Quest Journals
Journal of Architecture and Civil Engineering
Volume 11 ~ Issue 3 (March 2026) pp: 01-13
ISSN(Online): 2321-8193
www.questjournals.org

Research Paper

Time Delay Analysis in Urban Individual Septick Tank Construction Project in Pasuruan City – East Java

Wiwien Tulandari[1*], Lies Kurniawati Wulandari[2], Lila Ayu Ratna Winanda[3]
[1,2,3] *(Post Graduate Program of Civil Engineering, National Institute of Technology, Malang, Indonesia)*
Corresponding Author: Wiwien Tulandari

ABSTRACT : *The Pasuruan City Government continues to strive to improve access to proper sanitation to achieve the overall target of the Pasuruan City community, through the Wastewater Management Program with the construction project activities of individual urban septic tanks with funding sources from the Regional Revenue and Expenditure Budget (APBD). The construction of individual urban septic tanks is a very important solution for densely populated residential areas that have not been served by proper and safe wastewater management. This study aims to identify the factors of delay, analyze the dominant factors of delay, and formulate strategies for handling these delays. The research method used is a descriptive qualitative research approach with the Analytical Hierarchy Process (AHP) method and primary data analysis through questionnaires. The initial identification results indicate that delays are influenced by many factors including material, labor, equipment, location, managerial, and social aspects. Further analysis using AHP able to identify the dominant factor causing delays as managerial factors in the field manager's experience (X5.2) with the highest synthesis value of 0.2892, followed by social factors, namely home ownership (X6.1) with a value of 0.2058, and the mindset of the recipient community (X6.2) with a value of 0.1419. The handling strategy is focused on increasing managerial capacity for field implementers. The implications of this study suggest that the government and project implementers prioritize managerial experience in the implementation environment of urban individual septic tank construction projects in the future.*

KEYWORDS: *Manajemen proyek, analytical hierarchy process, keterlambatan proyek, urban individual septictank.*

*Received 13 Mar., 2026; **R**evised 25 Mar., 2026; **A**ccepted 27 Mar., 2026 © The author(s) 2026.*
P**ublished with open access at **www.questjournals.org

I. INTRODUCTION

There are several studies about identification of delay factors in building, road, and drainage projects where generally discuss the dominant factors from persepective of contractor management, labor, materials, design changes, and work quality. For road studies and building projects, they are also including external variables such as land acquisition, bureaucracy, and weather. Unfortunately, these literatures only focus on large-scale and complex project theories. [1,2]

The problem of delay in sanitation project cannot be separated from functional aspect from the final product. Individual urban septic tank construction is a part of proper sanitation efforts (access to safe sanitation) where technical failure means a public health failure. As found in the study of Wulandari, regarding the physical model of blackwater waste management in communal septic tanks also reduction of BOD and COD using stratified filters and constructed wetland of blackwater treatment. [3]

Pasuruan City Government put continue efforts to improve access to proper sanitation facility for achieving the overall target for entire city residents. Through Wastewater Management Program, project of individual septic tank construction for urban areas is funded by Regional Budget (*Anggaran Pendapatan Belanja Daerah/APBD).* The construction of individual septic tanks for urban areas becomes a crucial solution for resindetial area with dense population that lack of proper and safe wastewater management services.

However, these development projects often encounter problems during the implementation which leading to delay in its physical completion also undergoes cost overrun. These obstacles were evident in several construction projects between 2022 and 2024. From 32 individual septic tank construction work packages, there were 3.432 units experienced 70.96 % delay. [4]

Based on these conditions, this study aims to analyze causal factors of delay in the construction of individual urban septic tanks in Pasuruan City. Result of this study is expected to help Pasuruan City Government and implementing contractors able to formulate more accurate mitigation strategies to minimize obstacles for similar project in the future.

So far, discussions related to Analysis of Time Delay in Urban Individual Septic Tank Construction Project in Pasuruan City of East Java have not been carried out by many researchers, therefore the writer raised study problems of: (1) how to identify delay causal factors in the construction of urban-scale individual septic tanks? (2) what are the dominant factors causing delays in the construction of urban-scale individual septic tanks? and (3) what strategies should be implemented to address the main obstacles of time delay in the construction of urban-scale individual septic tanks?

