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The Impact of Dominant Factors on Project Delays in the Probolinggo Square Construction

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ABSTRACT

Delays in construction projects have become a significant issue globally, resulting in financial losses, reduced productivity, and negative impacts on the project's reputation. This research aims to identify and analyze the dominant factors contributing to delays in the Probolinggo City Square construction project, with a focus on understanding the underlying causes and proposing practical mitigation strategies. The research utilizes a quantitative approach, employing factor analysis through SPSS 25 to evaluate the factors influencing project delays. Data were collected through a questionnaire survey involving 35 respondents, including contractors, supervisory consultants, planning consultants, and project owners. The analysis revealed that the most dominant factors contributing to delays include the long process of material sample approval (0.879), changes in the scope of work during implementation (0.790), frequent additional work (0.786), and incomplete identification of work types (0.776). These factors were identified as both internal and external influences that affect the overall project timeline. The findings highlight the need for improved planning, better time management, and enhanced communication between all stakeholders involved. The research emphasizes the importance of addressing these issues in future construction projects to ensure more efficient project execution and to minimize delays. The research also offers valuable insights into effective mitigation strategies that can be applied to similar projects in the future.

Keywords: Dominant Factor, Factor Analysis, Probolinggo City Square, Project Delay.

INTRODUCTION

Delays in construction projects are a major concern globally, impacting industries and economies across various sectors (Alfa, 2018). These delays can result in financial losses, reduced efficiency, and damage to reputations (Ball, 2021). In the construction industry, delays not only affect the service providers but also impact the stakeholders involved, including the government, investors, and the public (Akbar Bahtiar et al., 2023). Various factors contribute to these delays, including planning errors, resource shortages, and unforeseen circumstances, which ultimately affect project completion within the planned timeline.

The Probolinggo city square is a project of the Probolinggo city government there are several stages in the project that are expected to be completed on time, but the project is experiencing time delays. Project delays do often occur with several factors in it can be from the service provider or from other parties which result in additional time and costs beyond the existing plan. If the delay comes from the provider or contractor, then the provider can be fined according to what is stated in the project development contract.

The first phase of the square work is planned to be completed during the 20-week contract period, in the field implementation for the first phase there was a significant delay from week 13 to week 20, namely the largest delay deviation of 37.55% from the time schedule planned by the provider, in the second phase of the Probolinggo city square work package is planned to be completed during the 18-week contract period, However, in its implementation there was a very large deviation starting from week 9 to week 18 where the largest physical delay reached 32% of the time schedule planned by the provider, there were many various problems that existed in the implementation process from additional budgets, material delays, lack of labor, and the method system carried out was less efficient to pursue existing delays. So at all stages of the construction work of the Probolinggo city square all experienced delays and in its implementation required an extension of time to exceed the budget year.

Despite all the planning, the construction process of Probolinggo City Square is often disrupted by disputes that arise during the construction process. So that it affects the performance of time in project completion. This is a problem that must be resolved. In addition, it is necessary to analyze the delay and how to mitigate the delay factor.

Delays in the implementation of construction projects are one of the biggest challenges faced by the construction industry, both at the domestic and international levels. (Siswanto & Salim, 2019) explains that various factors can trigger these delays, such as changes in plans during implementation, ineffective project management, and incomplete design documents and technical specifications. These conditions not only increase the cost of implementation, but also reduce the quality of the final project outcome and create dissatisfaction among stakeholders.

Globally, project delays have become a serious issue that impacts project success across sectors. In Indonesia, several main causes of delays have been identified, including a lack of adequately competent labor, material supply issues, and weak time management (Sambasivan & Soon, 2017). The impact of these delays is not only felt by construction service providers in the form of reduced reputation but also affects the effectiveness of government budget allocations. Based on research, the average construction project in Indonesia is delayed by 10% to 30% of the planned duration, indicating that this problem requires serious attention to improve the efficiency of the national construction industry (Alwi et al., 2002).

