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Project Risk Mitigation in Construction Projects (Case Study of Medan Station Building and Emplacement Development Project Phase II)

Andrew Hardiputra[1], Siska Noviaristanti[2], and Dadan Rahadian[3]
[1,2,3] Telkom University, Economics & Business Faculty, Bandung, Indonesia

Abstract
The success of a construction project can be determined by the achievement of targets in terms of time, cost and quality. The data shows that several construction projects undertaken by Waskita Karya experienced delays in the completion of work and increased costs. Risk mitigation has an important role in project control from the start in order to find out the causes of risk and how to handle them. This study aims to determine the risk mitigation strategy in the Medan Station Building and Emplacement Development Project Phase II. The research phenomenon is explored using a case study method through a qualitative approach. Data collection techniques are interviews and documentation. Construction risk factors include internal, external and project risks. More in-depth studies are limited to project risks, which have a direct impact on time, cost, quality, construction and technology. The results showed that 43 relevant risk factors had been identified. Obtained 11 risk factors with a very high level of risk, including (1) delay in handing over the project to the owner, (2) failure to achieve the productivity plan for the contractor's equipment, (3) delay in land acquisition, (4) delay in finalizing the design, (5) increase in BK/PU, (6) increase in material prices, (7) waste material exceeding plan, (8) potential for extreme weather to hinder project implementation, (9) there are existing utilities, buildings, or other objects that need permits in in terms of demolition in the work area, (10) delays in fulfilling labor and work tools, (11) innovative working methods.

Keywords—Risk; Mitigation; Project; Construction

Abstrak
Keberhasilan suatu proyek konstruksi dapat ditentukan oleh pencapaian target dari segi waktu, biaya dan mutu. Data menunjukkan beberapa proyek konstruksi yang dikerjakan Waskita Karya mengalami keterlambatan penyelesaian pekerjaan dan kenaikan biaya. Mitigasi risiko memiliki peran penting dalam pengendalian proyek sejak awal untuk mengetahui penyebab risiko dan cara penanganannya. Penelitian ini bertujuan untuk mengetahui strategi mitigasi risiko pada Proyek Pembangunan Gedung dan Penempatan Stasiun Medan Tahap II. Fenomena penelitian dieksplorasi dengan menggunakan metode studi kasus melalui pendekatan kualitatif. Teknik pengumpulan data adalah wawancara dan dokumentasi. Faktor risiko konstruksi meliputi risiko internal, eksternal dan proyek. Studi yang lebih mendalam terbatas pada risiko proyek, yang berdampak langsung pada waktu, biaya, kualitas, konstruksi, dan teknologi. Hasil penelitian menunjukkan bahwa 43 faktor risiko yang relevan telah diidentifikasi. Didapatkan 11 faktor risiko dengan tingkat risiko sangat tinggi antara lain (1) keterlambatan serah terima proyek ke owner, (2) tidak tercapainya rencana produktifitas alat milik kontraktor, (3) keterlambatan pembebasan lahan, (4) keterlambatan finalisasi desain, (5) kenaikan BK/PU, (6) kenaikan harga material, (7) waste material melebihi rencana, (8) potensi cuaca ekstrem yang menghambat pelaksanaan proyek, (9) terdapat utilitas eksisting, bangunan, atau objek lainnya yang perlu perizinan dalam hal pembongkaran pada area kerja. (10) keterlambatan pemenuhan tenaga kerja dan alat kerja, (11) dilakukannya inovasi metode kerja.

Kata kunci— Risiko; Mitigasi; Proyek; Konstruksi

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Corresponding_andrewhardiputra@student.telkomuniversity.ac.id
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I. INTRODUCTION

Changes in internal and external environmental conditions have an impact on uncertainty that can be detrimental to the company's business. In dealing with this, Waskita Karya has implemented risk management in business lines since 2004. Risk management has been implemented in all business lines to form an Enterprise Risk Management System. Risk management policies and procedures within the company have been updated to suit the needs of stakeholders. As a company that is always moving dynamically, Waskita Karya is always adaptive in adjusting to changes in the existing environment. The company designs a risk management system to handle and manage risk. Risk management is integrated with the process of formulating and implementing strategies to create, maintain and realize values. In practice, the scope of risk management applies to all business processes, from the corporate level to the project level. (Waskita, 2021)

Development in Indonesia has experienced significant development, especially in the construction industry. With so many infrastructure developments in Indonesia, it has a good impact on the pace of the nation's economy. To complete project development, an excellent project management is required, supported by competent human resources, the use of sophisticated equipment/technology and adequate financial capabilities. A project is said to be successful if it reaches 3 targets, namely time, cost and quality (Nurlela & Suprapto, 2014). Construction services are an industry with a high level of risk (Rehacek, 2017). The phenomenon that still occurs in the implementation of construction projects in the Waskita Karya environment is the completion of work that is not according to plan. There are still some projects that experience work delays which result in late fines being imposed, which affects cost increases, increased time which results in longer resource usage causing project costs to swell (over budget). The risk of delay causes an increase in costs and time (Rehacek, 2017).