II. LITERATURE REVIEW

2.1. Influential Factors to Project Delay

2.1.1. Definition of Delay

Construction delay is delay in work progress compared to the baseline construction schedule. Project delays have detrimental impacts to the community. According to Andi et al., project delay generally occurs due to changes of plan during implementation process, poor management within the contractor organization, poorly structured or no integrated work plans, incomplete drawings and specifications, or contractor failure. [5]

Nurfadlilah and Muhammad, with thesis title " *Analisis Pengaruh Faktor Penyebab Keterlambatan Proyek Pada Proyek Pembangunan Gedung Parkir dan Gedung RSUD Koja Jakarta Utara"* brought result research of: based on its determination coefficient value, aspect of labor (X1), aspect of material (X2), aspect of equipment (X3), aspect of project location (X4), aspect of work change (X5), aspect of managerial (X6), and aspect of external factor (X7) have significant influence on Project Delay (Y) with percentage of 78 % where the remaining 22 % is influenced by other factors which was not discussed in this study. Delay factor from aspect of project location (X4) has the highest influence on project delays when compared to the other six factors. [6]

2.1.2. Type of Delay

Type of delays can be classified into three points:

1. *Commensable Delay with compensation* is delays caused by the owner, including the owner's failure to hand over the site to the contractor on time, design errors or incomplete drawings and specifications, changes in work, different site conditions, and the owner's failure to convey vital information to the contractor. For this type of delay, the contractor is given compensation in the form of additional implementation time and reimbursement of costs due to the delay.
2. *Compensable Delay Without Compensation* is delays not caused by the owner or contractor. It occurs when the contractor's activities are hampered by events not caused by the owner or contractor. These delays are listed in the contract document as "Force Majeure." Compensation for these delays is limited to an extension of the project completion time, with no reimbursement of costs.
3. *Non-excusable delay* is delays caused by the contractor's actions. These delays occur due to errors by the contractor, sub-coordinator, or supplier. In these cases, the contractor receives no compensation, neither for costs nor additional time. In fact, the owner has the right to impose a fine or seek compensation from the contractor for the delay.

2.2. Analytical Hierarchy Process (AHP)

The Analytical Hierarcy Process (AHP) was a method developed by Thomas L. Saaty, a mathematician from University of Pittsburgh, United States in 1970s. It allows decision-makers to model complex problems into a hierarchical structure that encompasses objectives, criterias and alternatives. Decision made through the AHP method utilizes data, experience, insight and logical intuition ability with thoroughly approaches to problem. This method allows decision-makers to prioritize or weight decision and allowing these decision-makers to make both objective and subjective judgments. [7]

Methodology of this decision has a compensatory nature since there are deficient alternatives that relate to one or more objectives to make them able to compensate their workperformance in relation to other objectives. therefore, AHP consists of several pre-existing but unrelated concepts and techniques such as complexity hierarchy structuring, pairwise comparison, overestimation, eigenvector method for lowering weight and consistency considerations.

This decision methodology is compensatory in nature because alternatives that are deficient with respect to one or more objectives can compensate for their performance with respect to other objectives. Therefore, the AHP consists of several pre-existing but unrelated concepts and techniques such as complexity hierarchy structuring, pairwise comparisons, overestimation, the eigenvector method for deriving weights, and consistency considerations.

The identification to unstructured problem along with its characteristic must be recognized from clearly stated objectives and the outcomes. Next, breaking down the problem into a hierarchy consisting of the most important variable from the decision problem. The problem can be break down into hierarchy structure with decision variables stated in a relationship between goal – criteria – alternative.

AHP that developed by Thomas Saaty allows decision-makers to model a complex problem into a hierarchical structure based on objectives, criterias, and alternatives. This method allows decision-makers to prioritize or weight issues and make both objective and subjective judgement at the same time.

Therefore, AHP consists of several pre-existing but unrelated concepts and techniques such as complexity hierarchy structuring, pairwise comparisons, overestimation, eigenvector method for lowering weight, and consistency considerations.

AHP breaks down the problem into a hierarchy consisting of the most important variable of the decision problem. While problem can be breaking down into a hierarchical structure with decision variables in a relationship with goals, criterias, and alternatives.

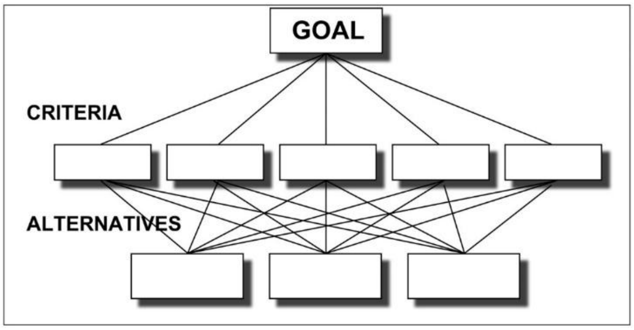

Figure 1. AHP Structure. [7]

For each hierarchical structure variable all related criteria are compared in a pair-wise matrix in the following equation:

$$A = \begin{bmatrix} 1 & \frac{w_1}{w_2} & \dots \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & 1 & \dots \frac{w_2}{w_n} \\ & \dots & \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots \ 1 \end{bmatrix} \quad (1)$$

Desciption:
A : *pair-wise* comparison matrix
w_1 : *weight* of criteria 1,
w_2 : *weight* of criteria 2,
w_n : *weight* of criteria n

To determine the relative preferences for two hierarchical criterias in matrix A, an underlying semantic scale is used with values ranging from 1 to 9 as a rating scale.

