ANALYSIS OF FACTORS CAUSING DELAY IN CONSTRUCTION PROJECTS IN THE IMPLEMENTATION OF ROAD IMPROVEMENT AND BRIDGE CONSTRUCTION ON THE PALAK SIRING - MATAI ROAD SECTION

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ABSTRACT

This study aims to: (1) identify the factors causing delays in construction projects for road improvement and bridge construction activities on the Palak Siring – Matai Road Section, and (2) determine the most dominant factors influencing the project delays. The method used is exploratory factor analysis with a quantitative approach. The research sample consisted of 114 respondents who were all workers involved in the project implementation, using a total sampling technique. The results of the analysis indicate that there are six main groups of factors causing project delays, namely: (1) availability of materials and equipment, (2) external interference and communication, (3) discipline and productivity of the workforce, (4) design complexity and funding, (5) location constraints and tool incompatibility, and (6) weaknesses in supervision and technology. These factors reflect the interaction between technical and non-technical aspects that affect the smoothness of construction projects. The most dominant factor is the availability of materials and equipment, as indicated by the highest factor loading values on the indicators of material delivery, material availability, and tool completeness. Dependence on supplies from outside the region, difficult access conditions, and weak logistics coordination are the main obstacles. These findings emphasize the importance of supply chain efficiency and equipment readiness in the field. Therefore, strengthening procurement systems, strategic logistics management, and selecting the right vendors need to be prioritized in future construction project management.
Keywords: project delays, factor analysis, logistics, materials, equipment, road and bridge construction.

INTRODUCTION

Infrastructure development is a top priority in supporting economic growth and equitable development in Indonesia. Several factors significantly influence the success of this project, including cost, time, and quality during construction. If the construction time deviates from the specified timeline, it can result in increased costs for both the contractor and the owner. The contractor incurs additional costs (overcosts) to complete the work and also pays penalties to the owner for missing the agreed-upon completion date. Meanwhile, the owner loses time due to delays or delays in project completion, which can result in significant economic losses.

Bridges are one form of infrastructure that plays a strategic role, as they connect regions and facilitate transportation and logistics flows. However, bridge construction projects often face various obstacles, one of which is delays in project completion. These delays not only increase costs but also hinder the long-term benefits of the infrastructure for the community and the local economy. According to Kareth (2012), construction project implementation consists of interdependent activities. The larger the project, the greater the risks involved, from planning to managing resources such as labor, costs, time, equipment, and so on, all the way through to project implementation (Abdul, 2016).

According to Heizer and Render (2017), a project is a series of tasks directed toward a primary outcome. In network analysis, a project is a series of activities aimed at producing a unique product and carried out only within a specific (temporary) period. Meanwhile, a construction project is a form of activity that takes place over a limited timeframe and requires specific resources to achieve a result in the form of a building or infrastructure (Puruhita & Suprapto, 2014).

Project completion requires project management to ensure proper implementation according to plan. Project management is the knowledge, skills, tools, and techniques used to carry out project activities to meet project requirements. Project management is achieved through the application and integration of project management processes: initiation, planning, implementation, monitoring, control, and closure (PMBOK, 2004).

Figure 1.1 Palak Siring-Matai Road Activity Location

The National Road Implementation Work Unit, Region II, Bengkulu Province, has carried out road improvement and bridge construction on the Palak Siring-Matai Road Section through the E-Catalog scheme. This project is part of the government's efforts to support the development of the land transportation sector and accelerate economic growth, particularly in South Bengkulu. This road section serves as an alternative route between regions and districts and plays a strategic role in improving connectivity and mobility. This infrastructure is expected to significantly contribute to logistics efficiency and equitable development between regions.

The project is under the supervision of PPK 2.3 of the National Road Implementation Work Unit, Region II, Bengkulu Province, and consists of two main activity areas: road improvement and bridge construction on the same section. Technical supervision of the project is carried out by the supervising consultant PT. Lima Pilar Persada, a joint venture of PT. Puri Dimensi under Contract Number: HK.02.03/Bb25/SATKER-P2JN/869 dated July 18, 2023.

The road improvement work was carried out by PT. Belibis Raya Group, under Contract Number: HK0201-Bb25/SATKER PJN.II/PPK2.3/531 dated July 20, 2023, with a contract value of Rp44,033,699,000 (including VAT) and a construction period of 165 calendar days. The scope of the road improvement work covers a 17.50 km road with a width of 4 meters, including: a 15 cm thick layer of selected embankment, a 30 cm thick layer of class A aggregate, a 5 cm thick AC-WC wearing course, and minor works such as stone overlays, drainage channels, and box culverts.

