Identification of Risk Factors Causing Delays in the Completion Schedule in the Case Study of Double-Double Track Development Project (Package A)

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Abstract

One of the strategic projects implemented by the Directorate General of Railways, Ministry of Transportation of the Republic of Indonesia is the Double-Double Track Development Project (Package A) from Manggarai to Jatinegara. This project is divided into two phases and has experienced several extensions of the implementation time which has resulted in delays in the project completion schedule. Delays in completion schedule will certainly have an impact on a number of things, both in terms of project financing, assessment of the performance of institutions / ministries, achievements felt directly by the community, can even lead to changes in the pattern of railway operations as a form of adjustment to the development process. This paper was created to identify risk factors that causing delays in the completion schedule in the case study of the Double-Double Track Development Project (Package A) from Manggarai to Jatinegara. The research process is carried out by making a questionnaire addressed to the respondents, by first validating every risk variable by the experts. The questionnaire consists of two main parts; risk impact intensity assessment and risk probability assessment. The results of the assessment by the respondents were then processed so that valid risk factors were obtained as an answer to the causes of delays in the completion schedule of the project case study. By identifying risk factors that have a potential to occur, it is hoped that there will be improvements in project implementation, especially in the preparation of schedules and processes for controlling and mitigating risks.

Keywords
Identify, Mitigation, Risk, Schedule and Track

1. Introduction
In the last 10 years, the construction of railway facilities in various parts of the country has been carried out by the Ministry of Transportation through the Directorate General of Railways (Ministry of Transportation, 2020). Some of the manifestations of this development include the construction of new stations, modernization of stations and railway facilities, construction of double track and Double-Double Track lines, construction of viaducts, and so on. In carrying

out these developments, it is not seldom for project completion delays to occur. One of the examples is Double-Double Track Development (Package A) which is the case study in this research. This project aims to improve the performance of rail transportation services, specifically along the Manggarai to Jatinegara. In the implementation process, this project is divided into two project phases, both of which use the same funding scheme, namely funding through State Sharia Securities (SBSN). For the Double-Double Track Development (Package A) Phase 1 project, the implementation period of the multi-year contract starts from 2014 to 2021, while for Phase 2 it starts in 2019 and is planned to be completed in 2022.

The phenomenon of delay in completion of this project is caused by a number of factors. In the case study of the project adopted in this study, of course, delays in project completion will affect a number of things, ranging from changes in passenger transport service capacity, changing train operating patterns, poor performance appraisal of budget absorption by the Ministry of Transportation as the employer and so on.

1.1 Objectives

The purpose of this research is to identify the risks that can have an impact on the delay in the completion schedule of the Double-Double Track Development Project (Package A), so that preventive actions can be applied to prevent delays in project completion in the future.

2. Literature Review

2.1 Project Management

According to PMBOK 6th Edition (2017), project management is a form of application of knowledge, capabilities, tools and techniques / methods for each project activity to achieve the requirements of the project itself. Basically, project management can be achieved from the proper implementation and integration of any identified project management process. Project management allows an organization to run projects effectively and efficiently. Siegel (2019) states that project management is a discipline that provides a method to achieve the desired results, namely the goods or services that we want to use or offer, where ultimately the application of technology or technological concepts becomes the center of success of a project.

Chitkara (2014) states that in the context of construction, project management is the art and science of managing all aspects of the project to achieve project objectives within a predetermined time span, with budgeted costs and predetermined quality specifications; work efficiently and effectively in the project environment with due regard to the safety and health aspects of construction workers. The principles of management in general i.e. planning, organizing, staffing, direction, motivation, monitoring, communication, control and decision making apply the same to management as traditional functional types as well as in project management, but management philosophies on project management vary greatly. Risk, uncertainty and complexity make project management a relatively difficult and complex process (Chitkara, 2014).

2.2 Project Success

According to Müller and Jugdev (2012), today, the success of the project has been expressed as a multidimensional form that includes the efficiency of short-term project management success and the long-term achievement of the desired results of the project, namely: effectiveness and impact. There are so many research findings and expert opinions on the key success factors of a project. Emanuel Camilleri (2011) summarizes his findings into the top six key success factors, in order of importance as outlined below (figure 1):

a. Implementation of effective project planning and control systems;
b. Strategic conformity to project objectives and stakeholder commitment to achievement;
c. Mature project scope with minimum changes;
d. Smooth communication of information on the right channels;
e. Effective management and leadership; and
f. Project risk management.

