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Research Paper

Effect of Implementation of Performance Risk Management on High Rise Building Structure Work (Junction City Building)

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ABSTRACT

There are risks in every construction project, uncontrolled risks will become a problem and cause losses to the project due to cost overruns and delays in work execution. Therefore, to manage risk, it is necessary to carry out risk management so that the project can survive, or perhaps optimize risk. The purpose of this study was to determine the dominant risk factors, how big the level of risk that occurred and the response given to the dominant risks of cost and time performance in the structural work of the Grand Jati Junction Apartment Development project. From the results of this study, it was found that 8 factors became the dominant risk factors with varying (different) levels depending on the complexity of the work and the conditions at the time of implementation of each stage of the work. Then from the results of the risk factor analysis, a risk response is obtained in the form of preventive measures to prevent or minimize these risks.

Keywords: Risk Management, Building Structure Work.

INTRODUCTION

A construction project is a series of activities that are carried out only once and are generally short-term. A project is a temporary endeavour undertaken to create a unique product, service or result, while the nature of the project indicates that the project has a definite beginning and end (Fewings & Henjewele, 2019). The word "Construction" can be defined as the arrangement/arrangement of the elements of a building in which the position of each part is according to its function (Ke et al., 2023). In this series of activities, there is a process that processes project resources into an activity result in the form of a building.

Every construction project has risks. The need for good risk management is very important because any treatment given to an activity that aims to reduce risk or maintain risk for the achievement of a target can have an impact on the emergence of other risks. Uncontrolled risks will become a problem and cause losses to the project as a result of cost overruns and delays in work implementation (Obondi, 2022).

Risk management aims to manage risk so that the project can survive, or perhaps optimize risk. Thus, through risk management, the appropriate method will be known to avoid/reduce the amount of loss suffered due to risk. Directly good risk management can avoid as much as possible the costs that must be incurred due to the occurrence of an adverse event and support increased business profits. The construction process on this project usually takes quite a long time and is complex, causing delays in work which will eventually lead to various risks (Zhao, 2023). This also happened to the Grand Jati Junction Apartment project, where the project is located in the city of Medan. The Grand Jati Junction Apartment Development Project consists of three towers. The total building area of this project is 168,934 m². The large work weight and high structure cause many risks that occur in this project.

Structural work is divided into two types based on its location on the ground, namely the substructure and the upper structure (Wang et al., 2022). Substructure work is a vital construction work related to its function as a support for the entire load of the building and transmitting the load of the building to the ground below. If the implementation of the substructure work is not well managed, there is a high risk of missing the project target, in terms of cost, quality, and time due to the complexity of the construction implementation (Shi et al., 2023).
Superstructure work is activity that is mostly repetitive work. In general, multi-storey buildings have several forms of superstructures, namely podiums and towers. The thing to note is the pattern of movement of work including the material. The higher the building structure to be built, the higher the risks that may occur due to the greater work weight. As a complex structural work, the design and construction implementation need to be carried out by taking into account many things so that the objectives of the structural work from the aspect of cost and time are achieved (Mokashi-Punekar et al., 2020). One of the things that is done to ensure the achievement of these targets is to manage the risks that may occur in structural work. The benefit of this study is to find out how much the level of risk that occurs against costs and time in the structural work of the project and the dominant risk response to the structural work of the junction city project.

MATERIALS & METHODS

The structural work of the Grand Jati Junction Medan Apartment development project uses descriptive analysis which identifies risk factors for cost and time and uses two types of variables, namely dependent variables and independent variables (Institute, 2021). The dependent variable is the impact on costs and time on the building structure work (Y) and the independent variable is the events that allow the occurrence of risks to the building structure work (X). Variables that depend on other variables are called independent variables which can be seen in Table 1.

Table 1. Independent Variables.