Research in the thesis titled "Analysis of the Influence of Factors Causing Project Delay on the North Jakarta RSUD Koja Parking and Building Construction Project" found that the Labor Aspect (X_1), Material Aspect (X_2), Equipment Aspect (X_3), Project Location Aspect (X_4), Work

Change Aspect (X_5), Managerial Aspect (X_6), and External Factor Aspect (X_7) affect Project Delay (Y) by 78%, with the remaining 22% influenced by other factors not discussed in the research. The Delay Factor from the Project Location Aspect (X_4) had the highest influence on project delays, as indicated by the regression equation (0.561). An increase in the delay factor from the project location aspect most affects the increase in the risk of project delays (Romadhon & Tenriajeng, 2020).

In a research titled "Analysis of Factors Causing Change Order and Its Effect on the Performance of Construction Project Implementation Time in North Sulawesi Provincial Government," it was concluded that 88.4% of the factors that cause change orders affect project performance, while the remaining 11.6% is related to other variables not examined. The dominant factor causing change orders was the discrepancy between field drawings, with the largest partial correlation of 0.7885 (78.85%), the largest count of 6,622, the smallest probability of 0.000, and the largest regression coefficient of 0.924 (Gumolili et al., 2012).

In previous research entitled "The Cause Delay Factors Analysis of Building Construction Project (The Application of Regression Model)," (Suyatno, 2010) stated that the factors contributing to project delays, based on research conducted at the Surakarta Public Works Office, included labor shortage, errors in planning and specifications, bad weather (such as heavy rain and flooded locations), low productivity by contractors, material mismanagement, and changes in the scope of work by consultants. According to (Levis & Atherley, 1996), the causes of delay in a project can be categorized into three types: excusable non-compensable delays, excusable compensable delays, and non-excusable delays.

Based on the background above, the objectives of this research are to identify the factors contributing to delays in the construction of Probolinggo City Square, analyze the impact of these factors on the project timeline, and propose strategies for mitigating these delays. The benefits of this research include providing a comprehensive understanding of the delay factors affecting the project, which will help in improving future project management practices and enhancing the overall efficiency and effectiveness of the construction process for Probolinggo City Square.

RESEARCH METHOD

Type of Research

This research was conducted on the Probolinggo City Square development project with the aim of evaluating the current conditions and exploring factual information related to the factors that influenced the project's delay. A quantitative method was used to identify, assess, and analyze the factors causing the delay using SPSS 25.

Object of Research

The object of research refers to the main focus of the research, covering various issues that are in line with the research objectives. The selection of this object is based on its relevance to the problem formulation that has been explained in the background, so that it can make a significant contribution to achieving the research objectives in a scientific and systematic manner. In this research, Probolinggo City Square was identified as the right object to be analyzed because it has direct relevance to the problem under research.

Determining the Sample

Population is the entire research subject. The sample is part of the number and characteristics possessed by the population, or the smallest part of the population members taken according to certain procedures so that they can represent the population (Siyoto & Sodik, 2015). So the sample obtained in this research is 35 respondents representing contractors, supervisory consultants, planning consultants, and project owners.

Data Analysis Method

The purpose of data analysis is to simplify data into a form that is easier to read and interpret. In this process, statistics are often used because one of the functions of statistics is to simplify data. Questionnaire measurement is carried out on a linkert scale where respondents are given choices which then only need to choose the degree of agreement / disagreement with the questions asked.

The linkert scale values are :

a. Very influential answers are rated 4
b. Influential answers are rated 3
c. Somewhat influential answers are rated 2
d. Answers with no effect are given a value of 1

The analysis methods that will be used include:

1. Determining Scores for Questionnaire statements
2. Determining the Dominant Factor

Respondent Population

The population in this research is determined by criteria that are relevant to the object to be studied itself, namely the delay in the Probolinggo city square project. The population itself is divided into 4 parts, namely as follows:

Table 1. Number of Respondents

No.	Description	Respondents
1	Contractor	15
2	Supervisory Consultant	10
3	Owner's Party	5
4	Planning Consultant	5
	Total	**35**

Validity and Reliability Test

To determine the validity of the 10 factors given in the questionnaire to the respondents, a validity test was carried out using the SPSS Version 29 program with reference to the Correlated Item Total Correlation column (see table). Validity is measured by correlating the item score with the total score, using the product moment technique. According to (Arikunto, 2010), a valid instrument has high validity, and items are considered valid if the correlation is greater than 0.361 for 35 respondents. In addition, the reliability of the instrument is tested to ensure consistency of results using the Alpha coefficient formula (Arikunto, 2010). The reliability test was carried out with SPSS 29.0 for Windows, where the instrument is considered reliable if the Cronbach Alpha value is more than 0.6.