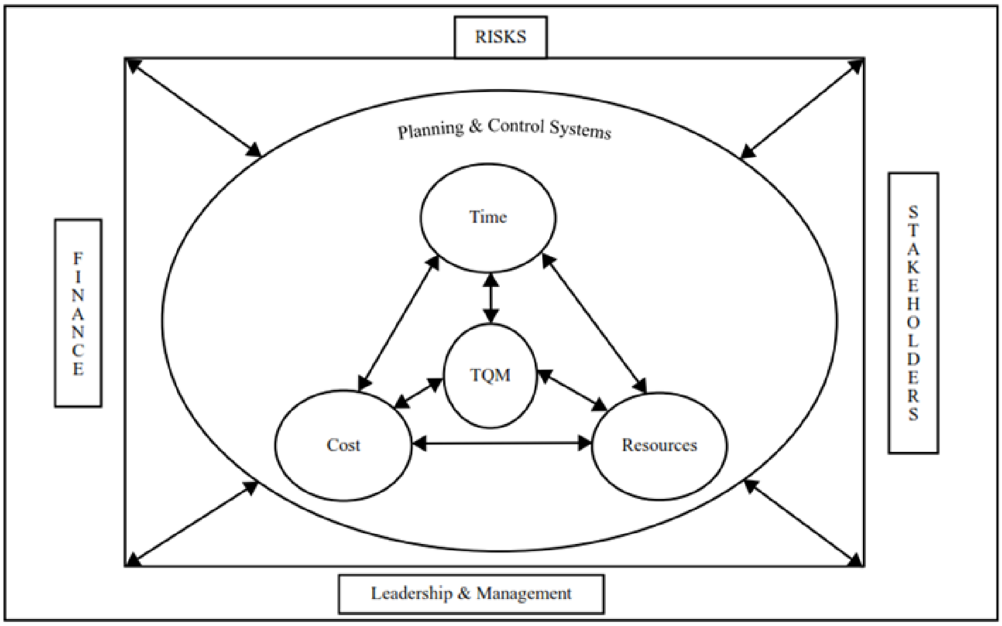

Figure 1. Construction Project Management Key Success Factor Model (Chitkara, 2014)

2.3 Project Risk Management

Risk control is one of the key factors in the success of a project. When all parties involved in a project are able to identify all existing risks and can control them, then the achievement of the project will certainly be the maximum, in accordance with the desired target. According to Damnjanovic and Reinschmidt (2018), risk management is not a function that job owners can delegate to contractors. Contractors and consultants can play a major role in the identification and assessment of risks, but there are still some very important things, which cannot be delegated by the job owner, namely, identification, mitigation, acceptance, and management of the risk of the owner of the work itself. Meanwhile, according to Hendradewa (2018), the inability to manage time, the unavailability of technical ability to deal with changes that can occur at any time and difficulty to describe the process are obstacles that can cause management difficulty to monitor the progress status of a project (Figure 2).

Project Risk Management includes the process of implementing risk management planning, identification, analysis, response planning, response implementation, and risk monitoring on a project. The goal of project risk management is to increase the likelihood and/or impact of positive risks and to reduce the likelihood and/or negative impact of risk, to optimize the chances of project success. According to PMBOK 6th Edition (2017), the processes in project risk management are as follows:

a. Risk Management Plan, which is the process of determining or defining how to carry out risk management activities on a project.
b. Risk Identification, the process of identifying a single/specific risk to a project as well as the sources of overall project risk, and documenting the characteristics of those risks.
c. Qualitative Risk Analysis, which is the process of prioritizing individual risks of the project for further analysis or assessment of the possibility of the occurrence of such risks and the impact of such risks and other characteristics.
d. Quantitative Risk Analysis, which is a process of numerical analysis of the combined effects of an identified individual project risk and other sources of uncertainty on the overall project objectives.
e. Risk Response Plan, which is the process of developing options, choosing strategies and agreeing to the intended action.
f. Implementing a Risk Response, which is the process of implementing an agreed risk response plan.
g. Monitoring Risk, which is the process of monitoring the implementation of an agreed risk response plan, tracking identified risks, identifying and analyzing new risks, and evaluating the effectiveness of the overall risk process of the project.