Meanwhile, the bridge construction work was carried out by PT. Kencana Pratama Konstruksi, based on Contract Number: HK0201-Bb25/SATKER PJN.II/PPK2.3/554 dated July 25, 2023 with a contract value of Rp5,044,438,000 (including VAT) and an implementation period of 160 calendar days. The scope of work includes the construction of a bridge structure with a length of 16.60 meters and a width of 8 meters, two abutment units with a well foundation with a diameter of 300 cm and a height of 3 meters, four precast girder beams type I, concrete floor slabs of quality fc' 30 MPa, and a 100-meter long abutment with a 5 cm thick AC-WC layer.

However, the project experienced delays in both work areas. Road improvement was delayed by eight weeks, or 50 calendar days, out of a total duration of 165 days. The deviation began to appear in the 10th week and reached its highest deviation of -17.28% in the 18th week. Bridge construction was also delayed by two weeks, or 10 calendar days, out of a total of 160 days, with the deviation beginning to appear in the 16th week and reaching -7.00% in the 18th week.

This situation indicates that project implementation has not proceeded according to the initial plan. A construction project delay can be defined as the project's completion deadline being missed from the contractual deadline, which ultimately leads to cost overruns, disruptions to other project schedules, and the loss of opportunities for subsequent activities. Several factors suspected of contributing to the delays include labor, implementation methods, time, costs, and the influence of external factors such as weather, social conditions, and local policies. Therefore, this study was conducted to thoroughly understand the causes, impacts, and solutions for delays in the road improvement and bridge construction projects on the Palak Siring-Matai section. It is hoped that this will provide solutions to support timely project completion and improve overall construction performance.

According to Taufan (2016), project delays are a constant occurrence in every project. Specifically for service providers, project delays result in time delays, which in turn reduce the profits targeted by the contractor. Consequently, the planned development program targets may not meet expectations. Delays can also be caused by environmental factors, unpreparedness of the land for the project, poor project management, and human resource errors. According to Kamaruzzaman (2012), project delays are caused by both the contractor and the owner.

Delays can also occur without being caused by either party. Construction project delays mean an extension of the project completion time, as outlined in the contract documents. Project delays often lead to disputes and lawsuits between owners and contractors, resulting in significant costs for both the contractor and the owner. Contractors are subject to contractual penalties. Furthermore, contractors incur additional overhead costs during the project's duration. From the owner's perspective, project delays result in reduced revenue due to delayed facility operations.

Based on the background outlined above, the researcher is interested in conducting further research entitled "Analysis of Construction Project Delay Factors in the Implementation of Road Improvements and Bridge Construction on the Palak Siring-Matai Road Section."

METHOD

The research methods used in this study were descriptive and verification. Descriptive methods are used to describe the condition or value of one or more variables independently, while verification methods can be defined as research conducted on a specific population or sample with the aim of testing a predetermined hypothesis. The population in this study was 114 workers on the Palak Siring-Matai Road Improvement and Bridge Construction Project. The sample used in this study was obtained using a non-probability sampling technique with saturated sampling.

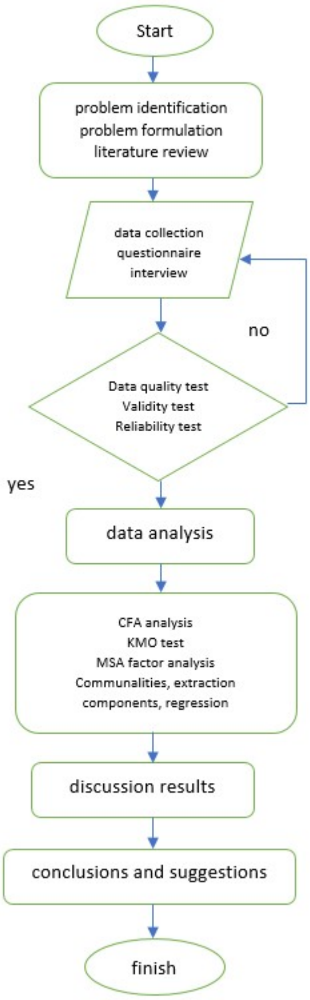

Figure 3.1 Research Flowchart

3.2.6.2 Factor Analysis

Factor analysis is used for exploratory research to identify factors influencing variables before they are clearly known. Furthermore, this analysis can test the validity of questionnaires, where indicators that do not cluster within a variable are considered invalid. Factor analysis simplifies a large number of variables into several main factors with similar characteristics, based on the correlation between the variables.

Prior to analysis, a normality test was conducted to ensure normal data distribution, followed by the KMO test (≥0.5) and Bartlett's Test of Sphericity ($p < 0.05$) to check the adequacy of the correlation between variables. The Determinant of Correlation Matrix was used to assess the interrelationships between variables (values close to 0 indicate variables are interrelated).

