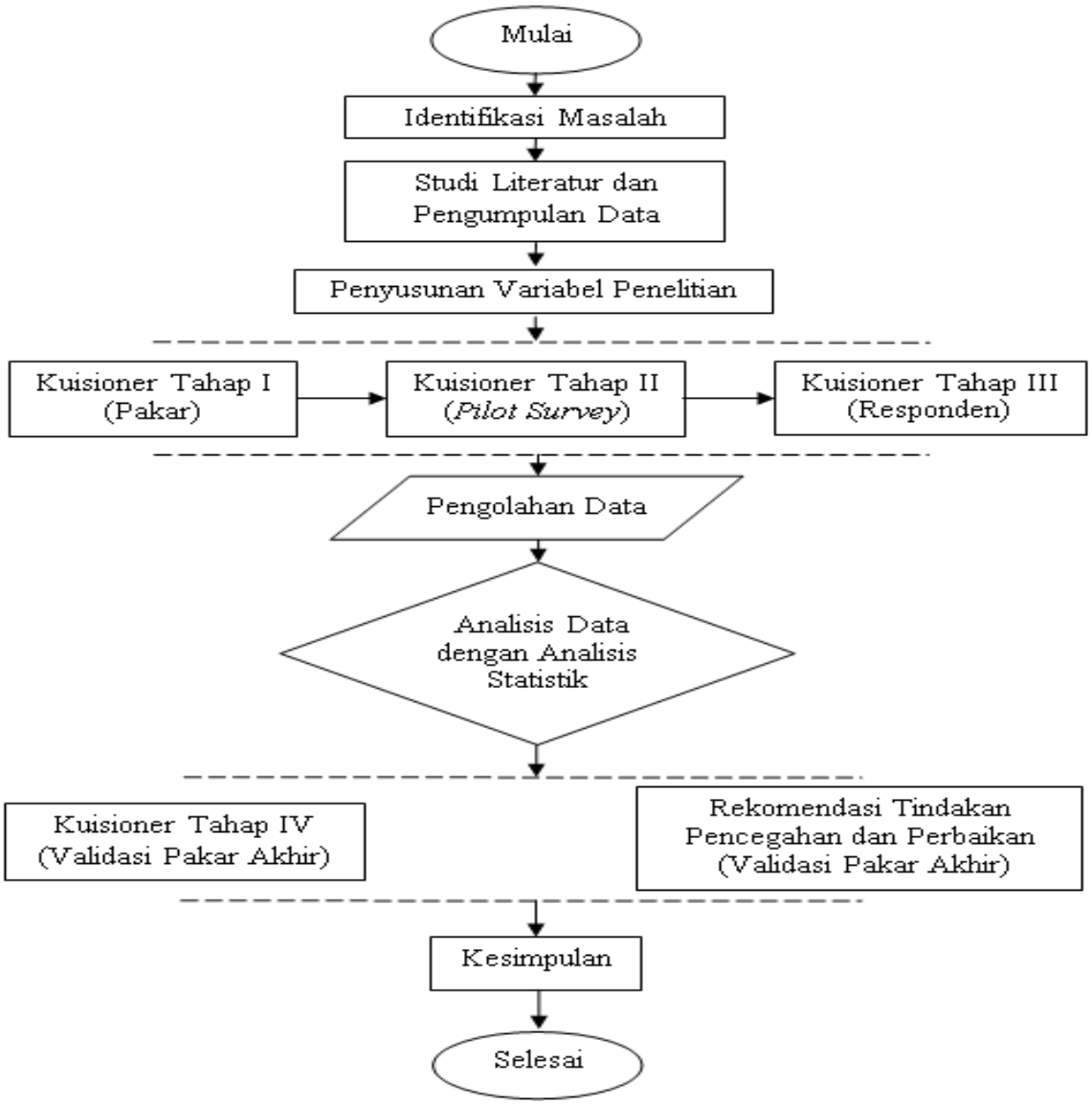

Figure 2. Research Flow Chart
*(*Source: Ilustration by the author, 2019*)*

In this study the authors began to conduct research by determining the object of the project that will be used as a research project, namely the Development of 6 Toll Roads in the City Section 1A Kelapa Gading - Pulo Gebang.