KMO test and Bartlett's test

The Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity are procedures used to measure the feasibility of data in factor analysis. Factor analysis is a statistical technique that aims to identify the basic structure or pattern of relationships between variables. KMO and Bartlett's test ensure whether the data used is suitable for factor analysis.

1. Kaiser-Meyer-Olkin (KMO) is a measure of sample adequacy that indicates how well the data can be analyzed through factor analysis. The KMO value has the following interpretation range:
   a. 0.90 and above: Excellent
   b. 0,80-0,89: Good
   c. 0,70-0,79: Enough
   d. 0,60-0,69: Marginal
   e. Below 0.60: Inadequate

   A high KMO indicates that the correlation patterns in the data are strong enough for factor analysis.
2. Bartlett's Test of Sphericity tests the null hypothesis that the correlation matrix is the identity matrix (no relationship between variables). If the probability value (p-value) of Bartlett's test is significant ($p < 0.05$), then there is a correlation between variables, so the data is suitable for use in factor analysis (Hair et al., 2014).

Anti- Image Correlations

Anti-Image Correlations is a step in factor analysis used to assess the suitability of variables for inclusion. The anti-image matrix shows the partial correlations between variables after controlling for others. According to (Hair et al., 2014), the Measures of Sampling Adequacy (MSA) on the diagonal of the matrix should be above 0.5 to indicate the variable is appropriate for factor analysis. Low MSA values suggest that a variable is less relevant and may be excluded. This step, complementing the KMO test and Bartlett's Test, provides a detailed, variable-specific review, ensuring the data's suitability before factor extraction, leading to more accurate and reliable results.

Eigenvalue

The eigenvalue is a measure used in factor analysis to determine how much variance can be explained by each resulting factor. In factor analysis, the eigenvalue describes the strength or contribution of a factor in explaining the total variability of all variables in the dataset. According to (Ghozali, 2018), an eigenvalue of 1 or more is often used as a minimum limit for determining significant factors in factor analysis. Factors with an eigenvalue below 1 are considered not to have a significant enough contribution in explaining the total variance and are usually not included in the factor structure. The eigenvalue plays an important role in deciding the number of factors to be used in the analysis. Factors with large eigenvalues represent the main dimensions of the data, while factors with small eigenvalues can be considered as noise or insignificant contributions.

Component Matrix or Rotated Matrix

The Component Matrix in factor analysis displays the correlation between each variable and the extracted factors before rotation, indicating the "loadings" or contribution of each variable to the factors. Significant factor loadings typically have a threshold based on sample size: for small samples (<100), a loading ≥ 0.7 is significant, and for large samples (>300), a loading ≥ 0.3 is acceptable (Hair et al., 2014). The Rotated Matrix, obtained through rotation, simplifies the factor structure for easier interpretation by maximizing loadings on one factor while minimizing them on others. Rotation can be performed using two approaches: Orthogonal Rotation and Oblique Rotation.

RESULT AND DISCUSSION

Data Description

This chapter presents an overview of the object of research and the results that have been obtained, along with data interpellation. This data analysis is the most important part of the preparation of the thesis because in this analysis a conclusion is obtained which is an overview of the answers to the problems raised in the introduction in front. In this research there is a table below.