Table 1. Project Progress Evaluation Data

Project	Plan Progress	Actual Progress	Deviation
Kampus UIII Tahap 1	100%	100%	-
Apartemen Soltera	86,788%	77,091%	-9,697%
UIN Jambi	85,540%	85,543%	0,003%
Kejati Palu	94,539%	93,413%	-1,126%
Terowongan Istiqlal	100%	100%	-
Twin Tower Makasar	24,407%	9,272%	-15,135%
Apron Lombok	100%	100%	-
RSUD Covid Sulbar	100%	100%	-
Kantor OJK Maluku	33,462%	31,531%	-1,931%
Masjid Raya Baiturahman	44,267%	46,130%	1,863%

Source: Company Report December 2021

Table 1 shows a list of project names implemented by Waskita Karya in 2021. Explain the plan progress, the actual progress, and the deviation between the plan progress and actual progress of each project can be seen. Based on these data, there are still 4 projects that have experienced delays out of a total of 10 projects

Table 2. Project Cost Evaluation Data

Project	Plan Cost	Actual Cost	Deviation
Kampus UIII Tahap 1	90,95%	88,89%	2,06%
Apartemen Soltera	88,45%	88,45%	-
UIN Jambi	98,92%	97,16%	1,76%
Kejati Palu	91,40%	82,91%	8,49%
Terowongan Istiqlal	88,99%	89,00%	-0,01%
Twin Tower Makasar	89,00%	93,18%	-4,18%
Apron Lombok	89,93%	89,93%	-
RSUD Covid Sulbar	88,56%	85,99%	2,57%
Kantor OJK Maluku	91,00%	91,00%	-
Masjid Raya Baiturahman	93,00%	92,67%	0,33%

Source: Company Report December 2021

Table 2 shows the Waskita Karya project cost evaluation data for 2021. Explain the plan cost, actual cost, and the deviation between the plan cost and actual cost of each project. Based on these data, there are still 2 projects that experienced cost increases out of a total of 10 projects.

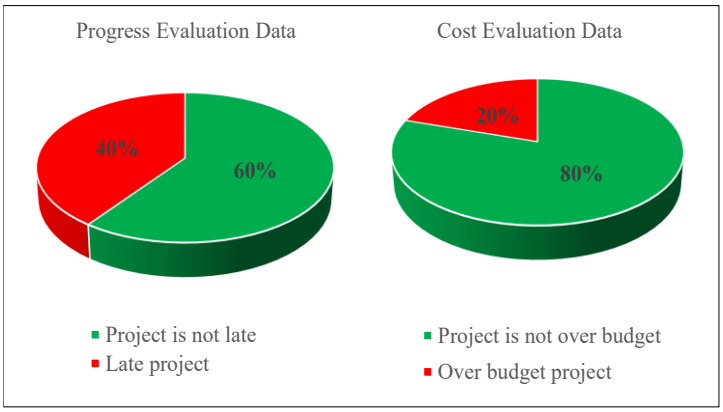

Fig. 1. Project Evaluation Data December 2021

Figure 1 shows the overall project evaluation data for December 2021. Explain the total of 10 projects, the percentage of projects that were late was 40.00%, and projects that were not late were 60%. While the percentage of projects that experienced an increase in over-budget costs was 20.00% and projects that were not over-budgeted were 80%. So based on the project evaluation data it can be concluded that the condition of these projects is that there are delays in the completion of work and increases in over-budget costs.

Research conducted by Serpella et al. (2014) states that an important element in project control measures is to always carry out risk mitigation strategies for projects from the start and obtain the expected mitigation, managerial implications are needed for each mitigation so that the causes of risks that occur can be reduced or even completely eliminated. On this basis, the current research proposes to carry out Project Risk Mitigation in Construction Projects (Case Study of Medan Station Building and Emplacement Development Project Phase II). Waskita Karya will start working on this new project in April 2022.

The originality of the research lies in the difference with previous research, namely the operationalization of variables in the number of risks presented based on the company's internal risk catalog for 2022. The list of risks was found based on the company's experience as a construction specialist company. The research contribution provides ideas for service users and service providers in the form of implementing risk mitigation in the case of a construction project so that it can be useful and become a reference for future projects. The research objectives include finding project risk factors, project risk matrices, and decision-making actions for project risk mitigation strategies.