After determining the object of research, the authors identify the problems experienced by the project. Then the authors make the formulation of the problem that will be a reference in research activities.

The next stage is the writer conducts a literature study by studying various journals related to the risks that occur in the project. From the journal the writer obtained some data, namely variables that have been studied, procedures that have been applied and results in research. After reviewing various journals, the author compiles variables that will be the basis for making the questionnaire. The results of the distribution of questionnaires will be the primary data in this study. In addition to distributing questionnaires, primary data were obtained by interviewing those involved in the implementation of the project (contractor), especially those

who were competent and knew the project conditions. In this study there are secondary data that will be used, namely time schedule for the implementation of foundation work.

Arrange the first stage questionnaire which aims to ask the opinions of experts (experts) on the questionnaire that has been made by the author. This step can be said as a validation of the questionnaire whether the expert agrees or not that the variables that exist are risks that affect time performance. In addition, ask experts to add or subtract existing variables.

The distribution of questionnaire phase II (pilot survey) where in this activity the writer spreads the questionnaire to several prospective respondents.

Distribution of stage III questionnaire where the questionnaire is the main questionnaire and distributed to several respondents. The respondents are selected people who are competent and know the conditions that occur in the project. To identify risk variables, a qualitative method of data analysis was carried out, namely interviewing experts and continued with quantitative data analysis for the results of the questionnaire from respondents. The data that has been collected is processed using the SPSS (Statistical for Social Science) program for validation and reliability testing. After that the results of the questionnaire were analyzed with the Risk Index method to determine the level of risk that occurred.

The distribution of the stage IV questionnaire was carried out to obtain recommendations from experts on the results of the analysis of research data. These opinions include preventive measures and corrective actions. Researchers provide conclusions in the form of answers to the identification of problems related to risk that affect the time performance of foundation work and the most dominant risk.

From the results of the literature study, the following research variables were obtained:

Table 1. Research Variables

Variables	Risks that affect time performance	Sources
X1	Occurrence of Natural Disasters (Force Majeure)	Evan, 2017
X2	Bad Weather Conditions (Rain)	Shanty and Fabian, 2019
X3	Field conditions that are difficult to reach	Reyner and Bonny, 2015
X4	Social problems	Shanty and Fabian, 2019
X5	There is a problem of land acquisition	Shanty and Fabian, 2019
X6	Social disturbances from the surrounding community	Evan, 2017
X7	The level of safety of the project environment	Evan, 2017
X8	Disputes occur with the local community	Iswanto and Hari, 2017
X9	Work accident	Evan, 2017
X10	Unstable social and political environment	Iswanto and Hari, 2017
X11	Lack of support from the local government for project activities	Iswanto and Hari, 2017
X12	Uncertainty from local government policy on project activities	Iswanto and Hari, 2017
X13	The emergence of congestion around the project site	Fahmi and Miftahul, 2018
X14	Job location not ready	Results of Interview, 2019
X15	Changes in design and scope of work	Fahmi and Miftahul, 2018