Table 2. Research Variables

No.	Variables	Researcher
1	Changes in design/details of work during implementation	According to Suyanto; in Deny dwiantoro (2024)
2	There is a lot of (frequent) additional work	According to Budiyaman Praboyo; in Deny dwiantoro (2024)
3	Long process of requesting and approving material samples	I.A.Rai Widhianti; in Deny dwiantoro (2024)
4	Changes in the scope of work at the time of implementation	According to Suyanto; in Deny dwiantoro (2024)
5	Lack of labor skills	According to I.A.Rai Widhianti in Deny dwiantoro (2024)
6	Late payment by the owner	According to Suyanto in Deny dwiantoro (2024)
7	Slow resource mobilization	According to I.A.Rai Widhianti in Deny dwiantoro (2024)

8	Insufficient number of workers	According to Suyanto in Deny dwiantoro (2024)
9	Incomplete identification of job types	According to Suyanto in Deny dwiantoro (2024)
10	Access to the project site is difficult	According to Suyanto in Deny dwiantoro (2024)

Based on the table above, these 10 variables will be used as independent variables for factor analysis. These factors are changes in design/work details at the time of implementation (X_1), a lot (often) of additional work (X_2), The process of requesting approval of old material samples (X_3), Changes in the scope of work at the time of implementation (X_4), Lack of labor expertise (X_5), Delay in payment by the owner (X_6), Mobilization of resources (materials, tools, labor) is slow (X_7), fewer workers are sufficient/in accordance with existing work activities (X_8), Incomplete types of work that must exist (X_9), Access to the project site is difficult (X_{10}). In accordance with the research stages described in the previous chapter after the required primary data is obtained, then proceed with data analysis and discussion to get answers to existing formulas. This data analysis was carried out with the help of the SPSS (Statistical Products and Services Solution) version 25 program.

Identification and Classification of Delay Factors

In this research there are 10 factors that cause delays in project completion. These ten variables were made into a questionnaire and submitted to 35 selected Respondents. These factors are shown in the table below.

Table 3. Delay Factors

No.	Question	Code	Factor
1	Changes in design/details of work during implementation	X1	Internal
2	There is a lot of (frequent) additional work	X2	Internal
3	Long process of requesting and approving material samples	X3	External
4	Changes in the scope of work at the time of implementation	X4	External
5	Lack of labor skills	X5	Internal
6	Late payment by the owner	X6	External
7	Slow resource mobilization	X7	External
8	Insufficient number of workers	X8	Internal
9	Incomplete identification of job types	X9	Internal
10	Access to the project site is difficult	X10	External

Of the 10 factors that were used as questions, each respondent answered the questions with an inkert scale, and filled in the answers according to the table below, namely:

a. Answers that are very influential are rated 4
b. Influential answers are rated 3
c. Somewhat influential answers are rated 2
d. Answers with no effect are given a value of 1

Table 4. Questionnaire Format

No.	Causes of Delay	Code	Rating Scale			
			1	2	3	4
1	Changes in design/details of work during implementation	X1				
2	There is a lot of (frequent) additional work	X2				
3	Long process of requesting and approving material samples	X3				
4	Changes in the scope of work at the time of implementation	X4				
5	Lack of labor skills	X5				
6	Late payment by the owner	X6				
7	Slow resource mobilization	X7				
8	Insufficient number of workers	X8				
9	Incomplete identification of job types	X9				
10	Access to the project site is difficult	X10				

Validity Test

The technique used is Pearson correlation. The guideline for seeing item validity is to compare the probability of each item with the total score. The validity test criteria in brief are if using 35 respondents, the correlation value is 0.361 if the correlation is greater than 0.361, the questionnaire can be said to be valid.

Table 5. Validity Test

Item	r_{table} (N=30, α= 5%)	Pearson Correlation Value (r_{count})	Description
Item number 1	0,361	0.657	Valid
Item number 2	0,361	0.817	Valid
Item number 3	0,361	0.810	Valid
Item number 4	0,361	0.630	Valid
Item number 5	0,361	0,699	Valid
Item number 6	0,361	0,678	Valid
Item number 7	0,361	0.845	Valid
Item number 8	0,361	0.788	Valid
Item number 9	0,361	0.723	Valid
Item number 10	0,361	0.688	Valid

From table 5. After testing all question items can be declared valid the correlation coefficient (r count) is greater than r table.

