Mitigating Risk in Construction Business: The Impact of Contractor Business Size and Risk Location (Office and Field)

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Abstracts: This study aims to evaluate the relationship between the size of the construction business and the location of the risk with the risks that arise in construction projects in Indonesia. The method used is two-way anova analysis by sampling 90 construction projects in Indonesia. The independent variable in this study is the size of the construction business and the location of the risk, while the dependent variable is the risk on the construction project. The results showed that there is a significant relationship between the size of the construction business and the risks of construction projects in Indonesia. In addition, there is also a significant relationship between the location of risks and risks in construction projects in Indonesia. However, there was no significant interaction between the size of the construction business and the location of risk to risk in construction projects in Indonesia. This research contributes to the construction industry in Indonesia in evaluating the factors that affect risk in construction projects. By knowing the relationship between the size of the construction business and the location of the risk with the risk on the construction project, the contractor company can improve the risk management strategy to minimize the risk to the construction project in the future. Future research may consider other variables such as contractor experience and expertise as well as external factors such as market and political conditions to better understand the factors that influence risk in construction projects in Indonesia.

Keywords: Construction business size, Office risk, Field risk, Risk management.

1. INTRODUCTION

The development of the construction industry in Indonesia has continued to increase along with the increasing number of infrastructure developments carried out by the government (Fitriani & Ajayi, 2022; Harymawan, Nasih, Ratri, Soeprajitno, & Shafie, 2020; Huda & Agung Wibowo, 2013). In the construction process, the contractor becomes one of the parties who play an important role in the success of a project (Karim, Latief, & Zagloel, 2022; Kog, 2019). However, in carrying out its business activities, contractors also face various risks that can affect the performance and continuity of their business.

The construction service business is increasing and optimistic in the future, the risk of complex and increasing construction projects from various sources remains (Rumawas, 2022; Siregar, Prabowo, Hamsal, & Siregar, 2020). Weak implementation of risk management in the implementation of construction projects can lead to uncertainty and problems that are often uncertain (Nkwunonwo, Whitworth, & Baily, 2020). This also applies in the construction business where losses that are often experienced by companies are mostly caused by weak understanding of risk management.

The risk is a variation in things that may occur naturally or the possibility of events occurring beyond the expected, which is a threat to property and financial benefits due to the hazard that occurs (Mechler, 2016). Therefore, risk management in the construction business is very necessary to reduce the possibility of losses caused. The categories of risks that are possible to occur and have potential impacts are Financial/Economic, Political/Environmental, and Construction (Purwantoro, Aditama, & Andini, 2018).

One factor known to affect the level of risk faced by contractors is the size of the business (Wang, Zou, & Li, 2016; Williams, 2016). Some studies show that the larger the size of a construction business, the less likely it is to occur risks in the implementation of construction projects (Tan & Lee, 2022). However, several other studies have found different results, some even showing a non-linear relationship between business size and risk.

Identification of risk factors and potential impacts of construction service providers in the field of construction work service providers in handling projects there are 2 risk factors, namely the Risk of construction work service

providers in office management and the Risk of construction work service providers in the field (*on site potential defects).* Risk to construction work service providers in the office (office management) can occur due to the initial costs incurred to obtain the project, the use of bank concessional loans, the risk of inflation and extreme inflation, and riskless returns.

An effective, efficient, and appropriate communication system can minimize initial risk, while alternative strategies such as risk retention can help reduce risk in the use of soft bank loans. The country's poor economic conditions and high inflation can also affect risks to construction work. In addition, construction work business people must also consider riskless returns in making investments. The risks of construction service providers include natural disasters, limited materials and skilled workers, difficulty accessing project sites, the influence of the equipment supply chain, the risk of changing field conditions, lack of awareness of work safety management systems, the risk of social costs, risks due to claims for limited human resources, and risk substitution within the scope (Alaloul, Liew, Zawawi, & Kennedy, 2020; Gatzert & Kosub, 2016; Govindan & Chaudhuri, 2016).

The purpose of this study is to identify and analyze the effect of construction business size on risks that arise in offices and the field in the construction industry. This study aims to provide a better understanding of the relationship between the size of the construction business and the risks associated with construction work, to provide recommendations and appropriate strategies for decision makers in managing these risks. In addition, this research is also expected to contribute to the development of risk management theory and project management practice in the construction industry.

2. METHOD

2.1. Research Design

This study used an experimental research design by collecting primary data through sampling from 90 contractors, with details of 30 large contractors, 30 medium contractors, and 30 small contractors. The observed risks consist of office risks and field risks, so there will be four treatment groups in this study, namely: (1) large contractors who face office risks, (2) large contractors who face field risks, (3) small contractors who face office risks, and (4) small contractors who face field risks.