II. Literature Review

Project management is the application of project activity knowledge, skills, tools and techniques to meet project requirements (Project Management Institute, 2021). Project management functions include planning, organizing, actuating, controlling (Dimyati & Nurjaman, 2014). Effective project management is required to achieve project requirements. One of the knowledge for effective project management is Optimizing risk response to opportunities and threats (Project Management Institute, 2021). Risk management is an integral part of the project planning process. Systematic steps for dealing with and minimizing or avoiding the occurrence of a risk consist of risk identification, risk assessment, risk acceptance, risk mitigation, and risk ownership allocation (Jaya, 2019). One part of risk management activities is through risk mitigation. Risk mitigation is a method used to eliminate or reduce identified risks (Yuliana, 2017), although not all consequences of risk can be eliminated (Norken et al., 2019). A risk mitigation measure is a response to risks that occur, including risk avoidance, which is refusing to accept the risk that occurs or refusing to accept the project, risk transfer, which is an activity carried out in order to transfer risk to another party, risk reduction, which is an activity to reduce current risks and reduce the possibility of losses or other negative effects, risk retention is an activity to choose to accept current risks and manage them to reduce their negative impact on the company (Nasrul, 2015).

Risk mitigation planning is the process of identifying, assessing and managing risks. Risk identification, which is the process of finding risk prospects that may impact business objectives and operations. Risk assessment carried out to identify and assess the potential risks that occur and their impact on the project or activity being carried out. The development of a risk mitigation strategy is an action plan to reduce or eliminate the possibility of a risk occurring based on the findings of a risk assessment that has been carried out, enabling decision makers to choose the most appropriate and efficient mitigation method. Matters related to operational activities must be carried out by operational managers to achieve maximum mitigation results (Hendayani et al., 2021). The

implementation of the risk mitigation strategy plan requires good cooperation of all personnel involved in the project. During the life of the project, periodic monitoring and evaluation should be carried out. to ensure that risks are kept under control and that mitigation strategies can effectively reduce or eliminate risks. The definition of risk can be interpreted as how actions, events, or activities have the potential to negatively impact project plans, quality, performance, schedules, or costs (Putri, 2015). Understanding project risk means being aware of the potential problems that can arise and how they can hinder the success of the project.

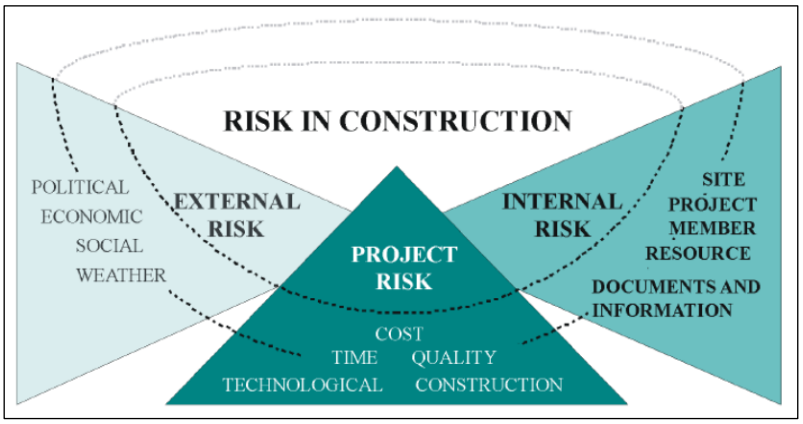

Fig. 2. Risk In Construction (Zavadskas et al., 2010)

Figure 2 shows risks in construction that can be explained, including internal, external and project risks. Internal risk is a risk that comes from within the company. External Risk is the risk posed by the environment outside the company. Project risk is everything that has an influence on the project timeline, performance and budget. These three risks in this study as variables. Each variable has sub-variables which can be shown in Table 3.

Table 3. Construction Risk Allocation Structure

Variable	Sub Variable
External Risk	Political, Economic, Social, Weather Conditions
Project Risk	Time Risk, Cost Risk, Quality Risk, Construction Risk, Technology Risk
Internal Risk	Resource Risk, Project Team Risk, Stakeholder's Risk, Planning Risk, Contractor Risk, Subcontractor Risk, Supplier Risk, Work Team Risk, Field Implementation Risk, Information and Document Risk