Scale	Explanation	Explanation
1	Very rarely	Rarely Happens, only in certain conditions
2	Seldom	Sometimes it occurs under certain conditions
3	Currently	Occurs under certain conditions
4	Often	Often occurs under certain conditions
5	Very often	Always happens in every condition

Project management is carried out through the application and integration of the stages of the project management process initiating, planning, executing, monitoring, and controlling and finally closing the entire project process (Armenia et al., 2019). In its implementation, each project is always limited by constraints that are mutually influencing and commonly referred to as the triangular project constraint, namely the scope of work (scope), time and cost. Where the balance of the three constraints will determine the quality of a project. Changes in one or more of these factors will affect at least one other factor. Meanwhile, risk is a combination of the probability of an event and the consequences of that event, without ruling out the possibility that there is more than one consequence for an event, and consequences can be positive or negative, while in the context of a project, risk is a condition that not sure. A risk has a cause and if it happens, there will be consequences. Every activity is inseparable from the existence of risks, so that risks that have been identified must be made into a good plan, if necessary, a system is created to be able to reduce failures to a minimum to an acceptable limit. The risk management process according to ISO (Akkiyat & Souissi, 2019) consists of three main processes, namely:

1. Establish the context
2. Risk assessment. Risk assessment consists of:
   a. Identification of risks (risk identification): identify any risks that can affect the achievement of organizational goals.
   b. Risk analysis (risk analysis): analyzing the likelihood and impact of the risks that have been identified.
   c. Risk evaluation: comparing the results of the risk analysis with the risk criteria to determine how the risk treatment will be applied.
3. Risk treatment.

The instruments used were interviews and questionnaires. Interviews were conducted to provide comments and input on this research. From the interviews conducted, input and comments were obtained for the variables of this study (factors that allow for risk) so that there were several variables that experienced reduction or reduced to become one new variable. Questionnaires were conducted to obtain the data needed in this study. The questionnaire was carried out in two stages, namely the first stage was carried out to find out the respondents' perceptions of the value of frequency, the impact on costs and the impact on time for each of the factors that allow the occurrence of risks in building structure work. After the first stage of the questionnaire was completed and then analyzed, the dominant risks that occur in building structure work will be obtained. The second stage of the questionnaire was carried out to provide responses to what could be done related. The scale used in the preparation of the questionnaire is ordinal. The scale and size used can be seen in Table 2.

Table 2. Scale of Likelihood or Frequency

Scale	Explanation	Explanation
1	Very rarely	Rarely Happens, only in certain conditions
2	Seldom	Sometimes it occurs under certain conditions
3	Currently	Occurs under certain conditions
4	Often	Often occurs under certain conditions
5	Very often	Always happens in every condition

RESULT

The projects reviewed in writing use qualitative data types. Qualitative data is numerical data in the true sense, it cannot be treated the same as quantitative. Qualitative data (nominal and ordinal) usually use non-parametric statistics (Lubis et al., 2021). So, the analytical method used in this study is as follows:

Descriptive Analysis
1. Normality Test
2. Non-Parametric Analysis
3. AHP (Analytical Hierarchy Process)
4. Risk Analysis

Descriptive Analysis and Normality

This analysis has the function of presenting the characteristics of a data from a particular sample so that researchers can get a quick overview and summary of the data that has been obtained.

Validity test

The validity and reliability tests aim to test the data collection instrument. Valid means that the instrument can be used to measure what should be measured. The measuring tool in testing the validity of a questionnaire is the number resulting from the correlation between the statement score and the overall score of the respondent's statements on the information in the questionnaire.

The instrument is said to be reliable if the instrument is used to measure the same object and will produce the same data. The reliability test is used to determine the consistency of the measuring instrument, whether the measuring instrument used is reliable and remains consistent if the measurement is repeated.

Analytical Hierarchy Process (AHP)

This method is used to make complex decisions in which there are dependencies and influences (feedback) which are analyzed for benefits, opportunities, costs and risks. In this study AHP is used to see the level of influence and the frequency of occurrence of project risks in building structure work. Broadly speaking, there are four stages of AHP in prioritization as explained in the sub-chapter above, namely: decomposition of the problem, assessment to compare the decomposed elements using pairwise comparison, calculation of element weights using Eigen Vector and test the consistency of the hierarchy.

Risk Analysis

From the data obtained then analyzed to determine the level of risk at each stage of the building structure work. The risk level group is divided into four levels, namely high (H), significant (S), medium (M) and low (L). Determination of this risk level is determined based on two criteria, namely the frequency (probability) and the impact of the incident (impact).

