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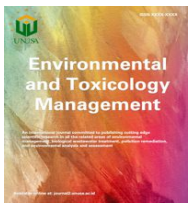

Analysis of the influence of environmental factors on the delay in the construction of Maluku traffic office service building

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Abstract

The objective of this study was to analyze the factor of COVID-19 and environmental factors that affect the delay of building construction. The construction of the BPKB Service Building for the Traffic Directorate of the Maluku Regional Police in T.A 2020 was a project that spends a very large budget with a planned time of 150 days. Building construction was delayed up to 4 weeks. This building construction experienced a delay of 27.895% of the work that had to be done. The method used is principal component analysis, which is multivariate and transforms correlated original variables into new uncorrelated variables by reducing the number of these variables so that they have smaller dimensions but can explain most of the diversity of the original variables. The results of the analysis of 25 respondents and 3 variables, namely: building tents to anticipate rain, good and harmonious relationships to prevent unexpected things from happening, and checking the location before making soft drawings.

Keywords:
Delay factor, environmental factors, principal component analysis

1 Introduction

Profits and losses are two important things that are taken into account in the world of work. cost and time greatly affect both of these things, as well as the construction sector. Both aspects of this influence must be sustainable well, in planning and direct execution in the field. Because if it does not go well according to plan it will result in problems that can affect the work being carried out, One such problem is project delays. There would be a domino impact on the economy if construction projects are delayed (Zamani et al., 2021). Delay has always been one of the major problems in the construction industry, and is caused by a multitude of reasons often mentioned in the literature (Arditi et al., 2017). Delay is considered as one of the most common problems causing a multitude negative effect on projects, and its participating parties (Gebrehiwet and Luo, 2017). Because this is one of the biggest problems in construction management, the delay in construction works poses a strong financial and social impact on all the stakeholders in the project (Carvalho et al., 2021). Normally, a delayed construction project is also accompanied by an additional cost and a decrease in quality and safety (Bajjou and Chafi, 2020).

Various researchers had been studying the causes and effects of delays in construction projects all over the world (Anondho, 2022; Bekr, 2018; Carvalho et al., 2021; Zidane, 2018; Dixit et al., 2019; Owolabi James et al., 2014; Shrivas and Singla, 2022; Umar, 2018; Vidyasagar Reddy and Rao, 2022; Wong, 2022). Delays in construction projects have several causes associated with owner, consultant and contractors (Umar, 2018). Contractor-related delays are found to be the most significant category that causes construction delays, followed by the owner-related delays, consultant-related delays, and material-related delays as the second most significant groups, respectively (Fashina et al., 2021). The influential causes of delay investigated are corruption, unavailability of utilities at site, inflation/price increases in materials, lack of quality materials, late design and design documents, slow delivery of materials, late in approving and receiving of complete project work, poor site management and performance, late release budget/funds, and ineffective project planning and scheduling (Gebrehiwet and Luo, 2017). Delays in the delivery of materials, damage to urgently needed materials, and late procurement, which are all related to poor project management, also occur widely (AlSehaimi et al., 2013).

In other case, (Tetelepta et al., 2019) had found 9 factors that influence the delay in building construction are project resource factor, material factors and project support, labor factor, tool and material factors, management factor, non-technical factors, work factor added less, equipment productivity factors, and surrounding environmental factors. A factor analysis by Yap, et al. (2021) identified the five principal managerial capabilities influencing schedule delays: competency management, communication and coordination management, financial management, risk management, and site management.

Since the COVID-19 pandemic in March 2020, there have been major changes in all countries in the world and in all aspects of

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life. Like other industries, the construction industry has also been impacted by the pandemic in a number of ways (Alsharef et al., Banerjee, 2021). This pandemic affected not only human health but also the operational health of businesses and organizations, the construction industry inclusive (Ogunnusi et al., 2020). Thus, the construction sector has been highly disrupted by the current pandemic. The construction sector represents a key component of countries' economies—it is approximately 13% of global GDP—as such, having their availability to perform construction activities with a minimum spread of COVID-19 may help to the financial response to the pandemic (Araya, 2021).

The COVID-19 pandemic has caused delays in construction projects. Some of the projects are being canceled and delayed. The productivity also will be slow because the construction worker needs to follow social distance to avoid the illness of the virus (Lam et al.,2022). This pandemic reduced investment in the construction industry by 17 to 30 % (Biswas et al., 2021). The construction sector, like it or not, must stay running with various changes for adapting during the pandemic and post-pandemic (Alsharef et al., 2021). Many projects have been affected by the COVID-19 pandemic in Indonesia, one of which is the construction of the BPKB office building of the Maluku Regional Police Satlantas. The construction of the BPKB office building of the Maluku Regional Police Satlantas Fiscal year 2020 is a project carried out by researchers with a budget of Rp. 21,701,579,200.00 and is planned to be carried out from January to July 2020 (150 calendar days). In this project, the planning uses a schedule and there are constraints on construction in the form of a four-week delay because the size of the plan drawing does not match the size of the field at the time of the field inspection, which results in (As Build Drawing) the manufacturing drawing is changed, adding and removing work volumes. This delayed the completion of this project by 27.895%.