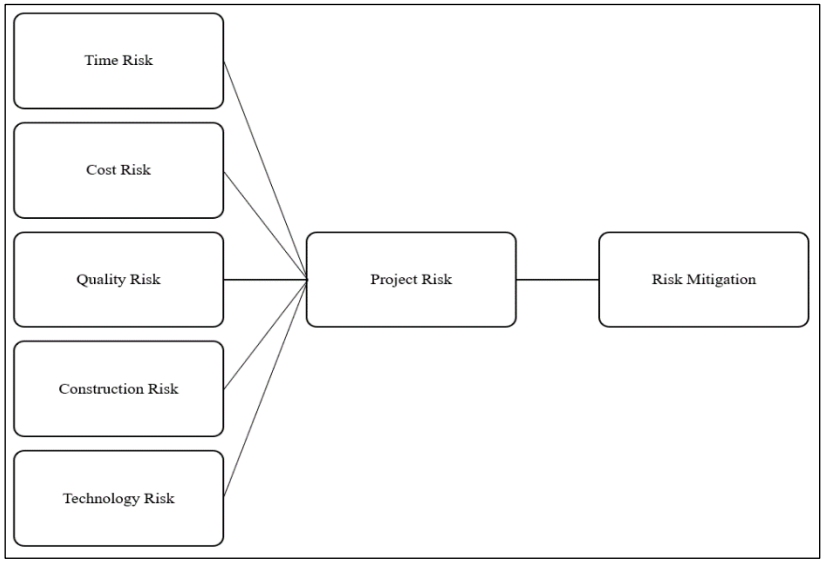

Fig. 3. Framework

Figure 3 shows the framework that explains the limitations in the research scope. Focus on project risk which consists of time risk, cost risk, quality risk, construction risk, and technology risk. From the list of risks a project case study measurement will be carried out, which will then be obtained a list of risks with their level of risk. Risks that have been identified will be taken to deal with risks with a risk mitigation strategy plan (Norken et al., 2019).

The matrix used in risk assessment where the level of risk is determined by calculating the probability and impact of each detected risk using risk assessment criteria. These risks are then mapped on a risk map to assess the location and level of risk after the risk value is determined. There are 4 criteria for the value of the impact and the possible value, including small with a value of 1, moderate with a value of 2, large with a value of 3, very large with a value of 4.

The negative impact value (threat) is the loss that arises due to the occurrence of a negative risk event. The value of the negative impact that is owned by a risk can be different according to the type of negative impact generated. Positive impact values (opportunities) are opportunities that have an impact in improving performance, encouraging innovation, and supporting the achievement of goals that arise due to the occurrence of a positive risk event. The value of the positive impact that is owned by a risk can differ according to the type of positive impact generated. Probability value is the degree of likelihood and/or frequency of a risk event occurring. The value of the probability of occurrence of a risk can be measured in the form of probability. Risk aggregation is a risk assessment based on risks identified at the project level as the main risks of the organization. The risk aggregation method is carried out by selecting those with the highest level of risk.

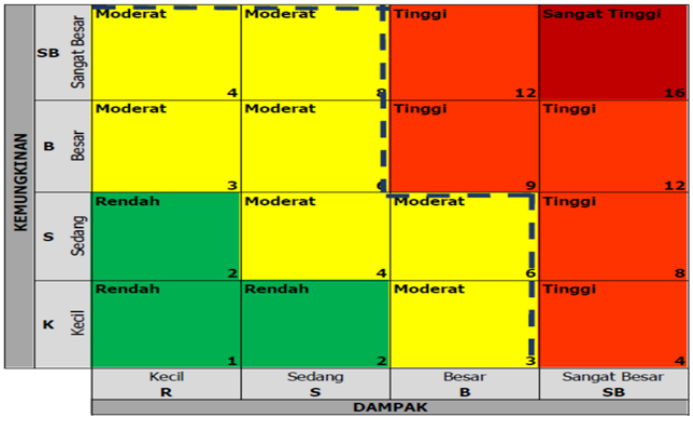

Fig. 4. Threat Map

Figure 4 shows the threat map is a graph consisting of 2 (two) axes with a 4x4 scale which shows the relationship between negative impacts and the possibility of a risk occurring. The risk map is used to map risks that have been determined by the value of the impact and the value of the possibility of occurrence. The negative impact value is shown on the x-axis (axis) on the risk map, the value of the possibility of a risk occurring is shown on the y-axis (ordinate).

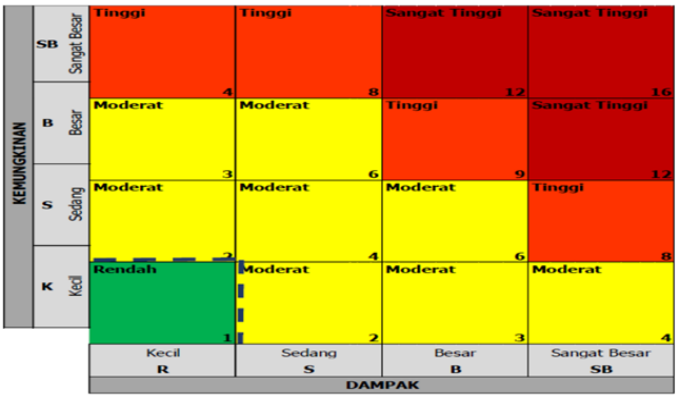

Fig. 5. Opportunity Map

Figure 5 shows the opportunity map is a graph consisting of 2 (two) axes with a 4x4 scale which shows the relationship between positive impacts and the possibility of a risk occurring. The risk map is used to map risks that have been determined by the value of the impact and the value of the possibility of occurrence. The positive impact value is shown on the x-axis (axis) on the risk map, the value of the possibility of a risk occurring is shown on the y-axis (ordinate).