Table 1. Pair wise semantic scale [7]

Numeric Scale Preference	Linguistic Scale Preference
Score 1	Both criterias have equal importance
Score 3	One criteria is slightly more important than the other criteria
Score 5	One criteria is more important than the other criteria
Score 7	One criteria is very important than the other criteria
Score 9	One criteria is absolutely more important than the other criteria
Score 2,4,6,8	Intermediate score, between two closely considerations

The Eigenvalue method is used to calculate the relative weights of the criteria in each pairwise comparison matrix. The relative weights of matrix A are obtained from the following equation:

$$A \times W = \lambda_{max} \times W \quad (2)$$

Desciption:
λ_{max} : Eigen *value* of matrix A
W : Relative *weight* of matrix A

The consistency properties of the matrix are examined to ensure certainty aspect for decision makers. The Consistency Index (CI) is calculated using the following equation:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

The Consistency Index (CI) from reciprocal matrix generated by random method must be called to Random Index (RI) with reciprocity imposed. The average RI for matrices of order 1 – 15 is generated using sample size of 100. The final ratio that must be calculated is the Consistency Ratio (CR). If the CR value is less than 0.1, then the assessment is consistent so the derived weights can be used with the following equation:

$$CR = \frac{CI}{RI} \quad (4)$$

The relative weights of the decision criteria are aggregated to obtain a total ranking of the alternatives which is written in the following equation:

$$w_i^s = \sum_{j=1}^{m} W_{ij}^s \, W_i \, , i = 1, \ldots, n \quad (5)$$

Desciption:
w_i : total weight from criteria *i*

2.3. Application of Super Decisions

SuperDecisions software is used for decision-making involving dependency and feedback factors. It applies the principles of the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP). The software provides tools for creating and managing AHP and ANP models, inputting judgments, generating results, and performing sensitivity analyses to the results.

The SuperDecisions model is the simplest hierarchical model consisting of a goal cluster containing goal elements, a criteria cluster containing criteria elements, and an alternative cluster containing alternative elements. When these clusters are connected by lines then their nodes are connected. A hierarchical decision model has a goal, criteria evaluated for its importance to the goal, and alternatives evaluated for its importance to each criterion.

Goals, criteria, and alternatives are elements in decision-making, or nodes in a model. The lines drawn from the goal to each criterion represent the importance of achieving the goal. Likewise, the lines drawn from each criterion to the alternatives have a nature of pairing.

A supermatrix is the result of a priority vector resulting from pairwise comparisons between clusters, criteria, and alternatives. It consists of three stages: the Unweighted Supermatrix, the Weighted Supermatrix, and the Limiting Supermatrix.

III. RESEARCH METHODS

3.1. Research Location

Research site is located in Pasuruan City, a city in East Java Province with an area of 39 km^2 and has geographical area located in lowland at an average altitude of 4 meters above sea level. Area topography is very shallow (slope of 0-3 %) with population condition in 2024 of 213.469 individuals with a popilation density of 5.437 individuals/km^2. [4]

The individual septic tank construction site is located in Krapyakrejo Sub-district, Gadingrejo District of Pasuruan City where there were 60 houses expected to be the beneficiaries of the urban individual septic tank construction project in 2025. The project was implemented in this area due to lack of proper and safe sanitation management, where it has high residential density with closely packed houses and often very limited land, especially in narrow alleys or narrow settlements with difficult road access for mobilizing large building materials.

3.2. Data Collection

This study used both primary and secondary data. The selection of these two data types was based on the need to obtain a comprehensive and in-depth picture of the phenomenon being studied.

Primary data was collected directly from the original sources through research instruments (interviews and questionnaires). Questionnaires were distributed to respondents involved in the urban individual septic tank construction project at the Pasuruan City Public Housing and Settlement Agency, with a total of 10 respondents as listed in the following table (Table 2).

Table 2. Research variable determination [4]

No	Job position in the Implementation of Individual Septic Tank Project	Respondents
1	Commitment Maker Officer	1 respondent
2	Sanitation Technical Team	1 respondent
3	Planning Consultant	1 respondent
4	Supervising Consultant	1 respondent
5	Contractor	2 respondents
	Total	10 respondents

Aside from primary data, secondary data was also collected as referring to any information already collected and published by the Pasuruan City Public Housing and Settlement Agency (such as official reports, statistical database, or organization documents). Secondary data helps researchers to verity primary findings, identify historical trends, and compare research results with the existing condition. For producing adequate analysis, the researchers combine primary and secondary data; direct obtained data from field surveys also validated through documented evidence to support a more holistic and accurate understanding. [8]

To produce an adequate analysis, researchers combined primary and secondary data; data obtained directly from field surveys was validated through documented evidence, thus supporting a more holistic and accurate understanding.