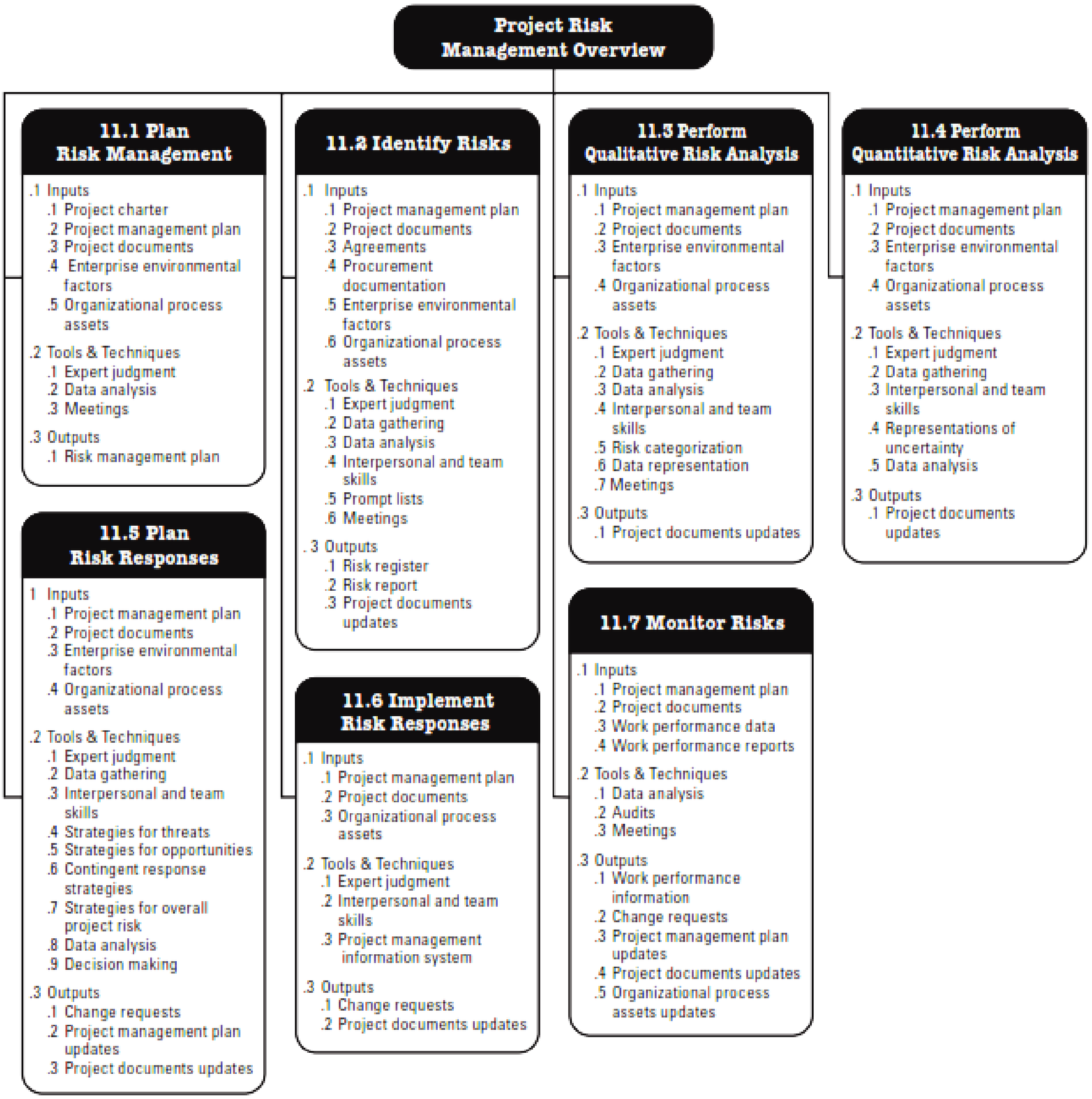

Figure 2. Project Risk Management Overview (PMBOK 6th Edition, 2017)

3. Methods

In this study, a number of processes were used to obtain valid data from respondents. The process begins with a risk identification process based on primary and secondary data available on the Double-Double Track Development Project (Package A). After that, the questionnaire concept is created and validated in advance by experts, according to the expert criteria in table 1. After the questionnaire validation process by experts, then the process of collecting data through questionnaires is carried out to respondents who have been chanted before. The flow of the research procedure is further explained in the following figure 3.

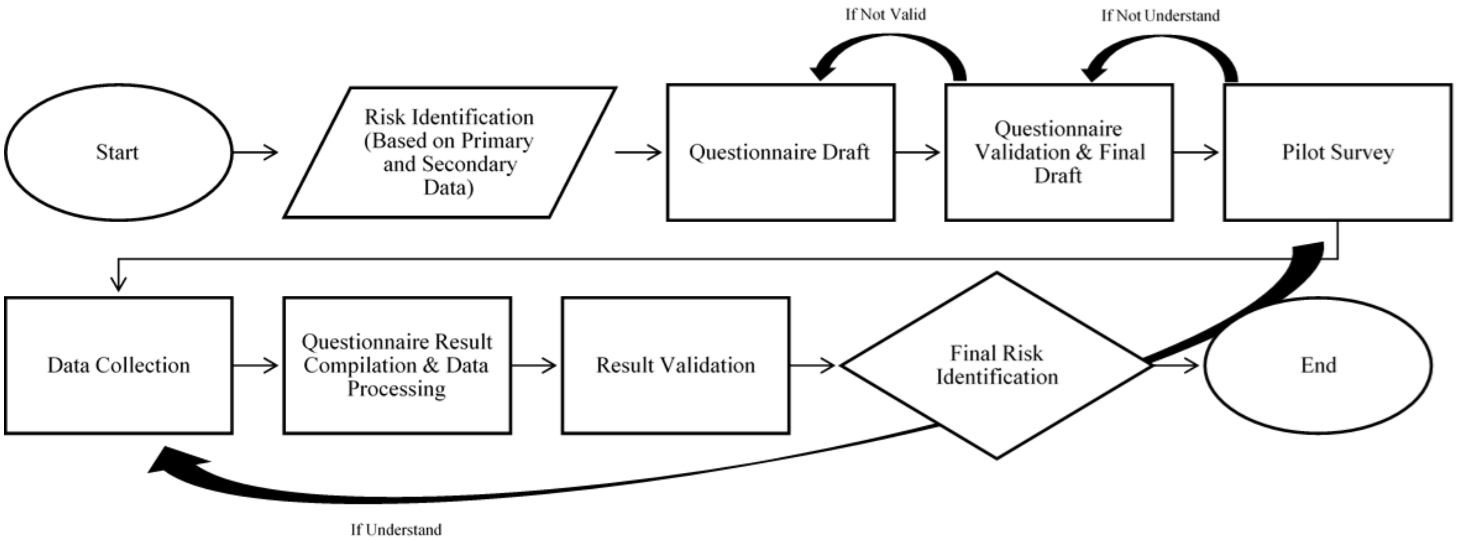

Figure 3. Study Flowchart

In this study, researchers use purposive sampling techniques. Purposive sampling is a data source retrieval technique carried out with certain considerations (Sugiyono, 2016). The main consideration of researchers in using this sampling technique is because not all samples are in accordance with the criteria that have been set to answer various problems raised in this study, so that later the researcher will determine directly the criteria for the sample to be used in this study.
The criteria specified in this study will be divided into:

a. Respondent criteria, to obtain a risk rating (risk rating) in this research case study;
b. Expert Criteria, for the validation process carried out in this study against samples that have been obtained from previous respondents.

Table 1. Criteria of Respondent and Expert

Respondent Criteria		**Expert Criteria**	
1	Healthy physically and spiritually	**1**	Healthy physically and spiritually
2	15 – 30 People(s)	**2**	3 – 4 People(s)
3	Have a minimum educational background of Diploma of Civil Engineering / Equivalent	**3**	Have a minimum educational background of Master of Civil Engineering
4	Has worked on the Double-Double Track Development Project (Package A) for at least 3 years	**4**	Have an academic or practitioner background in the field of railways and/or construction of buildings / bridges / track / railway operation facilities
		5	Have a work experience in the field of railways and/or construction of buildings / bridges / track / railway operation facilities for a minimum of 10 years

3.1 Analytical Hierarchy Process (AHP)

In conducting quantitative analysis for the results of the questionnaire, this study used the *Analytical Hierarchy Process* (AHP) method. The AHP is a general theory of measurement. It is used to derive relative priorities on absolute scales (invariant under the identity transformation) from both discrete and continuous paired comparisons in multilevel hierarchic structures (Saaty and Vargas, 2006).