III. RESEARCH METHODOLOGY

This study uses a qualitative approach. The unit of analysis in research is a project. The research location is in the city of Medan. The time of the research starts in July 2022 until September 2022. The population of this research includes Project Managers, Site Operational Managers, Site Contract Administration & Risk Managers, Site Engineering & Standardization Managers, Site QHSE Managers. Qualitative research samples are referred to as informants, amounting to 10 people. This study uses a non-probability sampling method with the criteria of informants including direct personnel involved in the Medan Station Building and Emplacement Development Project Phase II who have held important positions at the manager level, a minimum of 5 years work experience, and a minimum undergraduate education level. The role of informants at the managerial level in the project is considered to have leadership skills and can make decisions and policies in the project.

Data analysis techniques carried out included (1) risk identification, through interviews with informants according to the interview guidelines for the list of risks in Table 4. From this activity it can be obtained which risk factors are relevant to the project. (2) risk assessment, where the level of risk is determined by calculating the probability and impact of each risk. To get the value of the possibility and the value of the impact obtained through interviews with informants. (3) risk aggregation is carried out by choosing the one with the highest level of risk if there is a similarity in the risk list chosen by the informants. (4) risk matrix by mapping the risks obtained from the risk aggregation results. (5) risk mitigation based on risks that have been identified which are classified as very high risks through interviews with informants.

Table 4. Risk List

Type Of Risk	Risk List	Code Number
Time Risk	Unfinished work before	1
	Termination of project work by the project owner	2
	The work handover administrative document is incomplete	3
	Delay in delivery of equipment	4
	Delay in Handover of Project to Owner	5
	Delay in the arrival of materials	6
	Delays in the preparation/approval of the RAB	7
	Delay in payment of retention receivables	8
	Subcontractor productivity is not optimal	9
	Failure to achieve the productivity plan for the contractor's equipment	10
	Delay in material fulfillment	11
	Delay in land acquisition	12
	Delay in finalizing the design	13
	Delays in the flow of determining work methods	14
	Acceleration of land acquisition +	15
	Work progress increased beyond target +	16
	Subcontract productivity optimization +	17
	Acceleration of project completion +	18
	More efficient working methods +	19
Cost Risk	PMN absorption did not go according to plan	20
	Dollar Exchange Rate Difference +	21
	Current liquidity +	22
	WIP's acknowledgment exceeds the Company's tolerance	23
	Imposition of fines by the project owner	24
	BK/PU increase	25
	Realization of cash flow is not according to plan	26
	Late payment term	27
	Negative initial cashflow	28
	The amount of VAT in the Dashboard does not sufficiently cover the output VAT realization	29

	Recognized and obtained claims to Owner +	30
	There is a correction of business income by external audit	31
	WIP late to Receivable	32
	Jobs with BKPU < MAPP cannot be absorbed	33
	Reduction of Project Operating Income	34
Type Of Risk	Risk List	Code Number
	The price of the work item has not been approved by the owner	35
	DIPA reduction/restructuring	36
	Overhead cost over budget in APP	37
	The WIP acknowledgment file is incomplete or late	38
	Accounts receivable billing files are late or incomplete	39
	Input VAT is non-refundable	40
	Increase in prices of main subcontractors & foremen	41
	Increase in material prices	42
	Waste material exceeds the plan	43
	Error in calculating the volume and unit price of work	44
	Loss of material and equipment fuel	45
	Business income is not recognized by the owner	46
	Over budget project implementation budget	47
	WIP is recognized into accounts receivable faster +	48
	Payment of receivables before maturity +	49
	Efficiency of use of heavy equipment +	50
	Prices for materials, services and equipment are below MAPP prices +	51
	He admitted that the owner claimed an escalation +	52
	Claims for idle labour, plant and equipment were obtained +	53
	Differences in the method of recognizing work progress between the owner and the contractor	54
Quality Risk	There is a defect in the quality of work	55
	There is a defect list that has not been accommodated	56
	Tool calibration error	57
	Non-conformity of work specifications in accordance with the RKS	58
	Non-conformance of material specifications in accordance with the RKS	59
	Damage to the quality of material stock	60
	Report record discrepancies	61
	Damaged materials	62
	Error checking the quality of the work	63
Construction Risk	Working without legality (contractual, permits, etc.)	64
	Delays in the flow of design completion	65
	Self-management productivity is not achieved	66
	Miscommunication on the interaction between internal / external parts	67
	The occurrence of force majeure	68
	The potential for extreme weather that hinders project implementation	69
	There was a war that hindered the completion of the project	70
	There was a political crisis that hindered the completion of the project	71
	There is no proper access road to the project site	72
	The commissioning test potential cannot be carried out according to schedule	73
	There are existing utilities, buildings or other objects that require permits in terms of demolition in the work area	74
	Errors or delays in the preparation of backup quantity and backup quality	75
Technology Risk	Shortage of workers	76
	Delays in the fulfillment of labor and work tools	77
	Innovated work methods +	78
	Improvements made can be implemented optimally in the field +	79