Table 1. Research Variables

Variables	Risks that affect time performance	Sources
X16	Project scheduling is not perfect	Shanty and Fabian, 2019
X17	Redesign occurred	Evan, 2017
X18	Low productivity	Shanty and Fabian, 2019
X19	Added scope of work	Evan, 2017
X20	Working drawings aren't ready yet	Results of Interview, 2019
X21	The capacity of the project implementers is lacking	Reyner and Bonny, 2015
X22	The level of expertise of the workforce is not enough	Shanty and Fabian, 2019
X23	Personnel competence is not in accordance with their duties	Shanty and Fabian, 2019
X24	Lack of teamwork	Evan, 2017
X25	The division of tasks and authority is not clear	Shanty and Fabian, 2019
X26	Less competent core project staff	Evan, 2017
X27	Changes to specifications	Evan, 2017
X28	Error estimating time	Shanty and Fabian, 2019
X29	Cost estimation error	Shanty and Fabian, 2019
X30	The material used does not meet specifications	Shanty and Fabian. 2019
X31	Material and equipment delivery errors	Evan, 2017
X32	Material delivery delays	Fahmi and Miftahul, 2018
X33	Equipment delivery delays	Reyner and Bonny, 2015
X34	Difficulty getting material according to specifications	Evan, 2017
X35	Increase in material prices	Reyner and Bonny, 2015
X36	Equipment damage	Evan, 2017
X37	Lack of equipment	Evan, 2017
X38	Equipment that is not feasible	Reyner and Bonny, 2015
X39	Late payment by the project owner	Iswanto and Hari, 2017
X40	The number of results of work that must be repeated because of wrong (rework)	Iswanto and Hari, 2017
X41	Identification, duration, incomplete and non-sequential work sequence plan	Iswanto and Hari, 2017
X42	Accidents happen to workers	Iswanto and Hari, 2017
X43	Difficulties in mobilizing tools and materials	Iswanto and Hari, 2017

(Source : Processed by the author, 2019)

The population in this study were all staff and workers involved in the foundation work of the 6th Toll Road Construction Project in the City Section 1A Kelapa Gading - Pulo Gebang consisting of the main contractor, consultant, foundation contractor and field supervisor. From a total population of around 30 people and the percentage of inaccuracy used by 5% using the Slovin formula obtained the number of samples taken was 28 people. The respondent's identity can be described into several criteria, namely education, work experience in the field of foundation construction and position.

RESULT AND DISCUSSION

The data that has been collected will be carried out statistical analysis as follows:

a. Results of validity test

The sample data used was 28 (N = 28) and the significance level used was 5%, then by looking at the r Product Moment Value table, the r value = 0.374 was obtained. Then the r count is obtained by using SPSS software and the results can be seen in Table 2.

Table 2. Results of Validity Test

Code	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	r table	Remark
X1	79.18	391.485	.837	0,374	Valid
X2	79.07	388.143	.732	0,374	Valid
X3	78.93	402.661	.554	0,374	Valid
X4	79.07	404.810	.679	0,374	Valid
X5	79.43	392.476	.780	0,374	Valid
X6	79.11	385.729	.762	0,374	Valid
X7	79.11	384.692	.866	0,374	Valid
X8	78.71	396.508	.623	0,374	Valid
X9	79.57	414.106	.619	0,374	Valid
X10	79.14	414.571	.420	0,374	Valid
X11	79.82	398.152	.750	0,374	Valid
X12	80.18	411.485	.530	0,374	Valid
X13	79.61	416.470	.537	0,374	Valid
X14	78.61	421.951	.452	0,374	Valid
X15	80.07	394.143	.805	0,374	Valid
X16	79.43	423.217	.048	0,374	Valid
X17	79.18	421.337	.178	0,374	Not Valid
X18	78.96	407.295	.495	0,374	Valid
X19	78.64	409.571	.421	0,374	Valid
X20	79.00	408.889	.648	0,374	Valid
X21	79.18	377.411	.891	0,374	Valid
X22	78.96	387.073	.727	0,374	Valid
X23	79.14	387.608	.875	0,374	Valid
X24	79.14	386.942	.891	0,374	Valid
X25	78.82	376.597	.835	0,374	Valid
X26	78.54	400.851	.576	0,374	Valid
X27	78.96	405.888	.714	0,374	Valid
X28	79.29	384.434	.851	0,374	Valid
X29	80.04	417.369	.404	0,374	Valid
X30	79.79	418.026	.185	0,374	Not Valid
X31	79.86	410.868	.437	0,374	Valid