Reliability Test

Reliability shows an understanding that an instrument can be trusted enough to be used as a data collection tool because the instrument is good (Arikunto, 2010). Whether an instrument is reliable or not can be known by consistent results. Given that the instrument used in this research resembles the value of a description form question, where each test item has a score value of 1 to 4, the formula chosen to test reliability is the Alpha coefficient formula (Arikunto, 2010) The reliability test in this research was carried out with the help of SPSS 29.0 for windows software and saw the value of Cronbach Alpha if it was more than 0.6 then it was declared reliable, the criteria were as follows.

a. If the value of α> r_table, then the instrument item is declared reliable.
b. If the value of α < r_table, then the instrument item is declared unreliable.

Table 6. Reliability Test

Variables	ralpha	rcritical	Criteria
X1	0.895	0.6000	Reliable
X2	0.884	0.6000	Reliable
X3	0.884	0.6000	Reliable
X4	0.897	0.6000	Reliable
X5	0.893	0.6000	Reliable
X6	0.903	0.6000	Reliable
X7	0.881	0.6000	Reliable
X8	0.886	0.6000	Reliable
X9	0.891	0.6000	Reliable
X10	0.893	0.6000	Reliable

KMO test and Bartlett's test

The Kaiser-Meyer-Olkin (KMO) test is one of the testing techniques to measure sample adequacy in factor analysis. The KMO value indicates whether the data has a sufficient relationship pattern to proceed to factor analysis. This test calculates the ratio between partial variance and total variance. The KMO value ranges from 0 to 1, with the following interpretation:

a. KMO value ≥ 0.90: Very good.
b. KMO value ≥ 0.80: Good.
c. KMO value ≥ 0.70: Fair.
d. KMO value ≥ 0.60: Less.
e. KMO value < 0.50: Inadequate.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is used to measure sample adequacy, where values above 0.50 are considered adequate to proceed with factor analysis. Bartlett's test is used to test the assumption that the correlation matrix in factor analysis is the identity matrix. This test verifies whether there is a significant relationship between variables. If the test results show statistical significance (ppp-value <0.05), then the data is considered to have sufficient relationships to perform factor analysis.

1) If ppp-value <0.05: The correlation matrix is significant, so factor analysis can be performed.
2) If ppp-value ≥ 0.05: The correlation matrix is not significant, so factor analysis is not recommended.

Bartlett's test is used to determine whether the correlation matrix is significantly different from the identity matrix, which is a prerequisite for continuing factor analysis" (Hair et al., 2014).

In this case, the KMO value must be above 0.5 and the Bartlett's Test of Sphericity value must be below 0.05 so that the overall factor can be processed further (Eprillison, 2015).

Table 7. KMO and Bartlett's Test Values

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.822
Bartlett's Test of Sphericity	Approx. Chi-Square	239.958
	df	45
	Sig.	.000

In the table above, it can be obtained that KMO MSA is 0.685 ≥ 0.5 so it is considered adequate and the significance value is 0.01 <0.05. So this shows that the variables involved have a strong correlation and are suitable for further analysis.

Anti-Image Correlations

Anti-image Correlations is a matrix that shows the residual correlation between variables after excluding the influence of other factors in factor analysis. This matrix is useful for checking whether variables have a significant contribution to the factor model. A low anti-image correlation (near zero) indicates that the variable is less relevant to be included in the factor analysis, while a high anti-image diagonal correlation (close to 1) indicates that the variable is good enough to be analyzed further. If the AIC with MSA ≥ 0.50, the variable can be predicted and the analysis also continues, whereas if the AIC with MSA < 0.50, the variable must be excluded and the variable selection repeated (Eprillison, 2015).

Table 8. Anti-Image Correlations Value

Anti-image Correlations		
Anti-image Correlations	X1	.764 [a]
	X2	.831 [a]
	X3	.782[a]
	X4	.832[a]
	X5	.786[a]
	X6	.861 [a]
	X7	.831 [a]
	X8	.839 [a]
	X9	.859 [a]
	X10	.838 [a]

In the table there is a code (a) which indicates that the code is intended for MSA (Measure of Sampling Adequancy). It can be seen that the MSA value for 10 variables is > 0.5, so all variables have a strong enough correlation that all variables can be analyzed further.