3.3. Population and Sample Study

3.3.1. Population

Sugiyono in Mardhiyah et al., defines population as a generalization area consisting of objects/subjects with certain qualities and characteristics determined by researchers to be studied and then conclusions drawn. In this study, the population taken is all those involved in decision-making on urban individual septic tank construction project that have a project implementation level and have work experience in the construction sector of at least 5 (five) years as represented by respondents from commitment-making officials of the public housing and settlement service, the technical team of sanitation and buildings of the public housing and settlement service, planning consultants, supervisory consultants and implementers. [9]

3.3.2. Sample of the Study

Sampling in this study was conducted through purposive sampling, a non-probability technique in which researchers select samples based on considerations and requirements relevant to the research objectives. In a quantitative approach, purposive sampling is used to test initial hypotheses or determine important variables from previous research and field survey data. Before the quantitative research begins, experts with the capacity and expertise to provide insights and identify challenges in the construction of individual urban septic tanks are needed. The research sample consisted of 10 (ten) respondents with at least five years of work experience in the construction of individual urban septic tanks. [8]

3.4. Method of Validity and Reliability Tests

To determine the validity of the variables, this study uses Pearson's product moment correlation with the formula:

$$r_{xy} = \frac{N\sum XY-(\sum X)(\sum Y)}{\sqrt{(N\sum X^2-(\sum X)^2)(N\sum Y^2-(\sum Y)^2)}} \quad \text{......} (6)$$

Desciption:

r_{xy} : Correlation Coefficient between variable X (type score) and Y (total score)
N : Number of respondents (data)
$\sum X$: Total number of type scores
$\sum Y$: Total number of all type scores
$\sum XY$: Sum of multiplying result of each type of score with the total score
$\sum X^2$: Sum of squares of each type of score
$\sum Y^2$: Sum of squares of each total score

To determine the realibility of research variable, this study uses (α) with the following formula:

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\Sigma\sigma_t^2}{\sigma_t^2}\right) \text{......} (7)$$

Desciption:
r11 : Sought reliability
n : Number of tested types
$\Sigma\sigma_i^2$: Number of variance score for each type
σ_t^2 : Score of total variances of all types

IV. RESULT OF RESEARCH AND DISCUSSION

4.1. Influential Variables

Variables with significant influence to the delay in construction of individual urban septic tanks is listed in the following table (Table 3).

Table 3. Determination and codefication of research variables

Aspect	Code	Variable
X1. Material Aspect	X1.1	Material Availability
X2. Labor Aspect	X2.2	Lack of work experience
X3. Equipment Aspect	X3.2	Incompatible equipment
X4. Location Aspect	X4.1	Accesibility
	X4.2	Condition below the ground surface
	X4.3	Land limitation
X5. Managerial Aspect	X5.1	Quality of work supervision
	X5.2	Experience of field manager
X6. Social Aspect	X6.1	House ownership
	X6.2	Mindset of the beneficiary/recipient

For determining variables as mentioned in table 3, it is necessary to carry out validity and reliability tests on the variables that have influence to the delay in construction of individual urban septic tanks by distributing research questionnaire one more time.

4.2. Validity Test and Reliability Test

For any research, in particular for type of research that involving measurement, the validity and reliability tests are two crucial aspects that must be verified to ensure quality and reliability of the research results. Validity relates to the extent to which a measuring instrument (in this study is the questionnaire) actually able to measure matters that suppoused to be measured. Meanwhile, reliability relates to consistency or stability of measurement results when the research instrument is used repeatedly on the same subject or under similar condition. [8]

For determining the validity and reliability of the variables, this study uses Pearson product moment correlation and Cronbach's Alpha in assessing respondents' perceptions of the questionnaire results assisted by the IBM SPSS Statistics 27 computer application with the results are listed in the following table (Table 4).

Table 4. Result of statistic calculation

Item-Total Statistics

Variable	Scale Mean	Scale Variance	Total Correlation	Multiple Correlation	Cronbach's Alpha
X1.1	41,60	16.711	0,775	-	0,963
X2.2	41,00	17.778	0,765	-	0,962
X3.2	41,30	16.678	0,770	-	0,964

X4.1	41,00	17.333	0,879	-	0,958
X4.2	40,80	18.400	0,774	-	0,962
X4.3	41,00	17.333	0,879	-	0,958
X5.1	40,90	17.433	0,920	-	0,957
X5.2	40,90	17.433	0,920	-	0,957
X6.1	40,90	17.433	0,920	-	0,957
X6.2	41,00	17.333	0,879	-	0,958

The results of the statistical calculations in table 4 above were then tested on each calculated r value obtained to be compared with the r table value at N = 10 as listed in the following table (Table 5).