X32	79.96	419.073	.344	0,374	Not Valid
X33	80.21	419.878	.212	0,374	Not Valid
X34	80.21	422.471	.173	0,374	Not Valid
X35	80.14	418.053	.324	0,374	Not Valid

(Source : Result by the author, 2020)

Pada tabel di atas dapat dilihat bahwa variabel X17, X30, X32, X33, X34 dan X35 dianggap tidak valid karena r hitung masih di bawah r tabel. Kemudian keenam variabel tersebut dihilangkan dari proses analisa data selanjutnya.

b. Results of Realibility Test
Results of Realibility Test can be seen in Table 3 :

Tabel 3. Results of Realibility Test

Nilai Cronbach's Alpha	N of Items
0,950	35

(Source : Result by the author, 2020)

Cronbach's Alpha coefficient value of risk data which have an impact on time performance is obtained 0.950 where the value is greater than 0.5 so that the instrument used in retrieving the data can be said to be reliable.

c. Risk Analysis
After knowing the value of the frequency scale and the impact of events then make a weighting with the average results of the impact value and probability value. Furthermore, the average probability value is multiplied by the average impact value and the highest variables are taken to produce the results as the dominant risk affecting project time performance. To determine the risk level of research variables, the results of the above calculations are matched with the opportunity and impact matrix.

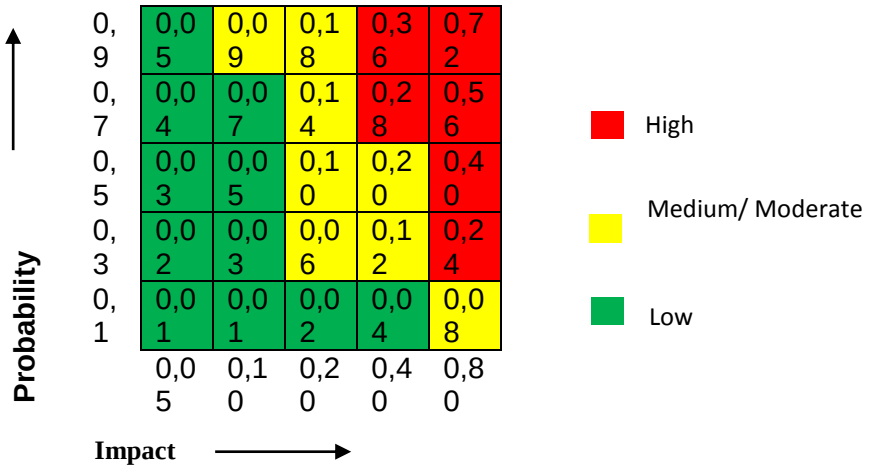

Figure 3. Probability and Impact Matrix
(Source : PMBOK, 2017)

Based on Figure 3. the risk rating range can be determined as follows:
1. Low risk = 0.01 - 0.05
2. Moderate risk = 0.06 - 0.19
3. High risk = 0.20 - 0.72

Risk calculations and risk rating categories can be seen in the table below:

Table 4. Risk Value and Risk Rating Category

Code	Frequency (I)	Impact (P)	Risk Value (I x P)	Risk Rating Category
X1	0.21	0.23	0.05	Low
X2	0.24	0.26	0.06	Low
X3	0.41	0.41	0.17	Moderate
X4	0.25	0.25	0.06	Moderate
X5	0.64	0.68	0.44	High
X6	0.23	0.24	0.06	Moderate
X7	0.39	0.39	0.15	Moderate
X8	0.22	0.23	0.05	Low
X9	0.43	0.43	0.18	Moderate
X10	0.66	0.65	0.43	High
X11	0.33	0.33	0.11	Moderate
X12	0.24	0.24	0.06	Moderate
X13	0.31	0.31	0.10	Moderate
X14	0.63	0.66	0.42	High
X15	0.33	0.33	0.11	Moderate
X16	0.43	0.43	0.18	Moderate
X17	0.44	0.44	0.19	Moderate
X18	0.49	0.39	0.19	Moderate
X19	0.21	0.24	0.05	Low
X20	0.66	0.69	0.46	High
X21	0.39	0.39	0.15	Moderate
X22	0.46	0.39	0.18	Moderate
X23	0.49	0.39	0.19	Moderate
X24	0.46	0.41	0.19	Moderate
X25	0.33	0.33	0.11	Moderate
X26	0.43	0.43	0.18	Moderate
X27	0.44	0.41	0.18	Moderate
X28	0.49	0.39	0.19	Moderate
X29	0.23	0.45	0.10	Moderate
X30	0.28	0.28	0.08	Moderate
X31	0.26	0.26	0.07	Moderate
X32	0.24	0.24	0.06	Moderate
X33	0.19	0.24	0.05	Low
X34	0.19	0.19	0.04	Low
X35	0.21	0.21	0.04	Low

(Source : Result by the author, 2020)

From the results of the phase III data analysis, four risk variables are included in the high category and can be seen in Table 5.

Table 5. High Risk that Affect Time Performance

Code	Risk that Affect Time Performance
X5	Problem of Land Acquisition
X10	Site Location has not ready for work
X14	The working drawing is not ready
X20	Inadequate core project personnel

(Source : Result by the author, 2020)

CONCLUSION

Based on the results of research and discussion of the data analysis process, conclusions can be drawn including:

1. Based on the results obtained from the risk analysis it is known that of the 35 variables there are 4 variables that have a high level of risk that affect the time performance of the implementation of foundation work which is stated with a value of 0.20 - 0.72 and has been validated by 3 experts as the following:
   - There is a problem of land acquisition (X5)
   - Site location has not ready for work (X10)
   - The working drawing is not ready (X14)
   - Inadequate core project personnel (X20)
2. From the results of stage IV data collection, recommendations for preventive actions and corrective actions resulting from the two risk variables are obtained. The recommendations of the three experts are as follows:

a. Land acquisition issues (X5)
   - Preventive action: clear scope of work in the contract, be careful in starting the implementation time and pay attention to environmental aspects related to each work item and carefully review the scope of work on the contract.
   - Corrective action: filing a claim against the employer, paying attention to environmental aspects at each start of the implementation period for the connection of each work item and submitting an amendment to the contract amendment to the employer.

b. Work location not ready (X10)
   - Preventive action: joint survey between employers, contractors and consultants, re-measuring work sites, and reviewing the suitability of work sites with contracts.
   - Corrective action: joint meeting to find the best solution for land acquisition, and submission of new contract improvements to employers.

c. Working drawings not ready (X14)
   - Preventive action: the design has been approved before the project starts and ensures the forcont drawing before starting the project.
   - Corrective action: submit a claim to the employer regarding the unfinished picture by the planner, submit the corrected drawing of the forcont picture to the planner and monitor every change in the detailed picture.

d. Inadequate core project personnel (X20)
   - Preventive action: provide training to project staff, set high standards for each new recruitment force and provide incentive / reward money for each competitive core of the project.
   - Corrective action: recruit workers according to the needs and competency standards, re-generation of less productive workers and termination of employment contracts to incompetent core workers.

Suggestion

In carrying out the work in the 6 (Six) Toll Roads Construction Project in the City of Jakarta, 4 high risks were found that affected time performance. For this reason, the author can provide some suggestions that might be useful for the parties concerned:

1. The contractor must take into account the non-productive time caused by the problem of land acquisition, location and work drawings that are not ready in preparing the project implementation plan.
2. Improve the quality of core staff by holding training on project management.
3. Improving the quality of work results by monitoring work and controlling whether the work is in accordance with the plan.
4. The need to apply Project Risk Management Analysis which must be applied to each project so that the risks that occur can be anticipated from the beginning.

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