Table 4 shows a list of risks that have been grouped for each type of risk. In the previous explanation it was explained that there are positive risks and negative risks. The positive risk is marked + while the negative risk is not marked. The list of available risks comes from the risk catalog of Waskita Karya in 2022. This list is used as material for interviews with informants as primary data. Researchers use the results of interviews with informants to answer research problems.

IV. RESULT / FINDING

Based on the results of interviews with 10 informants, from a total of 79 risks, the informants selected the list of risks presented so that 43 relevant (selected) risks were identified as can be seen in Table 5, while risks that were not selected were considered irrelevant risks. In Figure 6 shows the percentage of risk acceptance level of the total number of risks obtained 54% relevant risk list and 46% relevant risk list irrelevant. The percentage of relevant risks is greater than irrelevant risks, indicating that the list of risks from the risk catalog meets the requirements for the category of risk types in this study.

Table 5. Risk Identification Results

Type Of Risk	Risk Register Code Number
Time Risk	1,3,4,5,6,9,10,11,12,13,14,15
Cost Risk	24,25,26,27,28,30,34,35,37,42,43,44,55,57,58,59,60,61,62,63
Construction Risk	64,65,67,69,71,72,74
Technology Risk	76,77,78,79

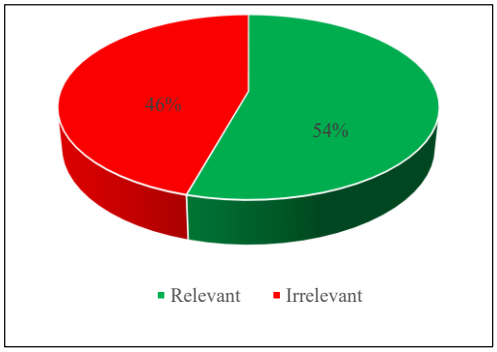

Fig. 6. Percentage of Risk Acceptance Rate

After knowing the list of relevant risks, then a risk assessment is carried out where the level of risk is determined by calculating the probability and impact of each risk. To get the value of the possibility and the value of the impact obtained through interviews with informants. In the previous explanation, there are 4 levels of criteria for the impact value and the likelihood value, including small 1, medium 2, large 3, and very large 4. The results of the risk aggregation assessment are carried out by choosing the one with the highest level of risk if there is a similarity in the list of risks selected by the informants. can be seen in Table 6.

Table 6 Risk Aggregation Assessment Results

Type Of Risk	Risk Register Code Number	Likelihood Value (A)	Impact Value (B)	Risk Level Value (C=AxB)	Risk Classification
Time Risk	1	3	4	12	High
	3	3	3	9	High
	4	2	3	6	Moderat
	5	4	4	16	Very High
	6	2	3	6	Moderat
	9	3	3	9	High
	10	4	4	16	Very High
	11	1	1	1	Low
	12	4	4	16	Very High
	13	4	4	16	Very High
	14	2	2	4	Moderat
	15	2	4	8	High

Cost Risk	24	2	2	4	Moderat
	25	4	4	16	Very High
	26	3	3	9	High
	27	1	1	1	Low
	28	2	2	4	Moderat
	30	3	3	9	High
Type Of Risk	Risk Register Code Number	Likelihood Value (A)	Impact Value (B)	Risk Level Value (C=AxB)	Risk Classification
	34	2	3	6	Moderat
	35	2	3	6	Moderat
	37	4	3	12	High
	42	4	4	16	Very High
	43	4	4	16	Very High
	44	2	4	8	High
Quality Risk	55	3	3	9	High
	57	1	3	3	Moderat
	58	1	3	3	Moderat
	59	3	4	12	High
	60	3	3	9	High
	61	2	2	4	Moderat
	62	3	3	9	High
	63	3	4	12	High
Construction Risk	64	3	4	12	High
	65	3	4	12	High
	67	3	4	12	High
	69	4	4	16	Very High
	71	2	3	6	Moderat
	72	3	3	9	High
	74	4	4	16	Very High
Technology Risk	76	3	4	12	High
	77	4	4	16	Very High
	78	4	4	16	Very High
	79	3	3	9	High