COVID-19 as pandemic is a decisive factor regarding construction sector since it has to follow social distancing that also categorized as environmental factor. In addition, as well as COVID-19, other environmental factors are also crucial regarding to the delay in building construction including rain on construction activities and environmental safety on project development. Either COVID-19 as environmental factor or others environmental factors are limited to be inspected. Study on COVID-19 and environmental factors is important to understand the impact of these factors on construction sector. Therefore, the objective of this study is to analyze the factor of COVID-19 and environmental factors that affect delays in this project.

2 Materials and method

2.1 Data collection

This research was conducted using a survey method. In the form of questionnaires and documents, as well as primary data from field data. This questionnaire contains a number of factors causing project delays obtained from observations and literature studies. Questionnaires were distributed at the BPKB office building of the Maluku Regional Police Satlantas project, located in Ambon city, to project workers. Secondary data is data that already exists. The data was obtained from the project contractor, PT Sinar Perdana Mandiri. The data obtained are project location map data, company organizational structure, and schedule.

2.2 Data analysis

Before analyzing the data that were collected, variability and reliability test were determined to validate the accuracy of the data. For processing expert data using principal component analysis with the help of the SPSS program. Principal Component Analysis is a multivariate transformation that changes the original correlated variables into new uncorrelated variables (Tetelepta et al., 2019). Reducing the number of these variables reduces the dimensions and allows us to account for most of the variability of the original variables. The number of principal components formed is equal to the number of initial variables. Dimension reduction (simplification) is carried out using the criteria for the percentage of data diversity. This is explained by the first principal component. If the first few principal components explain more than 75% of the variance of the original data, the analysis is sufficient to run it down to the principal components.

3 Results and discussion

3.1 Demographic overview

Describing respondents is the process of describing respondents based on their age and education. In this study, more than 25 respondents accepted the results due to the large number of survey results being shared. A maximum of 25 test samples were used when calculating the sample, and 25 questionnaires were distributed in this study. Of the survey distributions received, 25 surveys were returned, 0 surveys were damaged or incomplete, and 25 survey respondents were edited.

Correspondents were divided into two categories: age and education level. Based on the age group (Fig. 1), 36% are aged 20-25 years, 20% are aged 26-31 years, and 12% are aged 50-52 years. Meanwhile, according to the classification of education level (Fig. 2), the correspondence rate is 8% for elementary school graduates, 20% for junior high school graduates, 68% for high school graduates, and 4% for undergraduate students.

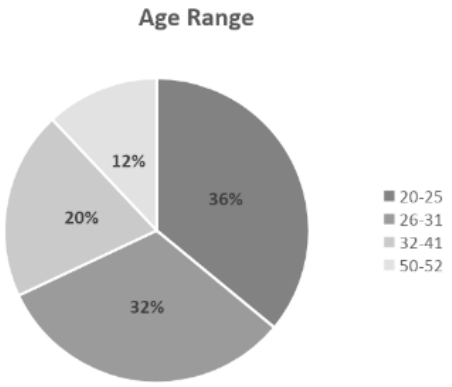

Figure 1 Age level chart of respondents

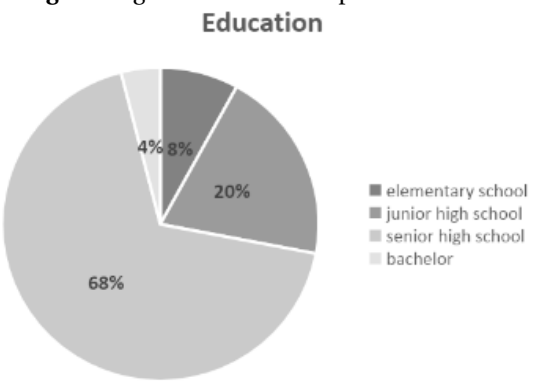

Figure 2 Respondent's education level diagram

3.2 Validity and reliability test

The validity and reliability analysis was performed based on the obtained data (Cevik and Senturk, 2019). A validity test is used to measure whether a survey is effective. A measuring instrument is said to be valid if it can make an accurate statement about the variable being measured. A survey is considered valid if the questions in the survey can say something that is measured by the survey. The validity test is done by comparing the value of r calculated

by the r-table with degrees of freedom (df) = n-2. where n is the number of samples. Letting Modal (df) = 25-2 gives 23, with alpha = 0.05 we get an R-table of 0.396, the analysis uses the SPSS program and we call the total modified article output. Metrics/surveys are valid if the calculated r-value is greater than the r-table. A reliability test is a tool to measure the questionnaire, an indicator of a variable or structure. A questionnaire is said to be reliable or credible if the responses to the questionnaire are consistent or stable. In this test, the researcher measures the reliability of the variable by looking at Cronbach's alpha used with a significance greater than 0.60. A component or variable is said to be reliable if the Cronbach alpha value is greater than 0.60.