The main method was Principal Component Analysis (PCA), which reduces the data to factors that contain the maximum variance. The number of factors was determined based on eigenvalues (>1), the percentage of cumulative variance, and a scree plot. Factor rotation (varimax) was used to simplify interpretation, so that each variable had a high factor loading on one factor and a low factor loading on another.

Significant factor loadings were determined based on sample size; in this study, with a sample of 108, the threshold factor loading was 0.55. After the factors were formed, they were named based on the characteristics of their member variables, and validation was performed by dividing the sample to ensure the stability and generalizability of the results.

RESULTS AND DISCUSSION

Factor analysis is a technique for analyzing the relationships between several interrelated variables, with the aim of simplifying the variables under study into a smaller number of factors than the initial number (Santoso, 2006). This study used the Confirmatory Factor Analysis (CFA) because it identifies the structure of the relationship between variables by revealing the factors (dimensions) that underlie the relationship.

4.1.1.1 Uji Kaiser Mayer Olkin (KMO) and Bartlett's Test of Sphericity

The Kaiser Meyer Olkin (KMO) test, Measure of Sampling Adequacy (MSA), and Bartlett's Test of Sphericity were used to determine the feasibility of factor analysis. The KMO test, with a value ranging from 0 to 1, questions the appropriateness of factor analysis. If the index value is high (ranging from 0.5 to 1.0), factor analysis is feasible. However, if the KMO value is below 0.5, factor analysis is not feasible. Meanwhile, Bartlett's test of sphericity is used to test the correlation between variables. If Bartlett's test of sphericity is significant, it indicates that the correlation matrix has a significant correlation with a number of variables. The following table shows the results of the KMO and Bartlett tests using SPSS 25 software.

Table 4.13 Results of the Kaiser Meyer Olkin (KMO) and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.814
Bartlett's Test of Sphericity	Approx. Chi-Square	2387.091
	df	465
	Sig.	<.001

Source: Author's Processed Results, 2025

The output table above shows that the KMO-MSA value of 0.814 (greater than 0.5) indicates that the variables can be predicted and further analyzed. The Bartlett's Test of Sphericity significance value of 0.001 (less than 0.05) indicates that the research variables can be predicted and further analyzed.

4.1.1.2 Anti-Image Matrices

In addition to the KMO-MSA value indicating the feasibility of factor analysis, this is also supported by the results of the Anti-image Matrices. These values are found on the main diagonal, indicated by the numbers marked with the letter (a). The value must be greater than 0.5 because this number indicates how much an indicator can be explained by other indicators; the higher the value, the better. Table 4.16 shows the Anti-image Matrices values for each indicator. This table indicates that all indicators have an anti-image correlation value above 0.5, allowing for further analysis. In this study, there was one indicator, BA5, that did not meet the requirements for the Anti-image Matrix test, because its value was below 0.5.

The following are the results of the BA4 variable extraction, which was removed, resulting in the Anti-image Matrix values as shown in Table 4.15 below.

Table 4.15 Anti Image Matrices Values

Item	*Anti-image Matrices*
TK1	0,878
TK2	0,693

TK3	0,907
TK4	0,835
TK5	0,813
TK6	0,862
PK1	0,726
PK2	0,829
PK3	0,853
PK4	0,812
PK5	0,806
BA1	0,821
BA2	0,764
BA3	0,820
BA4	0,800
MP1	0,821
MP2	0,716
MP3	0,858
MP4	0,803
MP5	0,770
DK1	0,883
DK2	0,779
DK3	0,811
KU1	0,830
KU2	0,828
KU3	0,807
FL1	0,775
FL2	0,844
FL3	0,916
FL4	0,825

4.1.1.2 Variable Extraction

The next stage of factor analysis is extracting a set of selected variables to form one or more factors. This can be seen from the magnitude of the communality of the variables described in each item. The greater the communality of a variable, the stronger the relationship between the variable and the factors formed. Conversely, the lower the communality of a variable, the weaker the relationship between the variable and the factors formed. The communality values of the variables can be seen in Table 4.16.

Table 4.16 Communality Values

Communalities		
	Initial	Extraction
TK1	1.000	0.598
TK2	1.000	0.667
TK3	1.000	0.364
TK4	1.000	0.600
TK5	1.000	0.566
TK6	1.000	0.539
PK1	1.000	0.641
PK2	1.000	0.601
PK3	1.000	0.684
PK4	1.000	0.853
PK5	1.000	0.635
BA1	1.000	0.888
BA2	1.000	0.948
BA3	1.000	0.931
BA4	1.000	0.785
MP1	1.000	0.655
MP2	1.000	0.768
MP3	1.000	0.652
MP4	1.000	0.610
MP5	1.000	0.662
DK1	1.000	0.534
DK2	1.000	0.513
DK3	1.000	0.605
KU1	1.000	0.779
KU2	1.000	0.766
KU3	1.000	0.631
FL1	1.000	0.642

FL2	1.000	0.727
FL3	1.000	0.639
FL4	1.000	0.668
Extraction Method: Principal Component Analysis.		