From the results of the risk aggregation assessment obtained, it is plotted into a threat map and opportunity map which can be seen in Figure 7 and Figure 8. The risk map is used to map risks that have been determined by the value of the impact and the value of the likelihood of occurrence. The value of the impact is shown on the x-axis (axis), the value of the probability of occurrence of the risk is shown on the y-axis (ordinate).

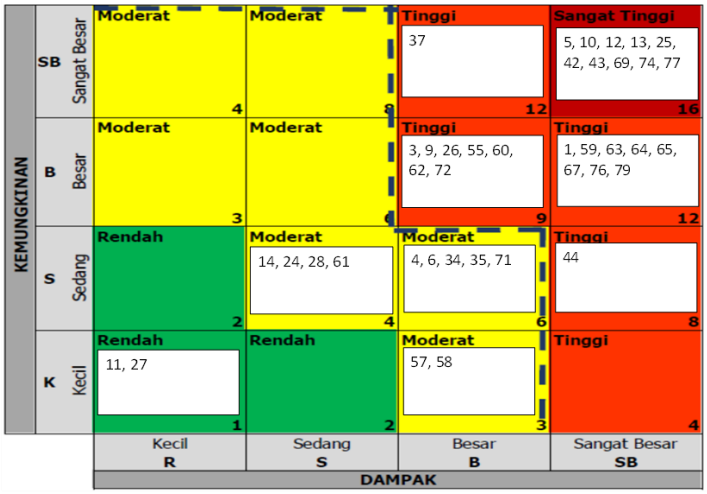

Fig. 7. Threat Map Results

In Figure 7 the threat map results show 5 risk level categories including Low Risk, occurring at risk list code numbers 11, 27. Moderate Risk, occurring at risk list code numbers 4, 6, 14, 24, 28, 34, 35, 57, 58, 61, 71. High Risk, occurs in risk list code numbers 1, 3, 9, 26, 37, 44, 55, 59, 60, 62, 63, 64, 65, 67, 72, 76. Very High Risk, occurs at risk list code numbers 5, 10, 12, 13, 25, 42, 43, 69, 74, 77.

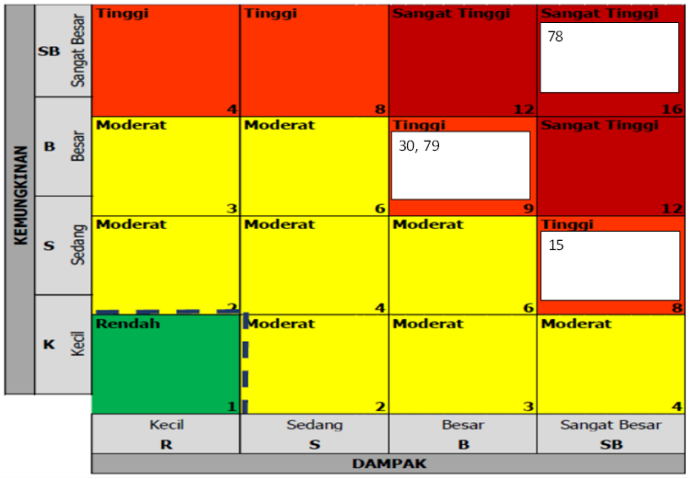

Fig. 8. Opportunity Map Results

In Figure 8 the results of the opportunity map show 2 risk level categories including High Risk, occurs at risk list code numbers 15, 30, 79. Very High Risk, occurs at risk list code number 78.

Based on the results of the risk map, the position of the risk location is obtained based on the level of risk. There are 11 risk factors that are classified as very high, 19 risk factors that are classified as high, 11 risk factors that are classified as moderate, and 2 risk factors that are classified as low. The percentage of risk levels in Figure 9 includes very high risk of 25%, high risk of 44%, moderate risk of 26%, and low risk of 5%. The risks being evaluated are those that are classified as very high risks, because they are a top priority and are critical and have the potential to greatly affect project implementation.