In this study will be used risk categories proposed by Al-Bahar and Crandall (1990), modified in such a way as to suit the desired conditions, namely the identification of risk factors that are likely to occur and their potential impacts, analysis of risk factors that are dominant to construction work service providers, and calculated risk handling from the point of view of construction work service providers that often occur in government projects and private. The risk categories are modified from the existing literature review so that we divide them into 2 categories, namely Risk in the office / Risk Management and Risk in the field.

Risk analysis is defined as a process that combines uncertainty in quantitative form, to evaluate the potential impact of a risk. The first step to carry out this stage is the collection of data relevant to the risk to be analyzed. These data can be obtained from the company's historical data or from past project experience.

2.2. Data Collection

The data used in this study were primary data collected through questionnaires distributed to 90 contractors randomly selected from the existing contractor population in the study area. The questionnaire will contain questions about the size of the construction business (large, medium, small) and the risks faced (office and field).

In this study, interviews were conducted with contractors who were willing to become respondents. This analysis is carried out separately between the three classifications, namely large contractors, medium contractors, and small contractors. After that, a risk analysis was carried out from a sample in the form of contractor respondents obtained a table containing factors from the analysis of identification and analysis of risks that can occur in

contractors based on the categories and classifications that have been made above. Respondents enter the amount of turnover and percentage of risk loss from the interview results to determine the existing MARR value as a percentage, for risk description using the Field Risk Office Risk, then formulated by adding up the percentage of risk results from each description and summing the *rate of traditional investment, risk rate of bank debt*.

2.3. Data Analysis

The collected data will be analyzed using Anova Two-Way statistical techniques with the help of computer programs such as SPSS. The purpose of this analysis is to determine whether there is a significant influence between the size of the construction business and the risk on the results obtained in the office and the field. After the data is collected, statistical analysis is carried out to determine the effect of the size of the construction business and risk on the results obtained in the office and field. The analysis used is Anova Two-Way using software such as SPSS. The results of the data analysis will be interpreted by comparing the results of the significance test (p-value) with the alpha value set earlier. If the p-value is less than the alpha value, then there is a significant influence between the size of the construction business and the risk on the results obtained in the office and field. Next, a post-hoc analysis will be carried out to find out which treatment groups differ significantly.

3. RESULTS

3.1. Descriptive Analysis

Descriptive statistics is a technique used to summarize, describe, and analyze data numerically using several metrics such as mean, median, mode, standard deviation, and range. Descriptive statistics provide an overview of the data collected, making it easier for the researcher or reader to understand the data being analyzed.

3.2. Contractor Size

Statistical methods used to describe or summarize data numerically and visually. The aim is to provide an overview of the characteristics of the data and provide a better understanding of the observed variables.

Table 1. Descriptive Statistics Contractor Size.

	Value		
	Large Contractors	**Small Contractor**	**Medium Contractor**
Valid	60	60	60
Missing	0	0	0
Mode [a]	1.23	0.92	1.37
Median	1.87	1.41	1.74
Mean	2.04	1.44	1.76
Std. Deviation	0.73	0.44	0.45
Variance	0.53	0.19	0.20
Minimum	1.23	0.92	1.14
Maximum	3.15	2.03	2.55
Sum	122.54	86.43	105.38

Note: [a] More than one mode exists, only the first is reported.

From the table provided, we can describe the descriptive statistical results where based on the average value, Large Contractors have a mean value of 2.04, Small Contractors have a mean value of 1.44, and Medium Contractors have a mean value of 1.76. Based on the smallest score in each group, Large Contractors have a minimum score of 1.23, Small Contractors have a minimum score of 0.92, and Intermediate Contractors have a minimum score of 1.14. Based on the largest value in each group, Large Contractors have a maximum value of 3.15, Small Contractors have a maximum value of 2.03, and Medium Contractors have a maximum value of 2.55. Based on the total of all values in each group, Large Contractors have a sum value of 122.54, Small Contractors

have a sum value of 86.43, and Medium Contractors have a sum value of 105.38. With this information, we can get a general idea of the values in each group and the comparison between those groups.

3.3. Risk Location

Statistical methods used to describe or summarize data numerically and visually. Its purpose is to provide an overview of the characteristics of the data and provide a better understanding of 1195the observed Variable.

Table 2. Descriptive Statistics Location of Risk.