DISCUSSION

The results obtained by means of several analyzes as a support to produce accurate data, namely by using several tests both on a sample basis and also correspondence for several supporting variables. Descriptive and normality analysis presents certain characteristics of a particular sample. This analysis allows the researcher to get a quick and concise overview of the data obtained using the SPSS software while the Normality analysis is by presenting 26 samples for each variable, using the SPSS software. The normality test output explains the test results whether a data distribution can be said to be normal or not (Lubis, 2021). Guidelines for decision making, namely:

a. Sig. Value or significance or probability value < 0.05, then the distribution is not normal (asymmetric).
b. Sig. Value or significance or probability value > 0.05, then the distribution is normal (symmetric).

Normality Test

Normality Test of Frequency

Table 3. Normality Test Results for Frequency Assessment

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.645	1.341	1.282	1.622	1.389	1.440	1.309	1.272	1.283	1.585
Asymp. Sig. (2-tailed)	.009	.055	.075	.010	.042	.032	.065	.079	.074	.013
	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.601	1.373	1.177	1.665	1.250	1.491	1.767	1.341	1.155	1.490
Asymp. Sig. (2-tailed)	.012	.046	.125	.008	.088	.023	.004	.055	.139	.024
	X21	X22	X23	X24	X25	X26	X27	X28	X29	X30
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.733	1.404	1.563	1.359	1.640	1.325	1.569	1.568	1.404	1.188
Asymp. Sig. (2-tailed)	.005	.039	.015	.050	.009	.060	.015	.015	.039	.119
	X31	X32	X33	X34	X35	X36	X37	X38	X39	X40
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.388	1.580	1.534	1.561	1.769	1.341	1.285	1.427	1.155	1.587
Asymp. Sig. (2-tailed)	.042	.014	.018	.015	.004	.055	.073	.034	.139	.013
	X41	X42	X43	X44	X45	X46	X47	X48	X49	X50
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.713	1.458	1.601	1.961	1.662	1.250	1.569	1.675	1.589	1.491
Asymp. Sig. (2-tailed)	.006	.028	.012	.001	.008	.088	.015	.007	.013	.023
	X51	X52	X53	X54	X55	X56	X57	X58	X59	X60
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.281	1.404	1.304	1.662	1.601	1.767	1.769	1.700	1.415	1.675
Asymp. Sig. (2-tailed)	.075	.039	.067	.008	.012	.004	.004	.006	.037	.007
	X61	X62	X63	X64	X65	X66	X67	X68	X69	X70
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.561	1.819	1.533	1.372	1.491	1.490	1.847	1.440	1.341	1.633

Asymp. Sig. (2-tailed)	.015	.003	.018	.046	.023	.024	.002	.032	.055	.010
	X71	X72	X73	X74	X75	X76	X77	X78	X79	X80
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.189	1.563	1.389	1.534	1.760	1.760	1.568	1.491	1.490	1.533
Asymp. Sig. (2-tailed)	.118	.015	.042	.018	.004	.004	.015	.023	.024	.018
	X81	X82	X83	X84	X85	X86	X87	X88	X89	X90
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.662	1.640	1.285	1.490	1.523	1.351	1.563	1.852	1.388	1.491
Asymp. Sig. (2-tailed)	.008	.009	.073	.024	.019	.052	.015	.002	.042	.023
	X91	X92	X93	X94	X95	X96	X97	X98	X99	X100
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.214	1.569	1.440	1.622	1.852	1.675	1.852	1.303	1.769	1.850
Asymp. Sig. (2-tailed)	.105	.015	.032	.010	.002	.007	.002	.067	.004	.002
	X101	X102	X103	X104	X105	X106	X107	X108	X109	X110
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.533	1.309	1.700	1.662	1.633	1.854	1.743	1.491	1.767	1.427
Asymp. Sig. (2-tailed)	.018	.065	.006	.008	.010	.002	.005	.023	.004	.034
	X111	X112	X113	X114	X115	X116	X117	X118	X119	X120
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.413	1.767	1.501	1.404	1.404	1.279	1.404	1.458	1.330	1.682
Asymp. Sig. (2-tailed)	.037	.004	.022	.039	.039	.076	.039	.028	.058	.007

Based on **Table 3**, it can be seen that the variable has a significance level or probability value below or above 0.05. This means that some sample data are not normally or normally distributed.