Source: Author's Processed Results, 2025

The table above shows the initial and extraction values. The initial value represents the variable variance before extraction, and the extraction value represents the percentage of a variable's variance that can be explained by the factors to be formed. A higher extraction value indicates a stronger relationship with the factors to be formed. The table above shows that each variable has a value above 0.5, and variables with values closer to 1 have a strong relationship with the factors to be formed.

4.1.1.2 Determining the Number of Factors (Factoring)

The number of factors needed to represent the variables to be analyzed is based on the magnitude of their eigenvalues and the percentage of total variance. Only factors with an eigenvalue ≥ 1 are retained in the factor analysis model, while all others are excluded. The results of the Total Variance Explained table are shown in Table 4.17.

Table 4.17 Total Variance Table

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	8.189	28.237	28.237
2	5.238	18.063	46.300
3	2.168	7.475	53.776
4	1.564	5.394	59.170
5	1.429	4.929	64.099
6	1.280	4.414	68.513
7	.952	3.284	71.798
8	.902	3.112	74.909
9	.824	2.842	77.752
10	.721	2.486	80.238
11	.598	2.063	82.300
12	.549	1.891	84.192
13	.514	1.772	85.964
14	.497	1.715	87.679
15	.479	1.652	89.330
16	.428	1.477	90.808
17	.401	1.383	92.190
18	.377	1.299	93.490
19	.317	1.093	94.583
20	.308	1.062	95.645
21	.262	.902	96.546
22	.217	.747	97.294
23	.202	.695	97.988
24	.169	.583	98.572
25	.137	.472	99.044
26	.125	.432	99.476
27	.069	.238	99.713
28	.060	.208	99.922
29	.023	.078	100.000

Extraction Method: Principal Component Analysis.

Source: Author's Processed Results, 2025

Table 4.17 shows that the number of factors formed is six. The first factor has an eigenvalue of 8.189, the second factor has an eigenvalue of 5.238, the third factor has an eigenvalue of 2.168, the fourth factor has an eigenvalue of 1.564, the fifth factor has an eigenvalue of 1.429, and the sixth factor has an eigenvalue of 1.280. From this table, six factors can be identified, with variance percentages of 28.237%, 18.063%, 7.475%, 5.394%, 4.929%, and 4.414%, respectively. Thus, a total of 68.513% of all variables can be explained by the six factors formed.

Furthermore, the number of factors can be seen from the resulting scree plot diagram. The scree plot explains the relationship between the number of factors formed in graphical form, as shown in Figure 4.1.

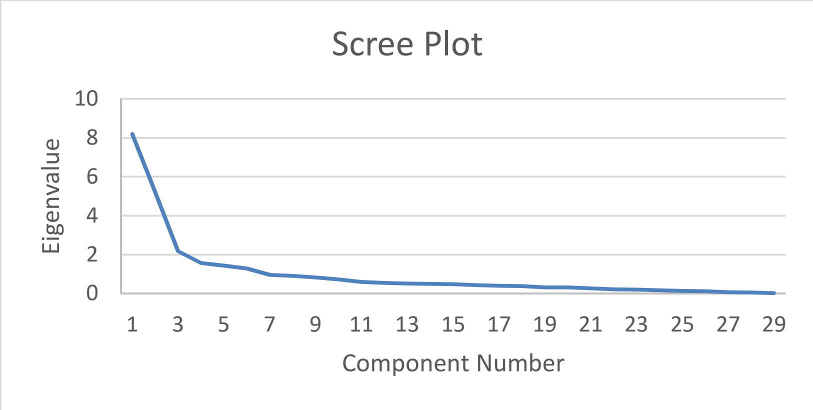

Figure 4.1 Scree Plot

Figure 4.1 shows the results of grouping based on the new eigenvalues. The higher the eigenvalue of a factor, the higher its placement. Seven factors had eigenvalues above 1.0, while items along the descending line had eigenvalues below 1.0.

4.1.1.2 Factor Rotation

According to Sutopo and Slamet (2015), factor rotation is essential to avoid difficulties in interpreting the new factors. This study used orthogonal rotation with the varimax (variance of maximum) procedure because it produces a simple factor structure by maximizing the sum of the variances of the factors containing the squared loading values. The results of the factor rotation are shown in Table 4.18 below.