	Value	
	Office Risk	**Field Risk**
Valid	90	90
Missing	0	0
Mode [a]	2.05	1.36
Median	2.14	1.29
Mean	2.27	1.22
Std. Deviation	0.39	0.16
Variance	0.16	0.03
Minimum	1.74	0.92
Maximum	3.15	1.44
Sum	204.24	110.12

Note: [a] More than one mode exists, only the first is reported.

In the table, there are two variables, namely Office Risk and Field Risk. The Office Risk Average is 2.27 and the Field Risk Average is 1.22. That is, the average level of risk that occurs in the Office is higher than the Field. The Office Risk Minimum Value is 1.74 and the Field Risk Minimum Value is 0.92. The minimum value indicates the smallest number on each variable. The Maximum Office Risk Value is 3.15 and the Maximum Field Risk Value is 1.44. The total sum or sum of all values in Office Risk is 204.24 and in Field Risk is 110.12. Thus, the descriptive results provide an overview of the level of risk in the Office and the Field, and can help researchers or readers to understand the data analyzed.

3.4. Prerequisite Test

3.4.1. Homogeneity Test

Homogeneity of variance test is a statistical test performed to check whether the variance between groups or treatments in a study is balanced or not. The homogeneity test aims to ensure that the variance among the groups compared in the study is not significantly different so that the statistical analysis carried out has better reliability.

Table 3. Test for Equality of Variances (Levene's).

F	**Df1**	**Df2**	**P**
18.99	5.00	174.00	< .001

The homogeneity test results in the table show Levene's test results with an F value of 18.99 and a p-value of < 0.001. Very small p-values indicate that there are significant differences between group variances. In this context, it can be concluded that the groups compared in the study do not have a balanced variance and it is necessary to find appropriate statistical analysis methods to accommodate these differences.

3.4.2. Normality Test

Q-Q plot or quantile-quantile plot is a graph used to check the extent to which the distribution of data matches the normal distribution. In Q-Q plots, the observed data values are paired with the expected values of the corresponding normal distribution. If the data is normally distributed, the plot will show a straight line with data points following that line.

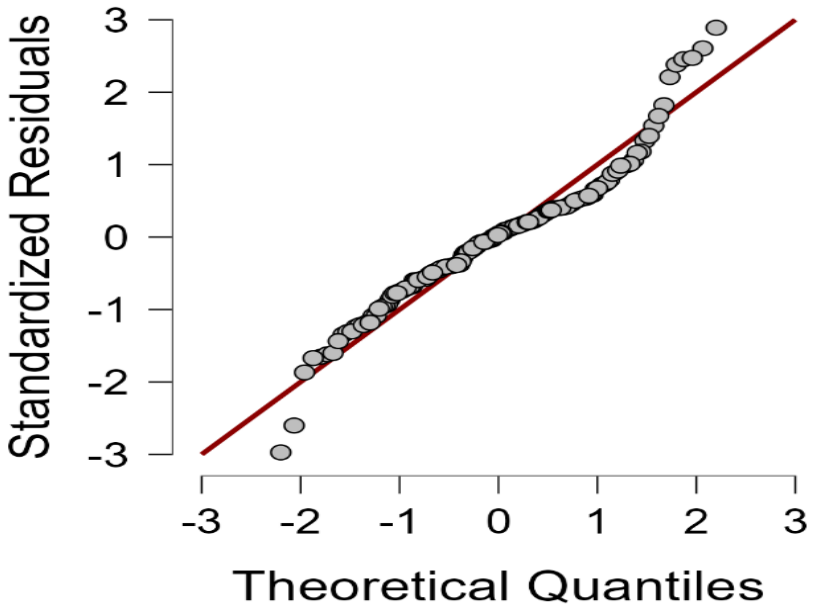

Figure 1. Q-Q plot.

The interpretation of the normality test with the Q-Q plot involves observing the curvature of the plot, spreading the data on the plot, and then comparing the plot with the diagonal line of the normal distribution. If the plot has curvature, it means that the data has no normal distribution. Curvature can be a curve that moves away from a diagonal line, or a curve that reverses. So it can be concluded that the data is abnormal. Because the Homogeneity and Normality Test are not met, the hypothesis test uses a non-parametric test. But in this study, researchers used parametric and non-parametric tests as a comparison of results

3.5. Test the Hypothesis

3.5.1. Non-Parametric Test

The Kruskal-Wallis Test is a non-parametric statistical technique used to test the median difference of three or more groups. The Kruskal-Wallis Test is often used as an alternative to the ANOVA test when the assumptions of normality and homogeneity of variance are not met.

Table 5. Kruskal-Wallis Test Results.