Table 2. Comparative Assessment Scale

Intensity of Importance	Definition	Explanation
1	Equally Important	Two activities contribute equally to the cause
3	A Little More Important	Experience and judgment support an activity less than others
5	High Importance	Experience and assessment are more supportive of an activity than other activities
7	Higher Importance	Experience and assessment are very supportive of an activity compared to other activities
9	Very High Importance	The evidence supporting that an activity is more when compared to other activities is from the highest possible order of affirmation
2,4,6,8	Values between two adjacent consideration values	

Referring to the table 2, quantitative analysis is then carried out by making a comparison matrix in pairs to determine the weight or value of risk factors that have an impact on delays in completing projects sequentially (in the form of risk ratings). After obtaining a risk rating for each scope of work, validation to the expert is carried out to assess whether the risk rating is in accordance with the facts that have been occurring in the case study of the Double-Double Track Development Project (Package A), to then obtain a final conclusion for this study.

4. Data Collection

The data collection process is carried out with the corresponding flow in figure 3 above. After the expert validation process is carried out and the final draft of the questionnaire is made, the researcher then collects data to the respondents (according to the criteria in table 1).

Table 3. Expert's Advice / Feedback for Questionnaire

Expert(s)	Expert's Advice / Feedback
Expert 1	- Add excavation/fill work activities after measurement/survey work. - Add the activity of the preparation of the rail bearing work before the rail installation work. - The risk factors are appropriate.
Expert 2	- The risk factors X1.1, X1.3 and X1.4 in land clearing work (Rail Road) are not necessary. - Risk factor X1.3 on survey/measurement work (Rail Road) is not necessary. - Risk factor X1.2 on survey/measurement work (Railway Bridge Structure) is not necessary. - Risk factor X1. for land clearing (Station Building) is not necessary. - Risk factor X1.2 on survey/measurement work (Station Building) is not necessary.
Expert 3	- **Rail Road:** It needs an element of land availability in X1 and an element of coordination with stakeholders in X3. - **Railway Bridge Structure:** It is best to include the element "organizational/ personnel structure changes" on X3. - **Building:** The thing that most often makes the schedule delayed is design changes whose frequency is quite high, both from the leadership of the Ministry and from stakeholders. - **Operation Facilities:** There is one case that is enough to make it difficult to prepare a schedule, namely the existence of 2 packages of work in the same location and the same time.

Questionnaires that have been validated by experts are then given to predetermined respondents. The questionnaire consists of 2 types, the first is a questionnaire regarding the assessment of the intensity of the risk impact. Second, a questionnaire regarding the assessment of risk probability. All respondents then gave an assessment on the questionnaire in accordance with the format of the questionnaire that has been finalized (table 3 and table 4).

Table 4. Questionnaire Sample (Risk Impact Intensity)

Risk Factors- Railway Bridge Structure Work				Risk Impact Intensity				
				NI	LI	QI	I	VI
Activity: Land Clearing								
X1	Technical Risks	X1.1	Change in Scope of Work / Review Design					
		X1.2	Delays in The Material Fabrication Process					
		X1.3	Unskilled Labor					
		X1.4	Technical Specifications That Are Not Met or Subject to Changes					
		X1.5	Untimely Completion Schedule of Activities					
		X1.6	Less Effective & Efficient Working Methods					
		X1.7	Availability of Working Land					
X2	Social Risks	X2.1	Vandalism					
		X2.2	Land Acquisition					
		X2.3	The Emergence of Social Costs Due to The Implementation of Work					
X3	Administration Risks	X3.1	Organizational Structure Changes					
		X3.2	Late Submittal of Documents					
		X3.3	Late Approval of Documents					
		X3.4	Coordination with Stakeholders (Indonesia Railway Company, DKI Jakarta Provincial Government, Etc.)					
X4	Economy Risks	X4.1	Inflation / Deflation					
		X4.2	Changes to Tax Rules					
		X4.3	Rupiah Exchange Rate Against Foreign Currency					
		X4.4	The Increase of Material Price					
		X4.5	Late Payment Process					
		X4.6	The Cost of Project Activities That Are Not as Planned					
		X4.7	Availability of Budgets to Project Owners					
X5	Environment Risks	X5.1	Environmental Pollution					
		X5.2	Weather Factors					
X6	SHE Risks	X6.1	Work Accident					
		X6.2	Covid-19 Pandemic					
		X6.3	Natural Disasters					
Activity: Survey / Staking Out								
X1	Technical Risks	X1.1	Change in Scope of Work / Review Design					
		X1.2	Delays in The Material Fabrication Process					
		X1.3	Unskilled Labor					
		X1.4	Technical Specifications That Are Not Met or Subject to Changes					
		X1.5	Untimely Completion Schedule of Activities					
		X1.6	Less Effective & Efficient Working Methods					
		X1.7	Availability of Working Land					
X2	Social Risks	X2.1	Vandalism					
		X2.2	Land Acquisition					
		X2.3	The Emergence of Social Costs Due to The Implementation of Work					
X3	Administration Risks	X3.1	Organizational Structure Changes					
		X3.2	Late Submittal of Documents					
		X3.3	Late Approval of Documents					
		X3.4	Coordination with Stakeholders (Indonesia Railway Company, DKI Jakarta Provincial Government, Etc.)					
X4	Economy Risks	X4.1	Inflation / Deflation					
		X4.2	Changes to Tax Rules					
		X4.3	Rupiah Exchange Rate Against Foreign Currency					
		X4.4	The Increase of Material Price					
		X4.5	Late Payment Process					
		X4.6	The Cost of Project Activities That Are Not as Planned					
		X4.7	Availability of Budgets to Project Owners					
X5	Environment Risks	X5.1	Environmental Pollution					
		X5.2	Weather Factors					
X6	SHE Risks	X6.1	Work Accident					
		X6.2	Covid-19 Pandemic					

		X6.3	Natural Disasters					

Abbreviations: Not Influential (NI), Less Influential (LI), Quite Influential (QI), Influential (I) and Very Influential (VI (table 5).