Normality Test for Cost Impact

Table 4. Normality Test Results for Impact Assessment on Costs

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.257	1.474	1.393	1.244	1.675	1.209	1.319	1.497	1.474	1.549
Asymp. Sig. (2-tailed)	.085	.026	.041	.090	.007	.107	.062	.023	.026	.016
	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.440	1.377	1.377	1.559	1.389	1.882	1.533	1.474	1.440	1.589
Asymp. Sig. (2-tailed)	.032	.045	.045	.016	.042	.002	.018	.026	.032	.013
	X21	X22	X23	X24	X25	X26	X27	X28	X29	X30
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.341	1.190	1.045	1.250	1.460	1.559	1.415	1.299	1.373	1.283
Asymp. Sig. (2-tailed)	.055	.117	.225	.088	.028	.016	.037	.068	.046	.074
	X31	X32	X33	X34	X35	X36	X37	X38	X39	X40
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.352	1.389	1.601	1.298	1.417	1.490	1.445	1.659	1.373	1.415
Asymp. Sig. (2-tailed)	.052	.042	.012	.069	.036	.024	.031	.008	.046	.037
	X41	X42	X43	X44	X45	X46	X47	X48	X49	X50
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.533	1.601	1.490	1.583	1.189	1.561	1.640	1.458	1.607	1.412
Asymp. Sig. (2-tailed)	.018	.012	.024	.013	.118	.015	.009	.028	.011	.037
	X51	X52	X53	X54	X55	X56	X57	X58	X59	X60
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.440	1.468	1.209	1.765	1.030	1.309	1.359	1.524	1.701	1.440
Asymp. Sig. (2-tailed)	.032	.027	.107	.004	.239	.065	.050	.019	.006	.032
	X61	X62	X63	X64	X65	X66	X67	X68	X69	X70
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.733	1.413	1.622	1.341	1.257	1.497	1.474	1.479	1.299	1.524
Asymp. Sig. (2-tailed)	.005	.037	.010	.055	.085	.023	.026	.025	.068	.019
	X71	X72	X73	X74	X75	X76	X77	X78	X79	X80
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.491	1.927	1.404	1.309	1.369	1.977	1.622	1.583	1.534	1.640
Asymp. Sig. (2-tailed)	.023	.001	.039	.065	.047	.001	.010	.013	.018	.009
	X81	X82	X83	X84	X85	X86	X87	X88	X89	X90
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.177	1.490	1.388	1.359	1.285	1.190	1.524	1.607	1.373	1.413

Asymp. Sig. (2-tailed)	.125	.024	.042	.050	.073	.117	.019	.011	.046	.037
	X91	X92	X93	X94	X95	X96	X97	X98	X99	X100
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.440	1.341	1.341	1.568	1.482	1.833	1.760	1.622	1.769	1.341
Asymp. Sig. (2-tailed)	.032	.055	.055	.015	.025	.002	.004	.010	.004	.055
	X101	X102	X103	X104	X105	X106	X107	X108	X109	X110
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.954	1.491	1.491	1.682	1.501	1.440	1.460	1.760	1.413	1.622
Asymp. Sig. (2 -tailed)	.001	.023	.023	.007	.022	.032	.028	.004	.037	.010
	X111	X112	X113	X114	X115	X116	X117	X118	X119	X120
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.341	1.716	1.341	1.341	1.189	1.561	1.460	1.568	1.569	1.559
Asymp. Sig. (2-tailed)	.055	.006	.055	.055	.118	.015	.028	.015	.015	.016

Based on **Table 4**, it can be seen that the variable has a significance level or probability value below or above 0.05. This means that some sample data are not normally or normally distributed.