Table 4.18 Rotation Factor Values

Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
TK1	-0.036	0.258	0.628	0.212	0.090	0.279
TK2	-0.113	0.167	0.762	0.073	0.101	-0.185
TK4	0.005	0.288	0.586	0.231	0.239	0.250
TK5	-0.079	0.040	0.643	0.098	0.068	0.363
TK6	0.201	0.423	0.554	0.016	-0.082	0.032
PK1	0.185	0.328	0.053	-0.298	0.582	0.300
PK2	0.276	-0.090	0.323	0.236	0.593	0.073
PK3	0.768	-0.031	-0.046	0.137	0.249	0.097
PK4	0.901	-0.072	0.062	0.091	0.146	0.043
PK5	0.156	-0.032	0.265	0.281	0.673	0.087
BA1	0.922	-0.049	-0.026	0.051	0.178	0.045
BA2	0.959	-0.049	0.015	0.057	0.150	-0.012
BA3	0.962	0.030	-0.039	-0.003	0.050	0.008
BA4	0.855	0.160	-0.041	-0.106	-0.115	0.030
MP1	0.015	-0.032	0.228	0.373	0.239	0.636
MP2	0.080	0.234	0.214	0.046	-0.125	0.804
MP3	0.055	0.336	0.317	0.403	0.281	0.440
MP4	0.184	0.337	-0.078	0.114	0.412	0.531
MP5	0.133	0.099	-0.122	0.091	0.780	-0.083
DK1	0.085	0.191	0.329	0.424	0.413	0.176
DK2	-0.022	0.002	0.045	0.679	0.273	-0.033
DK3	0.046	0.598	0.074	0.392	-0.042	0.289

KU1	0.085	0.488	0.224	0.663	-0.090	0.162
KU2	-0.003	0.572	0.109	0.606	0.043	0.237
KU3	0.137	0.184	0.127	0.732	0.075	0.156
FL1	-0.060	0.782	0.069	0.092	0.165	-0.017
FL2	-0.076	0.757	0.312	0.099	0.033	0.230
FL3	0.015	0.742	0.243	0.130	0.136	-0.012
FL4	-0.054	0.572	0.496	0.000	-0.137	0.276
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 16 iterations.						

Source: Author's Processed Results, 2025

Table 4.18 shows the distribution of the extracted variables into the formed factors based on their factor loadings after the rotation process.

The correlation values between factors 1 to 7 can be determined by examining the Factor Transformation Matrix. The Factor Transformation Matrix is shown in Table 4.19.

4.1.1.2 Factor Transformation Matrix

Table 4.19 Factor Transformation Matrix

Component Transformation Matrix						
Component	1	2	3	4	5	6
1	.281	.534	.450	.435	.316	.381
2	.903	-.280	-.233	-.078	.202	-.077
3	.299	.525	.025	-.354	-.713	.010
4	.012	-.203	.675	-.673	.213	.072
5	-.110	.551	-.408	-.422	.552	-.186
6	.069	.125	.349	.220	.011	-.900
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						

Source: Author's Processed Results, 2025

4.1.1.2 Factor Naming

Based on the results of the Rotated Component Matrix in Table 4.20, each statement item is grouped into six factors based on its factor loading value. To facilitate interpretation, researchers named each factor based on the similarity of themes and the interrelationships between the indicators that make up each factor group.

Table 4.20 Grouping of Statement Items according to Factor Loading Order

Factor	***Item***	Statement	***Factor Loading***
1	BA3	Delayed delivery of materials to the project site	0.962
	BA2	Inadequate availability of materials at the project site	0.959
	BA1	Scarcity of required materials due to the specific nature of the materials	0.922
	PK4	Equipment availability was inadequate for project requirements.	0.901
	BA4	Material replacement was required due to poor quality.	0.855
	PK3	Equipment damage disrupted the smooth running of the project.	0.768
2	FL1	Heavy rainfall affected project implementation.	0.782
	FL2	Natural disasters hampered project implementation.	0.757