Table 5. Questionnaire Sample (Risk Probability)

Risk Factors - Railway Bridge Structure Work				**Risk Probability**				
				N	**R**	**QO**	**O**	**S**
Activity: Lower Structure Work								
X1	Technical Risks	X1.1	Change in scope of work / review design					
		X1.2	Delays in the material fabrication process					
		X1.3	Unskilled Labor					
		X1.4	Technical specifications that are not met or subject to changes					
		X1.5	Untimely completion schedule of activities					
		X1.6	Less effective & efficient working methods					
		X1.7	Availability of working land					
X2	Social Risks	X2.1	Vandalism					
		X2.2	Land acquisition					
		X2.3	The emergence of social costs due to the implementation of work					
X3	Administration Risks	X3.1	Organizational structure changes					
		X3.2	Late submittal of documents					
		X3.3	Late approval of documents					
		X3.4	Coordination with Stakeholders (Indonesia Railway Company, DKI Jakarta Provincial Government, etc.)					
X4	Economy Risks	X4.1	Inflation / Deflation					
		X4.2	Changes to tax rules					
		X4.3	Rupiah exchange rate against foreign currency					
		X4.4	The increase of material price					
		X4.5	Late payment process					
		X4.6	The cost of project activities that are not as planned					
		X4.7	Availability of budgets to project owners					
X5	Environment Risks	X5.1	Environmental pollution					
		X5.2	Weather factors					
X6	SHE Risks	X6.1	Work accident					
		X6.2	COVID-19 Pandemic					
		X6.3	Natural disasters					
Activity: Upper Structure Work								
X1	Technical Risks	X1.1	Change in scope of work / review design					
		X1.2	Delays in the material fabrication process					
		X1.3	Unskilled Labor					
		X1.4	Technical specifications that are not met or subject to changes					
		X1.5	Untimely completion schedule of activities					
		X1.6	Less effective & efficient working methods					
		X1.7	Availability of working land					
X2	Social Risks	X2.1	Vandalism					
		X2.2	Land acquisition					
		X2.3	The emergence of social costs due to the implementation of work					
X3	Administration Risks	X3.1	Organizational structure changes					
		X3.2	Late submittal of documents					
		X3.3	Late approval of documents					
		X3.4	Coordination with Stakeholders (Indonesia Railway Company, DKI Jakarta Provincial Government, etc.)					
X4	Economy Risks	X4.1	Inflation / Deflation					
		X4.2	Changes to tax rules					
		X4.3	Rupiah exchange rate against foreign currency					
		X4.4	The increase of material price					
		X4.5	Late payment process					

		X4.6	The cost of project activities that are not as planned					
		X4.7	Availability of budgets to project owners					
X5	Environment Risks	X5.1	Environmental pollution					
		X5.2	Weather factors					
X6	SHE Risks	X6.1	Work accident					
		X6.2	COVID-19 Pandemic					
		X6.3	Natural disasters					

Abbreviations: Never (N), Rarely (R), Quiet Often (QO), Often (O) and Always (A).

In the next stage, after all respondents have filled out the questionnaire, the data will be processed and validated again by experts, so that the results provided become more valid and relevant to the current situation in the field. Researchers will only take the assessment with the highest score for each assessment; risk impact intensity assessment and risk probability assessment. If there are a number of risk factors with the same score and frequency, then the validation results from the expert will decide which risk factor is more appropriate to the conditions in the field.

5. Results and Discussion

Project Management Institute (2014) said that the process of identifying existing problems, brainstorming about predictions or possible problems that occur and determining potential impacts are some of the actions that need to be taken to increase the chances of timely completion of projects. Therefore, it is very important for all project organizers to know the potential risks that can have a very high impact on project completion, and to make a preventive action plan to reduce the potential for these risks.

5.1 Quantitative Risk Analysis

The assessment of the intensity of the impact of risk and the probability of risk of design is made in the form of a weighting matrix using paired comparisons (table 6) with reference to the comparison scale in table 7.

Table 6. Pairwise Comparison Matrix Assessment of Risk Impact Intensity and Risk Probability

	5	**4**	**3**	**2**	**1**
5	1,00	3,00	5,00	7,00	9,00
4	0,33	1,00	3,00	5,00	7,00
3	0,20	0,33	1,00	3,00	5,00
2	0,14	0,20	0,33	1,00	3,00
1	0,11	0,14	0,20	0,33	1,00
Total	**1,79**	**4,67**	**9,53**	**16,33**	**25,00**

From the data on the probability and impact weighting matrix, the matrix normalization is then made for the probability and impact sub-criteria. The matrix normalization figure in each column is obtained from the value of each column concerned divided by the total column so that the probability and impact matrix normalization is obtained. After the normality matrix is obtained, the next is to perform the calculation of the weight of the elements by summing the values on each row and dividing them by the number of elements.