Normality Test for Time Impact

Table 5. Normality Test Results for Time Impact Assessment

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.445	1.534	1.404	1.474	1.525	1.389	1.534	1.330	1.388	1.238
Asymp. Sig. (2-tailed)	.031	.018	.039	.026	.019	.042	.018	.058	.042	.093
	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.490	1.534	1.285	1.850	1.482	1.189	1.472	1.341	1.941	1.490
Asymp. Sig. (2-tailed)	.024	.018	.073	.002	.025	.118	.026	.055	.001	.024

	X71	X72	X73	X74	X75	X76	X77	X78	X79	X80
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.601	1.330	1.389	1.537	1.497	1.491	1.622	1.309	1.622	1.474
Asymp. Sig. (2-tailed)	.012	.058	.042	.018	.023	.023	.010	.065	.010	.026
	X81	X82	X83	X84	X85	X86	X87	X88	X89	X90
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.090	1.245	1.267	1.369	1.207	1.418	1.523	1.587	1.733	1.713
Asymp. Sig. (2-tailed)	.186	.090	.081	.047	.108	.036	.019	.013	.005	.006

	X91	X92	X93	X94	X95	X96	X97	X98	X99	X100
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.351	1.760	1.285	1.760	1.622	1.696	1.767	1.388	1.682	1.268
Asymp. Sig. (2-tailed)	.052	.004	.073	.004	.010	.006	.004	.042	.007	.080
	X101	X102	X103	X104	X105	X106	X107	X108	X109	X110
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.482	1.341	1.309	1.491	1.373	1.524	1.533	1.601	1.622	1.854
Asymp. Sig. (2-tailed)	.025	.055	.065	.023	.046	.019	.018	.012	.010	.002
	X111	X112	X113	X114	X115	X116	X117	X118	X119	X120
N	26	26	26	26	26	26	26	26	26	26
Kolmogorov- Smirnov Z	1.245	1.563	1.373	1.341	1.412	1.533	1.568	1.427	1.413	1.373
Asymp. Sig. (2-tailed)	.090	.015	.046	.055	.037	.018	.015	.034	.037	.046

Based on **Table 5**, it can be seen that the variable has a significance level or probability value below or above 0.05. This means that some sample data are not normally or normally distributed.

Analysis of AHP

Sample data, each in the form of frequency and impact of risk on cost and time at each stage of work, then becomes input for analysis with the AHP method which begins with matrix normalization treatment, matrix consistency calculation, hierarchy consistency and level of accuracy, calculation of local frequency values and calculation of values. local impact, then from the results of this calculation the final risk value and the risk level will be obtained (Dita et al., 2017).

Pair Comparison and Matrix Normalization

The first stage is to make a pairwise comparison matrix for frequency and impact on costs and time which is made based on a comparison scale for frequency and impact each of which has 5 criteria to be compared, where the pairwise matrices can be seen in Table 6, Table 7, and Table 8.

Table 6. Paired Matrix for Frequency

Information	Very often	Often	Moderately	Rarely	Very Rarely
Very often	1	3	5	7	9
Often	0.333	1	3	5	7
Currently	0.200	0.333	1	3	5
Seldom	0.143	0.200	0.333	1	3
Very rarely	0.111	0.143	0.200	0.333	1
Amount	1.787	4.676	9.533	16.333	25.000

Table 7. Paired Matrix for Impact on Costs

Information	Very Big	Big	Medium	Small	Very Small
Very large	1	3	5	7	9
Big	0.333	1	3	5	7
Currently	0.200	0.333	1	3	5
Small	0.143	0.200	0.333	1	3
Very small	0.111	0.143	0.200	0.333	1
Amount	1.787	4.676	9.533	16.333	25.000

Table 8. Pairwise Matrix for Effects Over Time

Information	Very High	High	Medium	Low	No Effect
Very high	1	3	5	7	9
Tall	0.333	1	3	5	7
Currently	0.200	0.333	1	3	5
Low	0.143	0.200	0.333	1	3
No Influence	0.111	0.143	0.200	0.333	1
Amount	1.787	4.676	9.533	16.333	25.000

Element Weight

Based on the paired matrix, the element weights for frequency, impact on cost and impact on time are calculated, so the element weights for frequency, impact on cost and impact on time are obtained which can be seen in Table 9, Table 10, and Table 11.