Factor	Statistic	Df	P
Company Size	32.74	2	< .001
Risk Location	134.26	1	< .001

Based on the table, the results of the Kruskal-Wallis Test show that there is a significant difference between the median in the table "Company Size" (H (2) = 32.74, p < .001) and the table "Risk Location" (H (1) = 134.26, p < .001). This shows that there is a significant difference between the medians of each group in the two analyses. Very small p-values indicate that the differences between the groups are statistically significant. Therefore, the Kruskal-

Wallis Test can be used as an alternative to ANOVA in cases where the assumptions of normality and homogeneity of variance are not met.

3.6. Uji Post Hoc

The post hoc test in ANOVA is a statistical test used to compare all group pairs after significant group effects have been identified in the ANOVA test. This post hoc test is performed to determine if there are significant differences between each group pair. The goal of the post hoc test is to identify statistically significant groups and to avoid type I errors that may occur when comparing many groups simultaneously.

3.6.1. Company Size

The table of post hoc test results given is a comparison table between t-statistics and p-values for each pair of groups. In the table, there are three groups of contractors, namely "Large Contractors", "Small Contractors", and "Medium Contractors". The first column shows the groups that are compared to the groups listed in the row.

Table 6. Test Post Hoc Comparisons – Company Size.

		Mean Difference	SE	T	p_{tukey}
Large Contractors	Small Contractor	0.60	0.02	27.94	< .001
	Medium Contractor	0.29	0.02	13.27	< .001
Small Contractor	Medium Contractor	-0.32	0.02	-14.66	< .001

In the test, it was seen that there was a significant difference between each pair of groups, because all p-values were less than 0.05. This showed that all comparisons between group pairs showed statistically significant differences. For example, for the pair "Large Contractors" and "Small Contractors", the t-value is 27.94 and the p-value is less than 0.001. This suggests that the differences between these two groups are statistically significant. The same is true for every other group pair. Therefore, the results of the post hoc test show that each group has significant differences with other groups.

3.6.2. Risk Location

A post hoc test is a statistical test used to compare all group pairs after a significant group effect has been identified in an analysis. This post hoc test is performed to determine if there are significant differences between each group pair.

Table 7. Test Post Hoc Comparisons - Risk Location.

		Mean Difference	SE	T	p_{tukey}
Office Risk	Field Risk	1.05	0.02	59.45	< .001

In the table, there is a significant difference between the two groups of "Office Risk" and "Field Risk", because the p-value is very small (<0.001). This suggests that the differences between the two groups are statistically significant. Because there are only two groups, there is no need for post hoc testing.

4. DISCUSSION

Based on the results of the analysis that has been carried out, it was found that there is an effect of the size of the construction business on the risks caused, both in the office and the field. The results of the two-way ANOVA test showed that there were significant differences between large, small, and medium-sized contractor groups in posing risks in the office and field. This finding is in line with previous research by Alzahrani and Emsley (2013) which showed that large contractors tend to be riskier compared to small contractors. This can be due to the higher organizational complexity of large contractors, which requires more difficult coordination and leads to the risk of

project delays or non-conformance with contract specifications. However, previous research has also shown that small contractors may be more at risk when it comes to quality control due to limited resources and experience.

From the results of data analysis that has been carried out, it can be concluded that there are differences in risk between large, small, and medium contractors in office and field locations. In office locations, large contractors have a higher average risk compared to small and medium-sized contractors, while at field sites, small contractors have a higher average risk compared to large and medium-sized contractors.

However, keep in mind that the results of this study cannot be generalized directly to the entire construction industry because this study was only conducted on contractors in certain regions. In addition, there are other factors such as the experience and skills of workers, the use of equipment and materials that meet safety standards, and environmental factors that can also affect the level of risk at the project site. For future research, variables that affect risk at the project site can be added, such as worker experience and skills, use of equipment and materials that meet safety standards, and environmental factors. In addition, research can be carried out in a wider area so that the results can be more representative for the construction industry.

This research is inseparable from various problems and limitations. Limited time and resources available to conduct more detailed and thorough research. In addition, this study only considers the size of the construction business in influencing risks in the office and field, so that other factors such as managerial ability, experience, and company policies may also affect the risks caused.

5. CONCLUSION

Based on the results of the study, there is a relationship between the size of the construction business and the risk in the office and field. Contractors with larger sizes tend to experience less risk compared to smaller contractors. This is supported by the fact that larger contractors have greater resources and better management. Therefore, contracting companies need to pay attention to the size of their business and pay attention to resources and management to reduce risks in the office and field. The contracting company needs to evaluate the risk management that has been carried out and improve if deficiencies are found. Contracting companies can develop better risk management strategies by considering the size of their business. The government can provide support in the development of the construction industry, especially for small and medium enterprises to minimize the risks caused. Future studies may consider other factors that might influence risk in the office and field, such as managerial experience and company policies. Future studies can develop mathematical models to predict risks that will occur based on the size of the construction business and can consider the influence of external factors such as economic conditions and government policies on risks in the office and field.