Table 7. Matrix Normalization and Weighting Calculations

	5,000	**4,000**	**3,000**	**2,000**	**1,000**	**Total**	**Priority**	**Percentage**
5,000	0,560	0,642	0,524	0,429	0,360	2,514	0,503	50,29%
4,000	0,187	0,214	0,315	0,306	0,280	1,301	0,260	26,03%
3,000	0,112	0,071	0,105	0,184	0,200	0,672	0,134	13,44%
2,000	0,080	0,043	0,035	0,061	0,120	0,339	0,068	6,78%
1,000	0,062	0,030	0,021	0,020	0,040	0,174	0,035	3,47%

The next stage is to carry out the calculation of the consistency of the matrix. Matrix consistency is obtained from vector values obtained from the multiplication of the matrix between the weighting matrix (table 8) and the pairwise comparison matrix (table 9).

Table 8. Consistency Matrix (Eigen Vector)

Priority	Pairwise Comparison					Result
0,503	1,00	3,00	5,00	7,00	9,00	2,742
0,260	0,33	1,00	3,00	5,00	7,00	1,413
0,134	0,20	0,33	1,00	3,00	5,00	0,699
0,068	0,14	0,20	0,33	1,00	3,00	0,341
0,035	0,11	0,14	0,20	0,33	1,00	0,176

Furthermore, the multiplication result is divided by the relative priority element concerned.

2,742	:	0,503	=	5,453
1,413	:	0,260	=	5,428
0,699	:	0,134	=	5,199
0,341	:	0,068	=	5,024
0,176	:	0,035	=	5,086
	Total			**26,191**

Next, the calculation of the maximum eigenvalue is carried out:

$$\lambda \text{ Max} = \frac{26{,}191}{5} = \mathbf{5{,}238}$$

After the maximum eigenvalue is obtained, the next calculation is the calculation of the bounded *Consistency Index* (CI):

$$\textit{Consistency Index}\ (\text{CI}) = \frac{(5{,}238-5)}{(5-1)}$$

$$= \mathbf{0{,}060}$$

Next, the *Consistency Ratio* (CR) calculation is carried out with the following formula:

$$\textit{Consistency Ratio}\ (\text{CR}) = \frac{\textit{Consistency Index}\ (\text{CI})}{\textit{Index Random Consistency}\ (\text{IR})}$$

Table 9. Index Random Consistency (IR) Value

Matrix Size	IR Value
1,2	0
3	0,58
4	0,9
5	1,12
6	1,24
7	1,132
8	1,41
9	1,45
10	1,49
11	1,51

12	1,57
13	1,48
14	1,57
15	1,59

Based on the formula above, the *Consistency Ratio* (CR) calculation is obtained as follows:

$$\textit{Consistency Ratio}\ (\mathrm{CR}) = \frac{0{,}060}{1{,}12}$$

$$= \mathbf{0{,}0531\ (5{,}31\%)}$$

The results shown above show that the *Consistency Ratio* (CR) number is 0.0531 or 5.31%. The *Consistency Ratio* (CR) value ≤ 0.1 indicates that the calculation results can be said to be correct, so it can be concluded that the above calculations are acceptable.

5.2 Risk Rating

After the quantitative analysis is carried out, the next step is to make a list of risk ratings based on the results of the calculation of risk factors carried out previously. Kerzner (2009) divides risk categories by value of risk factors into 3 types; low risk, medium risk and high risk.

Table 10. Risk Categories Based on Risk Factor Value

Risk Factor Value	Category
> 0,7	High Risk
0,4 - 0,7	Middle Risk
< 0,4	Low Risk

Referring to the table 10 and table 11, the results of the risk rating for each scope of work are obtained as follows:

Table 11. Risk Rating Sample (Scope of Work: Rail Work)

Risk Variable	Local Value		Final Risk Value	Risk Rating	Risk Level
	Impact Intensity (%)	Probability (%)			
VAR00001	0,186	0,106	0,273	111	Low Risk
VAR00002	0,350	0,206	0,484	5	Middle Risk
VAR00003	0,197	0,084	0,265	114	Low Risk
VAR00004	0,117	0,076	0,184	132	Low Risk
VAR00005	0,239	0,137	0,344	64	Low Risk
VAR00006	0,234	0,123	0,328	83	Low Risk
VAR00007	0,391	0,220	0,525	1	Middle Risk
VAR00008	0,223	0,140	0,332	78	Low Risk
VAR00009	0,263	0,133	0,361	53	Low Risk
VAR00010	0,245	0,144	0,353	56	Low Risk
VAR00011	0,190	0,089	0,263	116	Low Risk
VAR00012	0,252	0,130	0,350	58	Low Risk
VAR00013	0,248	0,095	0,320	88	Low Risk
VAR00014	0,273	0,128	0,367	46	Low Risk
VAR00015	0,237	0,078	0,297	102	Low Risk
VAR00016	0,391	0,160	0,489	4	Middle Risk
VAR00017	0,355	0,092	0,414	26	Middle Risk
VAR00018	0,315	0,096	0,380	40	Low Risk
VAR00019	0,289	0,146	0,393	36	Low Risk
VAR00020	0,190	0,095	0,267	113	Low Risk
VAR00021	0,183	0,081	0,249	123	Low Risk
VAR00022	0,248	0,098	0,322	86	Low Risk
VAR00023	0,248	0,098	0,322	86	Low Risk
VAR00024	0,340	0,216	0,482	7	Middle Risk