Table 9. Paired Matrix Consistency Calculations for Frequency

	Very Often	Often	Moderately	Rarely	Very rarely	Average
Very often	0.560	0.642	0.524	0.429	0.360	0.503
Often	0.186	0.214	0.315	0.306	0.280	0.260
Currently	0.112	0.071	0.105	0.184	0.200	0.134
Seldom	0.080	0.043	0.035	0.061	0.120	0.068
Very rarely	0.062	0.031	0.021	0.020	0.040	0.035

Table 10. Paired Matrix Consistency Calculations for Impact on Costs

	Very Big	Big	Medium	Small	Very Small	Average
Very large	0.560	0.642	0.524	0.429	0.360	0.503
Big	0.186	0.214	0.315	0.306	0.280	0.260
Currently	0.112	0.071	0.105	0.184	0.200	0.134
Small	0.080	0.043	0.035	0.061	0.120	0.068
Very small	0.062	0.031	0.021	0.020	0.040	0.035

Table 11. Paired Matrix Consistency Calculations for Impacts Against Time

	Very High	High	Moderate	Low	No Effect	Average
Very high	0.560	0.642	0.524	0.429	0.360	Average
Tall	0.186	0.214	0.315	0.306	0.280	0.260
Currently	0.112	0.071	0.105	0.184	0.200	0.134
Low	0.080	0.043	0.035	0.061	0.120	0.068
No Influence	0.062	0.031	0.021	0.020	0.040	0.035

Matrix Consistency Test, Hierarchy and Level of Accuracy

The comparison matrix must have a diagonal value of one and be consistent. To test consistency, the maximum eigenvector (λ max) must be close to the number of elements (n) and the remaining eigenvectors are close to zero (Pradana & Bhaskara, 2019).

Proving the consistency of the paired matrices is done by calculating the elements in each column divided by the number of columns in question. Furthermore, from these calculations, check the consistency of the matrix. The number of elements in the (n) matrix.

$$\lambda maks \ = \frac{26{,}211}{5} = \ 5{,}242$$

Thus, because the λ max value is close to the number of elements (n) in the matrix, namely 5 and the remaining eigen value is 0.24, which means it is close to zero, the matrix is consistent. The Random Consistency Index (RI) = 1.11 can be seen in the RI table.

To check the consistency of the hierarchy, an evaluation of the consistency of the pairwise matrix is carried out by calculating the Consistency Ratio (CR) where the equation used is CR = CI/RI, where the value of CI is the Consistency Index. CR is considered good if CR ≤ 0.1 (10%). The calculation is described as follows: To determine the AHP rating, it is calculated based on

N = 5; RI (Random Consistency Index) = 1.11

$$CI \ = \frac{(5{,}242 - 5)}{(5 - 1)} \ = \ 0.061$$

The CR value obtained was 5.4% <10% so it can be concluded that the hierarchy is consistent and the accuracy level is high.

Frequency Local Values

In the local frequency value there are several jobs, such as:

1. Local Value of Frequency in Dewatering Work.
2. Local Value of Frequency in Retaining Wall Work.
3. Local Value of Frequency in Excavation Work.
4. Local Value of Frequency in Foundation Work (Pile Cap).

Risk Level Analysis

The combination of multiplying the frequency value and the impact value. Risk level analysis is then carried out with a risk level index grouped into four classes. The class range is known from the highest weight minus the lowest weight and the result is divided by the number of levels. The main project risks are variables with high (H) and significant (S) risk levels. Below is a risk rating and risk level analysis for several jobs, such as:

1. Ranking of Risks Against Costs in Dewatering Works and Rankings of Risks Against Time in Dewatering Works.
2. Ranking of Risk to Cost in Retaining Wall Work and Risk Rating to Time in Retaining Wall Work.
3. Ranking of Risks to Costs in Excavation Work
4. Ranking of Risk Against Time in Foundation Work (Pile Cap).

Dominant Risk

In dominant Risk there are several jobs, such as:

1. Cost and Time Dominant Risks in Dewatering Work.
2. Cost and Time Dominant Risk in Retaining Wall Work.
3. Cost and Time Dominant Risks in Excavation Work.
4. Cost and Time Dominant Risks in Pile Cap Work.

Then the 8 dominant risks to cost and time obtained from the high-rise building structure work can be seen in Table 12.