Factor	*Item*	Statement	*Factor Loading*
	FL3	Disruption from non-governmental organizations (NGOs) related to the project.	0.742
	DK3	Communication between the contractor, consultant, and project owner was poor.	0.598
	FL4	The impact of inflation or monetary changes affected project costs.	0.572
3	TK2	The workforce on this project lacked discipline in carrying out their duties.	0.762
	TK5	Workforce mobilization for this project was slow.	0.643
	TK1	The number of available workers was insufficient for ongoing project activities.	0.628
	TK4	Workforce productivity on this project was low.	0.586
	TK6	Poor workforce culture, such as napping after breaks.	0.554
4	KU3	The contractor experienced difficulties in obtaining project funding.	0.732
	DK2	The project design was too complex or the design drawing details were incomplete.	0.679
	KU1	Payments by the project owner were late, disrupting the smooth running of the project.	0.663
	KU2	Payments by the contractor to workers were late.	0.606
	DK1	Design changes occurred before project implementation, or significant design errors occurred.	0.424
5	MP5	The project site was difficult to access, hindering work implementation.	0.780
	PK5	Equipment productivity was low or the quality of the equipment used was inadequate.	0.673
	PK2	Equipment used was not suitable for project requirements.	0.593
	PK1	Equipment provision or mobilization was delayed on this project.	0.582
6	MP2	Work supervision on this project was not carried out properly.	0.804
	MP1	The contractor handling this project lacked experience.	0.636
	MP4	New technology was not implemented properly on this project.	0.531
	MP3	Much of the work required corrections because it did not meet standards.	0.440

Sumber: Hasil Olahan Penulis, 2025

Based on Table 4.20, the results of the Rotated Component Matrix (Varimax) in the exploratory factor analysis (EFA) revealed six main factors that can explain construction project delays. The following is a complete description:

Factor 1: Availability of Materials and Equipment

Items that make up this factor:

• BA3 – Late delivery of materials to the project site (loading: 0.962)
• BA2 – Inadequate availability of materials at the project site (0.959)
• BA1 – Material shortages due to the specific properties of the materials (0.922)
• BA4 – Material replacements due to poor quality (0.855)
• PK4 – Inadequate availability of equipment according to project requirements (0.901)

• PK3 – Equipment failures disrupting project progress (0.768)
Explanation:
This factor reflects issues with the availability and readiness of materials and equipment in the field. Delays in deliveries, material shortages, and inadequate equipment are direct causes of delays. Therefore, it is called Material and Equipment Availability because these two aspects are interrelated in supporting project implementation.

Factor 2: External Disturbances and Communication
Items that make up this factor:
• FL1 – Heavy rainfall affects project implementation (0.782)
• FL2 – Natural disasters that hinder project implementation (0.757)
• FL3 – Disturbances from NGOs related to the project (0.742)
• FL4 – Impact of inflation or monetary changes affects project costs (0.572)
• DK3 – Poor communication between contractors, consultants, and project owners (0.598)
Explanation:
This factor emphasizes uncontrollable external challenges, such as weather, inflation, and social disruptions, as well as weak internal project coordination. It is called External Disturbances and Communication because these constraints originate both externally and within project management.

Factor 3: Workforce Discipline and Productivity
Items that make up this factor:
• TK2 – Workforce lacks discipline in carrying out tasks (0.762)
• TK5 – Slow workforce mobilization (0.643)
• TK1 – Inadequate workforce numbers (0.628)
• TK4 – Low workforce productivity (0.586)
• TK6 – Poor workforce culture (0.554)
Explanation:
This factor highlights low workforce performance due to insufficient numbers, lack of discipline, and an unproductive work culture. Hence, it is called Workforce Discipline and Productivity.

Factor 4: Design Complexity and Funding Issues
Items that make up this factor:
• KU3 – Contractor experiences difficulties in project funding (0.732)
• DK2 – Project design is too complex or drawings are incomplete (0.679)
• KU1 – Late payments by the project owner (0.663)
• KU2 – Late payments by the contractor to workers (0.606)
• DK1 – Design changes or significant errors occur (0.424)
Explanation:
Immature technical design and project financial issues are the main obstacles. Therefore, it is called Design Complexity and Funding Issues because it combines issues in the early stages of the project (planning and financing).

Factor 5: Equipment Mismatch and Location Constraints
Items that make up this factor:
• MP5 – Project location is difficult to reach (0.780)
• PK5 – Low equipment productivity (0.673)
• PK2 – Equipment does not meet project requirements (0.593)
• PK1 – Delayed equipment provision/mobilization (0.582)
Explanation:
This factor describes the project's geographic conditions and the unsuitability of the equipment used. The combination of the two slows down project activities. Hence, it is called Equipment Mismatch and Location Constraints.

Factor 6: Weaknesses in Supervision and Technological Innovation
Items that make up this factor:
• MP2 – Work supervision is not carried out properly (0.804)
• MP1 – Contractor lacks experience (0.636)
• MP4 – Implementation of new technology is not optimal (0.531)
• MP3 – Many work items need improvement (0.440)
Explanation:
Low contractor competence, weak supervision, and minimal innovation lead to low-quality work and delays. This is referred to as Weaknesses in Supervision and Technological Innovation.

4.2 Discussion Results

4.2.1 Delay Level of the Road Improvement and Bridge Construction Project on the Palak Siring-Matai Road Section

Based on the data processing results, the project delay level was 53.60%. This value indicates a moderate level of delay, as it falls within the sufficient category. Based on the descriptive analysis, the following respondents' responses to each variable are shown in Table 4.21.