VAR00025	0,161	0,111	0,254	120	Low Risk
VAR00026	0,167	0,100	0,250	122	Low Risk
VAR00027	0,239	0,095	0,311	93	Low Risk
VAR00028	0,282	0,111	0,362	51	Low Risk
VAR00029	0,211	0,154	0,332	76	Low Risk
VAR00030	0,169	0,084	0,239	124	Low Risk
VAR00031	0,158	0,150	0,285	104	Low Risk
VAR00032	0,200	0,073	0,258	119	Low Risk
VAR00033	0,300	0,133	0,393	35	Low Risk
VAR00034	0,329	0,084	0,385	38	Low Risk
VAR00035	0,324	0,103	0,394	33	Low Risk
VAR00036	0,361	0,126	0,441	18	Middle Risk
VAR00037	0,381	0,187	0,497	2	Middle Risk
VAR00038	0,156	0,112	0,250	121	Low Risk
VAR00039	0,198	0,101	0,279	107	Low Risk
VAR00040	0,222	0,118	0,313	92	Low Risk
VAR00041	0,238	0,121	0,330	82	Low Risk
VAR00042	0,303	0,200	0,443	16	Middle Risk
VAR00043	0,278	0,121	0,365	47	Low Risk
VAR00044	0,258	0,118	0,346	62	Low Risk
VAR00045	0,206	0,132	0,311	94	Low Risk
VAR00046	0,263	0,134	0,362	50	Low Risk
VAR00047	0,304	0,164	0,418	25	Middle Risk
VAR00048	0,243	0,101	0,319	89	Low Risk
VAR00049	0,211	0,154	0,332	77	Low Risk
VAR00050	0,236	0,096	0,310	95	Low Risk
VAR00051	0,370	0,114	0,442	17	Middle Risk
VAR00052	0,319	0,111	0,395	32	Low Risk
VAR00053	0,324	0,076	0,376	41	Low Risk
VAR00054	0,381	0,082	0,431	20	Middle Risk
VAR00055	0,300	0,090	0,363	49	Low Risk
VAR00056	0,350	0,167	0,459	11	Middle Risk
VAR00057	0,174	0,076	0,237	125	Low Risk
VAR00058	0,161	0,073	0,223	127	Low Risk
VAR00059	0,211	0,106	0,294	103	Low Risk
VAR00060	0,253	0,106	0,332	75	Low Risk
VAR00061	0,294	0,200	0,435	19	Middle Risk
VAR00062	0,294	0,132	0,387	37	Low Risk
VAR00063	0,268	0,096	0,338	71	Low Risk
VAR00064	0,263	0,120	0,351	57	Low Risk
VAR00065	0,310	0,095	0,375	42	Low Risk
VAR00066	0,166	0,073	0,227	126	Low Risk
VAR00067	0,255	0,128	0,350	59	Low Risk
VAR00068	0,209	0,076	0,269	112	Low Risk
VAR00069	0,252	0,123	0,344	63	Low Risk
VAR00070	0,227	0,073	0,283	105	Low Risk
VAR00071	0,370	0,133	0,454	14	Middle Risk
VAR00072	0,315	0,131	0,405	28	Middle Risk
VAR00073	0,252	0,100	0,327	84	Low Risk
VAR00074	0,340	0,121	0,420	23	Middle Risk
VAR00075	0,315	0,121	0,397	29	Low Risk
VAR00076	0,375	0,132	0,458	12	Middle Risk
VAR00077	0,208	0,087	0,277	110	Low Risk
VAR00078	0,200	0,078	0,262	117	Low Risk
VAR00079	0,232	0,095	0,305	98	Low Risk
VAR00080	0,273	0,089	0,338	70	Low Risk
VAR00081	0,284	0,169	0,405	27	Middle Risk
VAR00082	0,257	0,111	0,340	69	Low Risk
VAR00083	0,283	0,100	0,355	55	Low Risk
VAR00084	0,232	0,100	0,309	96	Low Risk
VAR00085	0,304	0,097	0,372	43	Low Risk
VAR00086	0,153	0,078	0,219	129	Low Risk
VAR00087	0,241	0,133	0,342	66	Low Risk
VAR00088	0,236	0,084	0,300	100	Low Risk
VAR00089	0,247	0,136	0,350	60	Low Risk
VAR00090	0,225	0,073	0,282	106	Low Risk

VAR00091	0,361	0,096	0,422	21	Middle Risk
VAR00092	0,340	0,084	0,396	31	Low Risk
VAR00093	0,324	0,108	0,397	30	Low Risk
VAR00094	0,361	0,092	0,420	24	Low Risk
VAR00095	0,361	0,095	0,421	22	Middle Risk
VAR00096	0,355	0,156	0,456	13	Middle Risk
VAR00097	0,136	0,087	0,211	130	Low Risk
VAR00098	0,195	0,084	0,263	115	Low Risk
VAR00099	0,263	0,095	0,333	74	Low Risk
VAR00100	0,294	0,095	0,361	52	Low Risk
VAR00101	0,303	0,212	0,451	15	Middle Risk
VAR00102	0,239	0,137	0,343	65	Low Risk
VAR00103	0,269	0,134	0,367	44	Low Risk
VAR00104	0,264	0,129	0,359	54	Low Risk
VAR00105	0,314	0,101	0,383	39	Low Risk
VAR00106	0,137	0,096	0,220	128	Low Risk
VAR00107	0,206	0,126	0,306	97	Low Risk
VAR00108	0,221	0,099	0,298	101	Low Risk
VAR00109	0,205	0,123	0,303	99	Low Risk
VAR00110	0,205	0,070	0,261	118	Low Risk
VAR00111	0,381	0,133	0,463	9	Middle Risk
VAR00112	0,421	0,108	0,484	6	Middle Risk
VAR00113	0,391	0,112	0,459	10	Low Risk
VAR00114	0,421	0,120	0,491	3	Middle Risk
VAR00115	0,391	0,118	0,463	8	Middle Risk
VAR00116	0,170	0,131	0,279	109	Low Risk
VAR00117	0,239	0,101	0,316	91	Low Risk
VAR00118	0,252	0,118	0,341	67	Low Risk
VAR00119	0,283	0,112	0,364	48	Low Risk
VAR00120	0,304	0,128	0,394	34	Low Risk
VAR00121	0,217	0,128	0,318	90	Low Risk
VAR00122	0,233	0,131	0,334	72	Low Risk
VAR00123	0,217	0,145	0,331	79	Low Risk
VAR00124	0,239	0,134	0,341	68	Low Risk
VAR00125	0,269	0,134	0,367	44	Low Risk
VAR00126	0,243	0,119	0,333	73	Low Risk
VAR00127	0,283	0,092	0,349	61	Low Risk
VAR00128	0,128	0,073	0,192	131	Low Risk
VAR00129	0,221	0,140	0,330	80	Low Risk
VAR00130	0,257	0,087	0,322	85	Low Risk
VAR00131	0,236	0,123	0,330	81	Low Risk
VAR00132	0,220	0,076	0,279	108	Low Risk