Table 12. Dominant Risk of Cost and Time

No	Variable	Risk Factor	Risk Source Category	Dominant At Work
1	X5, X21, X44, X66, X91 and X116	Rainfall that exceeds BMKG estimates	Predictable Externals	Dewatering Work, Retaining Wall Work, Excavation Work, and Foundation Work (Pile Cap)
2	X9	The groundwater level is higher than the results of the soil investigation	Technical Internals	Dewatering Work
3	X20, X65, X90 and X115	Inflation/price increases that exceed initial estimates	Predictable Externals	Retaining Wall Work, and Foundation Work (Pile Cap)
4	X55	Poor quality subcontractors	Technical Internals	Excavation Work
5	X52	Low equipment productivity	Technical Internals	Excavation Work
6	X75, X100 dan X124	Delay in delivery of materials	Technical Internals	Foundation Work (Pile Cap)
7	X86, X111	Other work that preceded it is still late	Technical Internals	Foundation Work (Pile Cap)

CONCLUSION

From the discussion that has been described above, several conclusions can be drawn. First, there are several dominant risk factors that have an impact on costs and time on the structural work of the Grand Jati Junction Apartment development project from several influential perspectives. These risk factors are as follows:

a. Rainfall that exceeds BMKG estimates.
b. The groundwater level is higher than the results of the soil investigation.
c. Inflation/price increases that exceed initial estimates.
d. Low equipment productivity.
e. Delay in delivery of materials.
f. Other work that preceded it is still late.
g. Weak time and cost control systems lead to delays and increased costs.

Both risk responses aim to prevent or minimize risks that impact costs and time. The risk response given to these dominant risk factors is in the form of preventive measures which have been described in Table 12 (Table of Dominant Risks Against Cost and Time).

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REFERENCES

1. Akkiyat, I., & Souissi, N. (2019). Modelling risk management process according to ISO standard. *Int J Recent Technol Eng*, *8*, 5830–5835.
2. Armenia, S., Dangelico, R. M., Nonino, F., & Pompei, A. (2019). Sustainable project management: A conceptualization-oriented review and a framework proposal for future studies. *Sustainability*, *11*(9), 2664.
3. Dita, A. O. F., Ratnaningsih, A., & Sukmawati, S. (2017). *Identifikasi Risiko Dominan Internal Non Teknis yang Berdampak pada Biaya Konstruksi High Rise Building Menggunakan Metode Severity Index*.
4. Fewings, P., & Henjewele, C. (2019). *Construction project management: an integrated approach*. Routledge.
5. Institute, P. M. (2021). *A Guide to the Project Management Body of Knowledge (PMBOK®Guide)-and The Standard for Project Management*.
6. Ke, Y., Zhang, J., & Philbin, S. P. (2023). Tradition and Innovation in Construction Project Management. In *Buildings* (Vol. 13, Issue 6, p. 1537). MDPI.
7. Lubis, Z. (2021). *Statistika terapan untuk ilmu-ilmu sosial dan ekonomi*. Penerbit Andi.
8. Lubis, Z., Lubis, A. H., & Sutrisno, S. (2021). *Pedoman Penggunaan SPSS (Statistical Product And Service Solution) Untuk Pengolahan Data* (Pertama). Penerbit: Perdana Mulya Sarana.
9. Mokashi-Punekar, S., Zhou, Y., Brooks, S. C., & Rosi, N. L. (2020). Construction of chiral, helical nanoparticle superstructures: progress and prospects. *Advanced Materials*, *32*(41), 1905975.
10. Obondi, K. (2022). The utilization of project risk monitoring and control practices and their relationship with project success in

construction projects. *Journal of Project Management*, *7*(1), 35–52.
11. Pradana, G., & Bhaskara, A. (2019). *Penentuan Risiko Proyek Kontruksi Swakelola dengan Integrasi Threshold Risk dan AHP (Analytical Hieracy Proces) Studi Kasus Pembangunan Gedung Fakultas Ilmu Agama Islam Universitas Islam Indonesia*. University Technology Yogyakarta.
12. Shi, Y. A., Liu, X. M., Zhou, J. L., Xie, P. L., Ge, L. B., & Geng, W. B. (2023). Design of Bridge Substructure Construction Measures Based on European Standards. *Journal of Physics: Conference Series*, *2476*(1), 12005.
13. Wang, C., Xu, Z., & Liu, X. (2022). Structural Dynamics and Vibration. *Journal of Physics: Conference Series*, *2386*(1), 12096.
14. Zhao, X. (2023). Construction risk management research: intellectual structure and emerging themes. *International Journal of Construction Management*, 1–11.

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