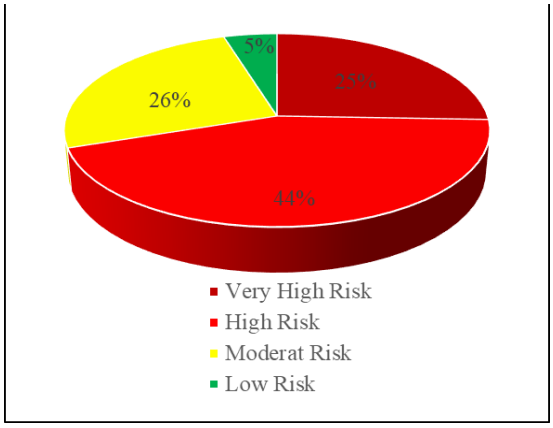

Fig. 9. Percentage of Risk Level Results

V. Discussion

Risks with a very high level of risk need special handling, because these risks are a top priority and are critical and have the potential to have a significant impact on project implementation. Based on the research results, the risks with the highest very high level of risk are those originating from time risk, cost risk, construction risk, and technology risk, as can be seen in Table 7 which will further explain the causes of risk and risk mitigation strategy actions in Table 8.

Table 7. The Results Of The Risk List With a Very High Risk Level

Type Of Risk	Risk Register Code Number
Time Risk	5,10,12,13
Cost Risk	25,42,43
Construction Risk	69,74
Technology Risk	77,78

Table 8. The Results Of The Risk List With a Very High Risk Level

Type Of Risk	Risk Register Code Number	Risk Cause	Risk Mitigation
Time Risk	5	There is a delay in work for 4 months from May 2022 to August 2022.	Acceleration of work, among others, by optimizing work methods and immediately bringing in materials.
	10	Access to the work area is limited so that the space for the tools to move is not optimal.	Selection of work methods that are in accordance with the condition of the railroad tracks that are still active.
	12	There is a delay in the minutes of land handover from the Assignment Giver to the Service Provider (Contractor), so that work is delayed.	Accelerating work progress and anticipating field conditions with optimal work methods.
	13	Collecting data on previous work requires time and there is a design review process in advance.	Conduct intensive coordination with related parties in previous work.
Cost Risk	25	Project personnel have been in the project since the beginning, although land handover has not yet taken place.	Hire planning consultants to conduct design reviews and determine efficient work methods.
	42	Inflation occurs every year, causing an increase in material prices in the market.	Accelerating the procurement of spending on the main materials used in projects such as concrete and cement.
	43	Setting the placement of material positions at project locations that are not quite right.	Carry out procedures for handling and placing materials properly and correctly.
Construction Risk	69	Natural events that occur during project implementation.	Optimizing work during good weather conditions and increasing working hours (overtime).
	74	The project location is inside a train station that is still active and operating so that there are existing utilities, buildings or other objects.	Coordinate and check together with KAI before starting work in the field. Design adjustments in accordance with existing conditions.
Technology Risk	77	There is a dependence on labor and work tools from a third party (Wika Beton) in the box girder installation work.	Coordinate with Service Providers on other projects to accelerate work.
	78	There are project personnel who are experienced in working on railroad projects for track line work.	Application of innovative work methods to the suitability of work in the field to achieve success.

VI. CONCLUSION AND RECOMMENDATION

The results showed that 43 relevant risk factors had been identified. Obtained 11 risk factors with a very high level of risk, including (1) delay in handing over the project to the owner, (2) failure to achieve the productivity plan for the contractor's equipment, (3) delay in land acquisition, (4) delay in finalizing the design, (5) increase in BK/PU, (6) increase in material prices, (7) waste material exceeding plan, (8) potential for extreme weather to hinder project implementation, (9) there are existing utilities, buildings, or other objects that need permits in in terms of demolition in the work area, (10) delays in fulfilling labor and work tools, (11) innovative working methods. Risk mitigation measures taken against a very high level of risk that has the potential to have a significant impact on project implementation in the Medan Station Building and Emplacement Development Project Phase II are expected to prevent or minimize these risks. Project risk mitigation is very important to do to increase the opportunities for positive risks and minimize the opportunities for negative or detrimental risks for the project. If implemented effectively, it can achieve company goals and success in terms of cost, quality, and time.

It is hoped that this research report can provide advice to service users and service providers on how to reduce the risk factors that cause construction failures and be able to complete projects on time, within budget, and with quality results. In accordance with the early stages of the work that the initial risk that arises in the Medan Station Building and Emplacement Development Project Phase II is the occurrence of delays in the handover of land from the owner to the contractor, so that it has an impact on the process of the next stage, the consequence is that the service provider must pay close attention to the contract clauses with the owner who relating to the issuance of Work Commencement Letters and land acquisition, including clauses relating to the impact of costs and

completion time on the whole. The existence of this delay can be used as a cost and time demand for service providers. This research study is only limited to risk analysis during the work preparation stage (pre-construction), so the suggestion for this research is to continue the risk analysis during the construction and post-construction periods.

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