Eigenvalue

In finding the value of a factor and the dominant factor can be determined by looking at the factor components formed by looking at the eigenvalue which must be above one (1), if the eigenvalue is not more than 1, it cannot be included in the factor model for further factor analysis. As for the value of the eigenvalue.

Table 9. Eigenvalue

Initial Eigenvalues			
Component	**Total**	**% of Variance**	**Cumulative %**
1	6.021	60.212	60.212
2	1.019	10.185	70.398
3	.727	7.270	77.668
4	.689	6.894	84.562
5	.461	4.609	89.170
6	.379	3.789	92.960
7	.333	3.326	96.286
8	.149	1.489	97.775
9	.128	1.285	99.059
10	.094	.941	100.000
Extraction Method: Principa; Component Analysis			

There are two components that show an eigenvalue of more than one, so that two factor components are formed that have an influence on delays in construction completion. In the above results there are 2 variations of factor components, namely with a total eigenvalue of 6.021 for component 1 and 1.019 for component 2. Next is to show the value of the correlation results of each factor variable as follows.

Table 10. Component Matrix Value

Component Matrix[a]		
	1	**2**
P01	.679	.340
P02	.847	-.269
P03	.822	-.425
P04	.711	-.408
P05	.749	.500
P06	.672	.254
P07	.877	.086
P08	.807	.129
P09	.780	-.320
P10	.787	.205
Extraction Method: Principal Component Analysis.		
a. 2 components extracted		

From the table above, it can be seen that the value of factor distribution is still uneven, only having the highest value in factor component 1. Then factor rotation is carried out so that the factor values can be evenly distributed with the following results.

Table 11. Rotated Component Matrix values

Rotated Component Matrix[a]		
	Component	
	1	2
P01	.722	.234
P02	.415	.786
P03	.288	.879
P04	.220	.790
P05	.885	.169
P06	.657	.290
P07	.686	.554
P08	.666	.475
P09	.331	.776
P10	.705	.406
Extraction Method: Pprincipal Component Analysis		
Rotation Method: Varimax with Kaiser Normalization		
a. Rotation cooonverged in 3 iterations		

In the table above, it can be seen that the distribution of factor values resulting from rotation is clearly distributed or has been evenly distributed. Of the two components formed, 10 factors are obtained with their respective values. So that the factors formed are as many as 10 factors. The factor value will determine which factor will be the most dominant factor among the 10 factors.

Determination of Dominant Factors

After the factors were previously determined by looking at the eigenvalue which must be> 1, in the end 2 factor components were selected which had an eigenvalue above 1 with a total of 10 factors. Then determining the most dominant factor can be done by looking at the highest factor value of the 8 factor indicators. The highest factor value will be the benchmark for what factor will be the most dominant factor in influencing delays in the Probolinggo City Square construction project. For more details regarding the most dominant factors can be seen in Table 12 as follows.

Table 12. Delay Factors

Code	Factor	Variables	Value
X3	External	Long process of requesting and approving material samples	0,879
X4	External	Changes in the scope of work at the time of implementation	0,790
X2	Internal	There is a lot (often) of additional work	0,786
X9	Internal	Incomplete identification of job types	0,776

Table 12 shows the dominant delay factors in the Probolinggo City Square construction project. The factors with the highest values, such as material approval processes (0.879) and changes in scope (0.790), were identified as the main contributors to delays, with both external and internal factors playing a significant role.

CONCLUSION

The conclusion of this research, based on the results of an analysis of the delays in the Probolinggo City Square construction project, is that the research succeeded in identifying the main factors that contributed to the delays. The most dominant factor is the length of the material sample request and approval process (X_3) with a value of 0.879, followed by changes in the scope of work during implementation (X_4) with a value of 0.790, frequent additional work (X_2) with a value of 0.786, and incomplete identification of the type of work (X_9) with a value of 0.776. These factors are interrelated and highlight the need for a more structured approach to project planning, time management, and communication among stakeholders. The findings of this research provide valuable insights that can guide future projects in minimizing delays and improving project efficiency. Future research can explore further mitigation strategies and their practical applications in similar construction projects.

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