Based on the example in the table above, it is obtained that the highest risk rating in the scope of rail road work is a risk variable with the code VAR00007, namely "Coordination with Stakeholders, with a risk level category, namely Middle Risk level. The results of the full risk rating analysis are presented in the following table 12:

Table 12. Final Risk Rating

Scope of Work	Dominant Risk Variable	Risk Value	Risk Category
Rail Work	VAR00007 - Coordination with Stakeholders	0,525	Middle Risk
Railway Bridge Structure Work	VAR00073 - Coordination with Stakeholders	0,606	Middle Risk
Building Work	VAR00081 - Change in Scope of Work / Review Design	0,529	Middle Risk
Operation Facility Work	VAR00026 - Coordination with Stakeholders	0,597	Middle Risk

Based on the results of the analysis presented in table 13, it is obtained that for the scope of work of Rail Work, Railway Bridge Structure Work and Operation Facility Work, the dominant risk variable is "Coordination with Stakeholders". As for Building Work, the dominant risk variable is Change in Scope of Work / Review Design. This is in line with the validation results carried out by experts, where the three experts agreed on the dominant risk variable obtained from quantitative analysis.

Table 13. Expert's Validation

Scope of Work	Dominant Risk Variable	Expert's Validation		
		E1	E2	E3
Rail Work	VAR00007 – Coordination with Stakeholders	Agree	Agree	Agree
Railway Bridge Structure Work	VAR00073 – Coordination with Stakeholders	Agree	Agree	Agree
Building Work	VAR00081 – Change in Scope of Work / Review Design	Agree	Agree	Agree
Operation Facility Work	VAR00026 – Coordination with Stakeholders	Agree	Agree	Agree

6. Conclusion

Study shows that the risk factors "Change in Scope of Work/Review Design" and "Coordination with Stakeholders" are risk factors that are very influential and often occur in Double-Double Track Development Projects (Package A). Both of these risk factors need to be followed up on their handling (against the conditions of the work that is currently running), as well as a preventive action plan for the future, so that what happens in this project can be a lesson for the implementation of subsequent projects.

The results of this study also show that the identification carried out is very relevant to what has happened so far in the Double-Double Track Development Project (Package A). The validation process by experts who are also directly involved (or have been involved) in this project is also very in line with what actually happened, so it can be concluded that the process of identifying risk factors causing delays in the completion schedule of the Double-Double Track Development Project (Package A) through this research went well and in accordance with the conditions of the project.

References

Camileri, E., *Project Success Critical Factors and Behaviours*, Gower Publishing Limited, England, 2011.

Chitkara, K.K., *Construction Project Management: Planning, Scheduling and Controlling*, 3rd Edition, McGraw Hill Education., New Delhi, 2014.

Damnjanovic, Ivan and Reinschmidt, K. *Data Analytics for Engineering and Construction Project Risk Management.* Springer Nature Switzerland AG, Cham, Switzerland, 2020.

Hendradewa, A. P., Schedule Risk Analysis by Different Phases of Construction Project Using CPM-PERT and Monte-Carlo Simulation, *IOP Conference Series: Materials Science and Engineering*, 528(1), 2019.

Kerzner, Harold, *Project Management 12th Edition*, John Wiley & Sons Inc., New Jersey, 2017.

Kumar, Ranjit. (2011). Research Methodology 3rd Edition. London: SAGE Publications Ltd.

Müller, R. and Jugdev, K., Critical Success Factors in Projects: Pinto, Slevin and Prescott – The Elucidation Of Project Success, *International Journal of Managing Projects in Business*, *5*(4), 757–775, 2012.

Project Management Institute, *A Guide to The Project Management Body of Knowledge: PMBOK® Guide*, 6th Edition, Project Management Institute, Inc, Pennsylvania, 2017.

Project Management Institute, *CPM Scheduling for Construction; Best Practices and Guidelines*, Project Management Institute, Inc, Pennsylvania, 2014.

Saaty, Thomas L., *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*, McGraw-Hill Inc, United States of America, 1980.

Saaty, Thomas L. and Vargas, Luis, *Decision Making With The Analytic Network Process: Economic, Political, Social and Technological Application with Benefits, Opportunities,Costs and Risks*, Springer Science + Bussiness Media, LLC, Pitssburgh, PA, USA, 2006.

Siegel, Neil G., *Engineering Project Management*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019.

Singarimbun, Masri and Effendi, Sofian, *Metode Penelitian Survei*, LP3ES, Jakarta, 2006.

Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif dan R&D*, Alfabeta, Bandung, 2016.

Yang, Xiaotian., Yu, Miao. and Zhu, Fangwei. (2020). *Impact of Project Planning on Knowledge Integration in Construction Projects*. 146(7), 1–11.

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