REFERENCES

[1] Al-Bahar, J. F., & Crandall, K. C. (1990). Systematic risk management approach for construction projects. *Journal of Construction Engineering and Management, 116*(3), 533-546. doi:10.1061/(ASCE)0733-9364(1990)116:3(533)

[2] Alaloul, W. S., Liew, M., Zawawi, N. A. W. A., & Kennedy, I. B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. *Ain shams engineering journal, 11*(1), 225-230.

[3] Alzahrani, J. I., & Emsley, M. W. (2013). The impact of contractors' attributes on construction project success: A post construction evaluation. *International journal of project management, 31*(2), 313-322.

[4] Fitriani, H., & Ajayi, S. (2022). Barriers to sustainable practices in the Indonesian construction industry. *Journal of Environmental Planning and Management*. doi:10.1080/09640568.2022.2057281

[5] Gatzert, N., & Kosub, T. (2016). Risks and risk management of renewable energy projects: The case of onshore and offshore wind parks. *Renewable and Sustainable Energy Reviews, 60*, 982-998.

[6] Govindan, K., & Chaudhuri, A. (2016). Interrelationships of risks faced by third party logistics service providers: A DEMATEL based approach. *Transportation research part E: logistics and transportation review, 90*, 177-195.

[7] Harymawan, I., Nasih, M., Ratri, M. C., Soeprajitno, R. R. W. N., & Shafie, R. (2020). Sentiment analysis trend on sustainability reporting in Indonesia: Evidence from construction industry. *Journal of Security and Sustainability Issues, 9*(3), 1017-1024. doi:10.9770/jssi.2020.9.3(25)

[8] Huda, M., & Agung Wibowo, M. (2013). Strategies, performance, sustainability and competitiveness model: Small and medium construction services industries in Indonesia. *World Applied Sciences Journal, 25*(8), 1186-1196. doi:10.5829/idosi.wasj.2013.25.08.13394

[9] Karim, R. A., Latief, Y., & Zagloel, T. Y. (2022). Measuring and Benchmarking the Quality Culture Maturity of Construction Companies in Indonesia. *International Journal of Engineering, Transactions A: Basics, 35*(10), 2028-2039. doi:10.5829/ije.2022.35.10a.20

[10] Kog, Y. C. (2019). Construction Delays in Indonesia, Malaysia, Thailand, and Vietnam. *Practice Periodical on Structural Design and Construction, 24*(3). doi:10.1061/(ASCE)SC.1943-5576.0000434

[11] Mechler, R. (2016). Reviewing estimates of the economic efficiency of disaster risk management: opportunities and limitations of using risk-based cost–benefit analysis. *Natural Hazards, 81*, 2121-2147.

[12] Nkwunonwo, U., Whitworth, M., & Baily, B. (2020). A review of the current status of flood modelling for urban flood risk management in the developing countries. *Scientific African, 7*, e00269.

[13] Purwantoro, A., Aditama, S., & Andini, N. (2018). ANALISIS FAKTOR-FAKTOR RISIKO PADA KONTRAKTOR DI KOTA PALANGKA RAYA YANG MENANGANI PROYEK PEMERINTAH. *Jurnal Teknika: Jurnal Teoritis dan Terapan Bidang Keteknikan, 1*(2), 114–128-114–128.

[14] Rumawas, W. (2022). Employees' Turnover Intention in the Construction Industry in Indonesia. *Journal of Construction in Developing Countries, 27*(2), 127-146. doi:10.21315/jcdc-03-21-0050

[15] Siregar, S., Prabowo, H., Hamsal, M., & Siregar, E. I. (2020). The effects of managing innovation and technological adoption on business performance through differentiation strategy in indonesia's construction industry. *International Journal of Innovation, Creativity and Change, 11*(12), 583-601.

[16] Tan, C., & Lee, S. Z. (2022). Adoption of enterprise risk management (ERM) in small and medium-sized enterprises: evidence from Malaysia. *Journal of Accounting & Organizational Change, 18*(1), 100-131.

[17] Wang, J., Zou, P. X., & Li, P. P. (2016). Critical factors and paths influencing construction workers' safety risk tolerances. *Accident Analysis & Prevention, 93*, 267-279.

[18] Williams, T. (2016). Identifying success factors in construction projects: A case study. *Project management journal, 47*(1), 97-112.

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