Table 5. Distribution of r table score for 0.05 and 0.01 significant values

N	Level of Significance		N	Level of Significance	
	0,05	**0,01**		**0,05**	**0,01**
3	0.997	0.999	16	0.497	0.623
4	0.950	0.990	17	0.482	0.606
5	0.878	0.959	18	0.468	0.590
6	0.811	0.917	19	0.456	0.575
7	0.754	0.874	20	0.444	0.561
8	0.707	0.834	25	0.396	0.505
9	0.666	0.798	30	0.361	0.463
10	0.632	0.765	35	0.334	0.430
11	0.602	0.735	40	0.312	0.403
12	0.576	0.708	45	0.294	0.380
13	0.553	0.684	50	0.279	0.361
14	0.532	0.661	55	0.266	0.345
15	0.514	0.641	60	0.254	0.330

Note: r table value at N = 10 is 0,765 for α = 0,01.

4.2.1. Validity Test

Validity testing refers to measurement accuracy. A measuring instrument is considered valid if it accurately measures the desired variable without any deviation. This validity test refers to the correlation coefficient values in Table 4 and the r table value in Table 5. Testing basis:

- Significance level α = 1% = 0.01
- r table value = 0.765
- Calculated r value (correlation coefficient value) > r table= valid (accurate)
- Calculated r value (correlation coefficient value) < r table= invalid (innacurate)

The comparison of each calculated r value with r table value in this validity test is shown in the following table (Table 6).

Table 6. Result of validity test

Code	Variable	Validity Test (N = 10 ; α = 0,01)			Description
		r hitung		r tabel	
X1.1	Material Availability	0,775	>	0.765	VALID
X2.2	Lack of work experience	0,766	>	0.765	VALID
X3.2	Incompatible equipment	0,770	>	0.765	VALID
X4.1	Accesibility	0,879	>	0.765	VALID
X4.2	Condition below the ground surface	0,774	>	0.765	VALID
X4.3	Land limitation	0,879	>	0.765	VALID
X5.1	Quality of work supervision	0,920	>	0.765	VALID
X5.2	Experience of field manager	0,920	>	0.765	VALID
X6.1	House ownership	0,920	>	0.765	VALID
X6.2	Mindset of the beneficiary/recipient	0,879	>	0.765	VALID

According to result of validity test on Table 6, for all variables that have a correlation and declared as VALID then will be subjected to a reliability test to determine their consistency.

4.2.2. Reliability Test

Reliability testing relates to the consistency and stability aspect of result measurement. A reliable measuring instrument will produce similar score when used repeatedly under the same condition. This reliability test refers to the Cronbach's Alpha value stated in Table 4 and the r table value stated in Table 5. Testing basis:

- Significance level of α = 1% = 0.01
- r table value = 0.765
- calculated r value (Cronbach's alpha) > r table = Reliable (consistent)
- calculated r value (Cronbach's alpha) < r table = Unreliable (inconsistent)

the comparison of each calculated r value with r table value in the reliability test is shown in the following table (Table 7).

Table 7. Result of Reliability Test

Code	Variables	Validity Test (N = 10 ; α = 0,01)			Description
		r hitung		r tabel	
X1.1	Material Availability	0,963	>	0.765	RELIABLE
X2.2	Lack of work experience	0,962	>	0.765	RELIABLE
X3.2	Incompatible equipment	0,964	>	0.765	RELIABLE
X4.1	Accesibility	0,958	>	0.765	RELIABLE
X4.2	Condition below the ground surface	0,962	>	0.765	RELIABLE
X4.3	Land limitation	0,958	>	0.765	RELIABLE
X5.1	Quality of work supervision	0,957	>	0.765	RELIABLE
X5.2	Experience of field manager	0,957	>	0.765	RELIABLE
X6.1	House ownership	0,957	>	0.765	RELIABLE
X6.2	Mindset of the beneficiary/recipient	0,958	>	0.765	RELIABLE

According to result of validity test on Table 7, all variables are verified to have consistency and declared as RELIABLE.

From the results of the validity and reliability tests in Tables 6 and 7 above, all variables have adequate correlation and consistency for the study of delays in urban individual septic tank construction project. Therefore, all variables (10 variables) can be used as criteria in the Analytical Hierarchy Process (AHP).

4.3. AHP Modelling

These variables are then grouped and processed using the AHP method as a very effective decision support technique for complex problems involving multiple criteria, where it allows hierarchical problem solving, from the main objective to alternative choices, as well as pairwise comparisons between elements at each level. [7]

In the context of work delay factor analysis, AHP is used to construct a hierarchical structure model that represents the main objective (delay aspect), relevant criteria (specific variables), and available options to achieve the objective (alternatives). This pairwise comparison process allows for the determination of the relative weight of each factor, thus identifying of which one that have the most significant influence on work delay.