Table 4.21 Respondents' responses to each variable

Variables	**Score**	**%**	Category
Labor Factors	1.543	45,12%	Sufficient
Equipment Factors	1.952	68,49%	High
Material Factors	2.127	74,63%	High
Project Management/Management Factors	1.444	50,67%	Sufficient
Design and Communication Factors	741	43,33%	Sufficient
Financial Factors	761	44,50%	Sufficient
Weather and Work Environment	1.014	44,47%	Sufficient
Average	**9.582**	**53,60%**	Category

Source: Author's Processed Results, 2025

1. Based on Table 4.21, it is known that the majority of factors causing construction project delays fall into the "Sufficient" category, with a percentage of 53.60%. This indicates that all factors contribute to delays, but with a moderate level of influence and are not yet dominant overall. The average percentage of the seven variables is 53.60%, which confirms its position as sufficient. Among all factors, the Material Factor ranks highest with a percentage of 74.63% (the "High" category), indicating that late delivery, scarcity, and material quality are the main causes according to respondents' perceptions. This is quite reasonable, because materials are a core component in project implementation, and their unavailability will directly hamper the completion time. Conversely, the Design and Communication Factor ranks lowest with a percentage of 43.33%, indicating that although funding issues occur, their impact is not as significant as the other factors. Other factors such as Labor (45.12%), Equipment (68.49%), Management (50.67%), Finance (44.50%), and Weather and Environment (44.47%) also showed significant influence. This illustrates the complexity of construction projects, where delays are caused by the interaction of various technical and non-technical aspects. Therefore, project management must prioritize material logistics management, alongside improving the management of human resources, equipment, communication systems, and mitigating external factors.
2. Furthermore, the results of the open-ended questionnaire survey are as follows:
3. 1. Main Problem: Material Delays and Site Access
4. One of the most significant causes of delays in the Palak Siring-Matai Road Improvement and Bridge Construction project was the delay in the delivery of materials, particularly bridge girders, originating from outside the province (Lampung), approximately 500 km from the project site. This distribution process was hampered by the difficult terrain of the road to the project site: narrow, steep, and damaged, making it impossible for heavy equipment and material transport vehicles to reach the site directly. As a result, materials had to be unloaded twice: first to a stockpile, then redelivered to the site by small-load vehicles. Furthermore, the scarcity of key materials, such as concrete sand and crushed stone of the required quality, exacerbated the situation, as these materials were not available locally and had to be imported from outside the district/province.

5. Difficult accessibility also resulted in delays in the delivery of heavy equipment, such as erection cranes and scaffolding, which are large and require wide and stable access roads. Consequently, girder installation work was delayed because the equipment could not arrive on site on time. Several respondents also noted that tools and materials were often unavailable when needed, indicating weak logistical coordination and procurement management. These problems not only hampered work progress but also reduced the efficiency and effectiveness of the overall project implementation.

6. Infrastructure Limitations and Logistics Coordination

Furthermore, delays were caused by suboptimal logistics management. Many respondents stated that required materials were not consistently available daily. The supply of class A aggregate for road works, for example, was frequently disrupted due to breakdowns in production equipment such as stone crushers. Furthermore, the number of transport vehicles was limited, and transportation times were inefficient due to the difficult terrain and the short implementation timeframe for the complex scope of work. Misalignment between field schedules and material procurement also caused delays at several key points, particularly during high-speed work such as the casting of the main structure.

Contractors also experienced difficulties in managing the need for labor, equipment, and materials. Several respondents stated that labor could not perform optimally because materials were not yet available. This indicates that resource management was not working well. Furthermore, the mobilization of equipment and workers was also considered slow and not commensurate with field needs. Another problem was the lack of alternative local supplies, which made the project heavily dependent on supplies from outside the region, making it vulnerable to distribution disruptions. 7. Human Resources, Weather, and Field Supervision

In addition to logistical issues, human resources (HR) issues also contributed to project delays. Respondents complained that workers were often undisciplined, did not follow occupational safety (K3) procedures, and experienced minimal supervision from management. This situation not only posed a risk of workplace accidents but also impacted daily productivity in the field. Some projects were hampered by workers not arriving on time or not following the workflow established by the technical planner.

Weather and natural factors also exacerbated project delays. Unpredictable heavy rain, which occurred at crucial times, such as casting or installing the superstructure, disrupted the smooth progress of physical work. Furthermore, the project's terrain, located in an area with non-standard contours (extreme slopes/inclines), added challenges to the distribution and execution of work. This resulted in higher demands for labor, equipment, and materials, which were not commensurate with the available resources.