Table 1 Validity and reliability test

Question	A	R table	R count	Cron bach's alpha	Alphas' stan dart	Description
Effect of rain on construction activities.	0.05	0.396	0.543	0.782	0.06	valid and reliable
Effect of environmental safety on project development.	0.05	0.396	0.463	0.782	0.06	valid and reliable
Covid-19 pandemic	0.05	0.396	0.485	0.782	0.06	valid and reliable

Based on Table 1, any coefficient of Cronbach's alpha that is greater than 0.6 is considered acceptable (Ogunnusi et al., 2020), whereas all Cronbach's alpha values are 0.782. The largest R count value is in the aspect of rain activity of 0.543, then the influence of environmental security gets an R count value of 0.463 and the covid pandemic is 0.485.

3.3 Environmental delay factor

The five main components are formed based on the results of the principal component analysis using SPSS, as shown in Table 1. The number of components is known from the initial eigenvalues. The initial eigenvalues indicate the importance of each variable's factor in calculating the variance for all analyzed variables. Components indicate the number of factors or variables. The number of factors formed is reflected in the initial eigenvalue (>1) which is greater than one. Using eigenvalues > 1 is only one indication of how many factors xto retain (Finch, 2020).

From the results of the SPSS analysis in the appendix, it can be seen that the main components formed up to the fifth component in the matrix as a whole. It is concluded that the five main components can explain the diversity of the data with a cumulative percentage of 73.317%. Then take the combined variables to form a factor. Although the component matrix table in the appendix shows the distribution of variables for the five formed factors, the results of this matrix must be rotated first to clarify which variables are included in certain factors.

The results of a survey conducted regarding project delays caused by environmental factors can be seen in Table 2.

Table 2 Respondents' perceptions of factors causing delay

Project Delay Factors	TB	AB	B	CB	SB	Amount
The impact of rain on construction activities	4	9	5	4	1	25
The impact of environmental safety on project development	4	10	6	3	2	25
COVID-19 pandemic	9	8	5	1	2	25

The total number of respondents who took part in the survey on the delay in the construction of the Maluku Regional Police BPKB building was 25 workers. The environmental category study divides it into three causes: the impact of rainfall activities, the impact on environmental safety around the project, and the Covid19 pandemic. Table 2 shows that weather activity is the most influential cause of project delays. When it rains, the pre-rain construction process stops until the rain stops. Even after the rain stopped, construction could not resume immediately because the project and materials were still wet. Continued work in wet conditions will damage the material. Projects may be suspended for up to 1 day or 24 hours due to rain. This result is same with (Durdyev & Hosseini, 2019) which found that the impact of wheater conditions during the planning and implementation stage affected project scheduled.

This is different from the surrounding circumstances. Although the environmental conditions are not good, the project will continue to run, but there are some environmental problems, but the impact will not be significant until the project construction is stopped. The same is true for the COVID-19 pandemic. Construction work continues even though several workers have contracted the Covid-19 virus. Infected workers will be temporarily self-isolating while those who are still healthy can continue construction of the project as usual.

In a matrix, the numbers listed in each column are called loading factors and show the results of the correlation between the variables and each factor formed. Each variable is grouped into factors according to the maximum factor load. This component has an eigen value of 1.150 and consists of the following variables: the impact of rain on construction activities, the impact of environmental safety on project development, and the COVID-19 pandemic. Based on the cluster variable component 4, these factors are called environmental factors. The most dominant lag factor between classes, with a large influence of 8.846%.

4 Conclusion

The aim of this study was to analyze the factor of COVID-19 and environmental factors that affect the delay of building construction. From the analysis, it was known that the causes of the delay in the Maluku Regional Police BPKB project were high rainfall, environmental safety around the project, and the COVID-19 pandemic. The most impacting influence was caused by rain activities. As a solution to delays, contractors must provide alternative materials to anticipate material shortages. Workers must be careful when lifting incoming materials or materials to avoid damage. In addition, it requires spare equipment to prevent equipment shortages, build tents to anticipate rainfall, maintain good and harmonious relations to prevent unforeseen circumstances, and inspect locations before making soft drawings.

Declaration of competing interest

The authors declare no known competing interests that could have influenced the work reported in this paper.

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