The AHP structural model in this study is divided into three main clusters: the Objective Cluster, the Criteria Cluster, and the Alternative Cluster. Each cluster has its own elements/nodes, as follows:

1. Objective cluster: consists of one element (delay factor);
2. Criteria cluster: consists of ten elements of:
   - X1.1 material availability
   - X2.1 lack of labor experience
   - X3.1 incompatible equipment
   - X4.1 accessibility
   - X4.2 condition below ground surface
   - X4.3 Land limitation
   - X5.1 Quality of work supervision
   - X5.2 field manager experience
   - X6.1 house ownership
   - X6.2 mindset of beneficiary/recepient
3. Alternative cluster: consists of three elements of:
   - Profound significant impact to delay of individual septic tank construction
   - Has impact to the delay of individual septic tank construction, and
   - No impact to the delay of individual septic tank construction

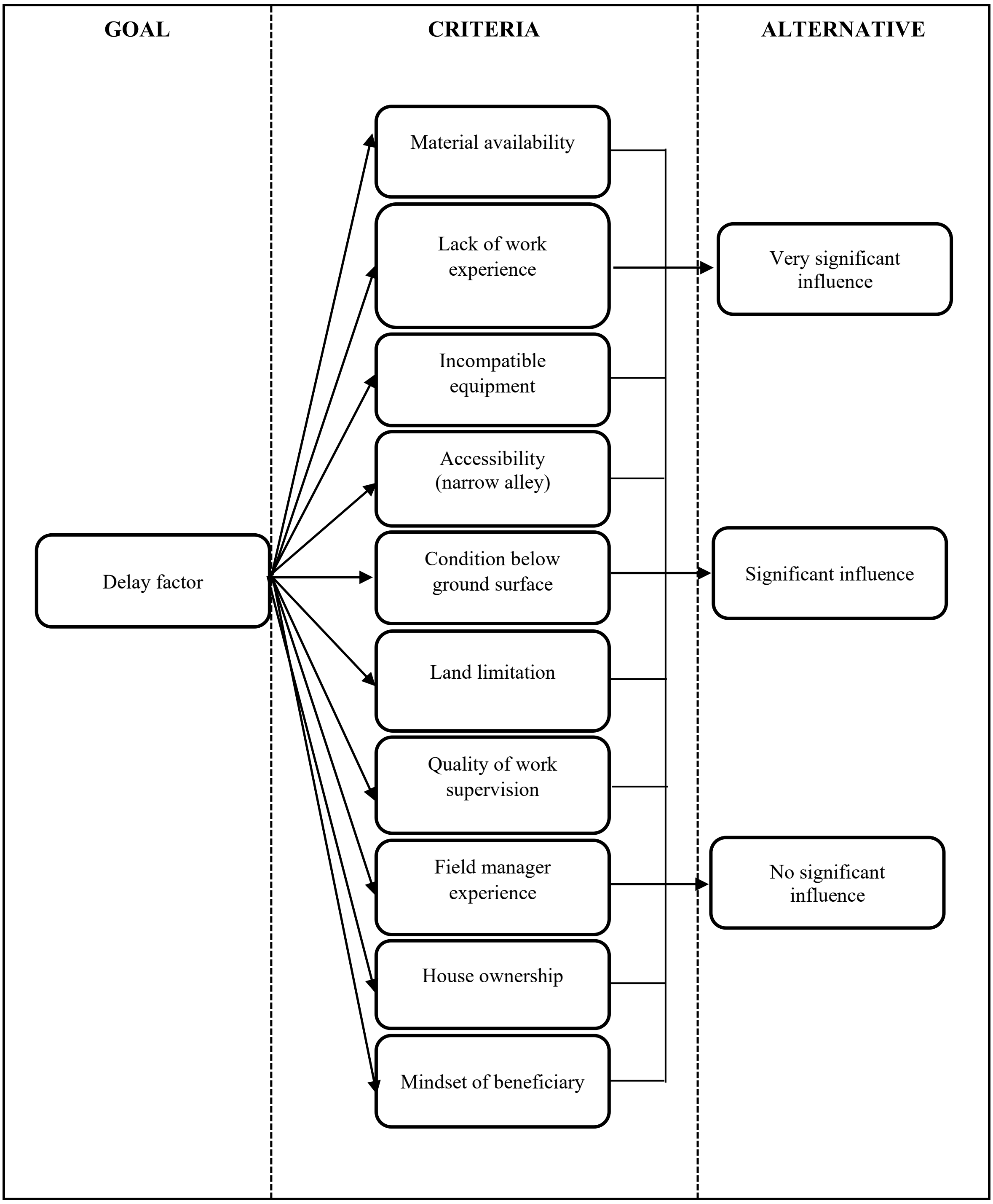

Figure 2. Delay factors AHP structure model urban-individual septic tank project

Furthermore, the AHP structure model in Figure 2 is the basis for building the AHP structure in the SuperDecisions V.3.2 application system.

4.4. Synthesis of AHP Criteria

The synthesis of AHP criterion elements begins with determining the relative weights of the criteria, calculated based on their eigenvalues. This is a mathematical method for representing the relative priority between elements in a decision hierarchy. Through the process of creating a pairwise comparison matrix and calculating the eigenvectors for each criterion, the relative importance of each criterion to the primary decision-making objective is reflected. [7]

The calculation of these relative weights uses a pairwise while comparison matrix using the SuperDecision V.3.2 application. This pairwise comparison matrix is determined based on the aggregation of data from the relevant respondents. The resulting pairwise comparison matrix weights are listed in the following table (Table 8).