4.1.2 Factors Causing Construction Project Delays in the Road Improvement and Bridge Construction Project on the Palak Siring-Matai Road Section

Based on the results of an exploratory factor analysis (EFA) using the Principal Component Analysis (PCA) method and varimax rotation, six main groups of factors were identified as contributing to delays in the Road Improvement and Bridge Construction Project on the Palak Siring-Matai Road Section. These six factors are the result of grouping 29 indicators that were previously tested for feasibility using KMO analysis, anti-image matrices, communalities, and eigenvalues. Each factor combines indicators with high correlations and forms a new, simpler dimension.

The first and most dominant factor is Material and Equipment Availability, which consists of issues such as late deliveries, material shortages, and unpreparedness of equipment. This factor is a major concern because much of the physical work depends directly on the availability of these resources. The second factor is External Disturbances and Communication, which consists of weather constraints, natural disasters, social disruptions, and poor coordination between parties. The third factor is Workforce Discipline and Productivity, where project delays are related to inadequate workforce numbers, low productivity, and a work culture that does not support efficiency.

The fourth factor is Design Complexity and Funding Issues, which relate to design changes, technical errors, and late payments from the project owner and contractor to the workforce. The fifth factor is Equipment Inappropriateness and Location Obstacles, which illustrates that difficult-to-reach project locations and inadequate equipment significantly hamper implementation. Finally, the sixth factor, Weaknesses in Supervision and Technological Innovation, indicates that contractors' inexperience, weak oversight systems, and low utilization of new technology are significant obstacles to completing the project on time.

By understanding these six factors, project management can design more focused and effective risk mitigation strategies, such as improving logistics systems, workforce training, and strengthening internal controls and communication between project parties.

4.1.2 Most Dominant Factors Influencing Delays in the Road Improvement and Bridge Construction Project on the Palak Siring-Matai Road Section

Based on the results of factor rotation and item loading analysis, the most dominant factor influencing delays in the road improvement and bridge construction project is the Availability of Materials and Equipment. This is indicated by the high factor loadings for the variables within this factor, particularly indicators BA3 (delayed delivery of materials to the project site) with a loading of 0.962, BA2 (insufficient availability of materials) with a loading of 0.959, BA1 (scarcity of required materials due to the specific nature of the materials) with a loading of 0.922, and PK4 (insufficient equipment) with a loading of 0.901.

This factor is highly dominant because construction project delays are highly dependent on the availability of materials and work equipment at the project site. Inadequate quantity, quality, and timing of material procurement can delay overall field activities. Furthermore, equipment failure or inadequate supplies will delay the construction process, especially for heavy-duty work such as girder erection or concrete pouring.

The dominance of these factors indicates that logistics and supply chain aspects of construction projects must be a primary focus. Project management needs to ensure efficient material supply chains, strengthen inventory monitoring systems, and strictly select vendors or suppliers to ensure smooth project implementation. By improving these aspects, it is hoped that delays in similar projects can be minimized in the future.

CONCLUSION

Based on the results of data collection, data processing, and analysis, the author can draw the following conclusions that address the research questions:

1. Based on the descriptive analysis, the level of delay in the Palak Siring-Matai Road Bridge construction project is in the "sufficient" category with an average score of 53.60%. However, delays still occur due to the contribution of various factors, particularly material delays and difficult site access. Materials are the primary cause, with the highest score (74.63%), while financial factors are the lowest. Logistical issues, infrastructure limitations, work schedule inconsistencies, and low workforce discipline and productivity also exacerbated the delays. Extreme weather, difficult terrain, and weak oversight also contributed to the project's reduced efficiency. Overall, this project demonstrated a complex problem that required comprehensive improvements, particularly in the logistics and procurement management system.

The results of the exploratory factor analysis revealed six main groups of factors causing project delays: (1) material and equipment availability, (2) external disruptions and communication, (3) workforce discipline and productivity, (4) design and funding complexity, (5) site constraints and equipment incompatibility, and (6) weaknesses in supervision and technology. These factors reflect various interrelated technical and non-technical aspects that impacted the smooth running of the project. These findings provide a strong basis for project management to make focused improvements in logistics, workforce training, technology utilization, and strengthening the coordination system to minimize similar delays in future projects.

The most dominant factor influencing project delays is the availability of materials and equipment, as evidenced by the highest loading factor values for the indicators of material delivery, material availability, and equipment completeness. High dependence on external supplies, difficult access, and weak logistics coordination make this factor a major obstacle. This confirms that project success is highly dependent on supply chain efficiency and equipment readiness in the field. Therefore, improving procurement systems, more strategic logistics management, and selecting the right vendors must be priorities in future construction project management.

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