Table 8. Weight of pairwise matrix criteria

Criteria		Weight of Criteria									
		X1.1	**X2.2**	**X3.2**	**X4.1**	**X4.2**	**X4.3**	**X5.1**	**X5.2**	**X6.1**	**X6.2**
Weight of Criteria	X1.1	1,00	0,50	2,00	0,50	0,25	0,33	0,33	0,14	0,17	0,20
	X2.2	2,00	1,00	2,00	1,00	0,33	0,50	0,50	0,17	0,20	0,25
	X3.2	0,50	0,50	1,00	0,50	0,20	0,25	0,25	0,13	0,14	0,17
	X4.1	2,00	1,00	2,00	1,00	0,33	0,50	0,50	0,17	0,20	0,25
	X4.2	4,00	3,00	5,00	3,00	1,00	2,00	2,00	0,25	0,33	0,50
	X4.3	3,00	2,00	4,00	2,00	0,50	1,00	1,00	0,20	0,25	0,33
	X5.1	3,00	2,00	4,00	2,00	0,50	1,00	1,00	0,25	0,33	0,50
	X5.2	7,00	6,00	8,00	6,00	4,00	5,00	4,00	1,00	2,00	3,00
	X6.1	6,00	5,00	7,00	5,00	3,00	4,00	3,00	0,50	1,00	2,00
	X6.2	5,00	4,00	6,00	4,00	2,00	3,00	2,00	0,33	0,50	1,00

After determining the relative weight of the criteria in table 8 above, the eigenvector can be calculated with result presented in the following table (Table 9).

Table 9. Criteria of eigen vector

Criteria		Eigen Value									
		X1.1	**X2.2**	**X3.2**	**X4.1**	**X4.2**	**X4.3**	**X5.1**	**X5.2**	**X6.1**	**X6.2**
Eigen Value	X1.1	0,030	0,020	0,049	0,021	0,019	0,020	0,023	0,046	0,033	0,024
	X2.2	0,060	0,040	0,049	0,028	0,028	0,040	0,034	0,053	0,039	0,030
	X3.2	0,015	0,020	0,024	0,017	0,014	0,020	0,017	0,040	0,028	0,020
	X4.1	0,060	0,040	0,049	0,028	0,028	0,040	0,034	0,053	0,039	0,030
	X4.2	0,119	0,120	0,122	0,083	0,114	0,120	0,137	0,080	0,065	0,061
	X4.3	0,090	0,080	0,098	0,041	0,057	0,080	0,069	0,064	0,049	0,041
	X5.1	0,090	0,080	0,098	0,041	0,057	0,080	0,069	0,080	0,065	0,061
	X5.2	0,209	0,240	0,195	0,330	0,284	0,240	0,274	0,319	0,390	0,366
	X6.1	0,179	0,200	0,171	0,248	0,227	0,200	0,206	0,160	0,195	0,244
	X6.2	0,149	0,160	0,146	0,165	0,171	0,160	0,137	0,106	0,098	0,122

Note:

X1.1 material availability
X2.1 lack of labor experience
X3.1 incompatible equipment
X4.1 accessibility
X4.3 Land limitation
X5.1 Quality of work supervision
X5.2 field manager experience
X6.1 house ownership

X4.2 condition below ground surface X6.2 mindset of beneficiary/recepient

The synthesis of the criteria can be calculated after the eigenvectors are determined, as shown in Table 9. The eigenvectors represent the priority weights of a pair-wise matrix and are then used to construct the Supermatrix (unweighted supermatrix, weighted supermatrix, and limit supermatrix) using the SuperDecision V.3.2 application (presented in the appendix).

The Supermatrix calculation is conducted based on the Consistency Ratio (CR) value obtained from the criteria priority values, with a maximum value of 0.02, not exceeding 0.1 and the synthesis of the resulting criteria elements can be seen in the following table (Table 10).

Table 10. Result of synthesis of criteria

No	Criteria	Synthesis Value		
		Ideals	**Normals**	**Limits**
1.	Material Availability	0,0955	0,0276	0,0138
2.	Lack of work experience	0,1354	0,0392	0,0196
3.	Incompatible equipment	0,0732	0,0212	0,0106
4.	Accesibility	0,1354	0,0392	0,0196
5.	Condition below the ground surface	0,3485	0,1008	0,0504
6.	Land limitation	0,2245	0,0649	0,0325
7.	Quality of work supervision	0,2431	0,0703	0,0352
8.	Experience of field manager	1,0000	0,2892	0,1446
9.	House ownership	0,7118	0,2058	0,1029
10.	Mindset of the beneficiary/recipient	0,4907	0,1419	0,0710

Based on the synthesis results in table 10 above, the ideal value, normal value and limit value can be seen in each element from the AHP criteria. The highest ideal value (1.0000), the highest normal value (0.2892) and the highest limit value (0.1446) are found in the field manager experience criteria (X5.2), while the lowest ideal value (0.0732), the lowest normal value (0.0212) and the lowest limit value (0.0106) are found in the incompatible equipment criteria (X3.2).

Table 11. Rank of delay criteria

Aspect	Criteria	Value	Rank
X5. Managerial Aspect	X5.2 field manager experience	0,2892	1
X6. Social Aspect	X6.1 house ownership	0,2058	2
X6. Social Aspect	X6.2 mindset of beneficiary/recepient	0,1419	3
X4. Location Aspect	X4.2 condition below ground surface	0,1008	4
X5. Managerial Aspect	X5.1 Quality of work supervision	0,0703	5
X4. Location Aspect	X4.3 Land limitation	0,0649	6
X2. Labor Aspect	X2.2 lack of labor experience	0,0392	7
X4. Location Aspect	X4.1 accessibility	0,0392	8
X1. Material Aspect	X1.1 material availability	0,0276	9
X3. Equipment Aspect	X3.2 incompatible equipment	0,0212	10

V. CONCLUSION

Based on the results of the analysis of time delays in the urban individual septic tank construction project in Pasuruan City, the following conclusions can be drawn:

1. There are 10 variables causing delays in the construction of individual urban septic tanks in Pasuruan City namely: a. (X1.1) Availability of materials with a value of 0.0276, b. (X2.2) lack of labor experience with a value of 0.0392, c. (X3.2) inappropriate equipment with a value of 0.0212, d. (X4.1) Accessibility (narrow alleys) with a value of 0.0392, e. (X4.2) conditions below ground level with a value of 0.1008, f. (X4.3) limited land with a value of 0.0649, g. (X5.1) quality of work supervision with a value of 0.0703, h. (X5.2) experience of field managers with a value of 0.2892, i. (X6.1) home ownership with a value of 0.2058 and j. (X6.2) mindset of the beneficiary/recipient with a value of 0.1419.
2. There are 3 factors with highest weight that able to cause delay in the construction of individual urban septic tank project found in this study namely: a. (X5.2) Field Manager Experience with a value of 0.2892, b. (X6.1) Home ownership with a value of 0.2058, (X6.2), and c. The mindset of the recipient community with a value of 0.1419.
3. Strategy implemented on the dominant factors that able to cause delay in this project is stated in the factor (X5.2) or the field manager's experience with a value of 0.2892. With this strategy, there is a need to get competency standardization or certification for field managers.

REFERENCES

[1]. Ananda, R., Mulyani, E., & Rafie., (2021). Analisis keterlambatan dan kualitas hasil pekerjaan pada proyek konstruksi gedung. *Jelast: jurnal teknik kelautan, PWK, Sipil, dan Tambang*, **8**(*1*); pp. 1–7.

[2]. Nugraha, T. B., Nova N. R., & Ayu K. R. S., (2024). Analisis faktor keterlambatan pekerjaan konstruksi drainase dengan menggunakan Metode Kaiser Mayer Oklin (KMO). *Jurnal Ilmiah Universitas Batanghari Jambi*, 2(20); pp. 1404–1412.

[3]. Wulandari, L. K., (2019). "Model fisik pengolahan limbah blackwater pada septic tank komunal". Malang: Dream Litera Buana.

[4]. Department of Public Housing and Residential Areas of Pasuruan City, (2024). Laporan pekerjaan fisik sanitasi. Pasuruan: Department of Public Housing and Residential Areas of Pasuruan City.

[5]. Andi, A., Susandi, A., & Wijaya., H., (2003). On representing factors influencing time performance of shop-house contructions in Surabaya, *Civil Engineering Dimension*, **5**(*2*).

[6]. Nurfadlilah, A., & Muhammad., (2015). Analisis pengaruh faktor penyebab keterlambatan proyek pada Proyek Pembangunan Gedung Parkir dan Gedung RSUD Koja Jakarta Utara. [PhD Thesis, Universitas Gunadarma Indonesia].

[7]. Saaty, T. L., (1993). "Pengambilan keputusan bagi para pemimpin, proses hirarki analitik untuk pengambilan keputusan dalam situasi yang kompleks". Jakarta: PT. Pustaka Binaman Pressindo.

[8]. Sugiyono., (2018). Metode penelitian kuantitatif, kualitatif, dan R&D (19 Ed.). Bandung: CV. Alfabeta.

[9]. Mardhiyah, N. A. D.,Yona, A., Adelia, A., Rully, H., & Harmonedi, (2025). Populasi dan sampel dalam penelitian pendidikan: Memahami perbedaan, implikasi, dan strategi pemilihan yang tepat. *Jurnal Ilmu Pendidikan dan Matematika*, **2**(*2*); pp. 208–218.