Multiple Regression Analysis to The Influence of Communication Management on Project Success

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Abstract. The success of a construction project, in general, is known to have a triple constraint with the criteria of being on time, on cost, and quality. Project success is highly dependent on effective communication as it can increase project success by up to 80% compared to poor communication by only 52%. Several studies have found that poor communication is one of the most critical obstacles to construction project success. The purpose of this study is to analyze the relationship between communication management (X) and the success of construction projects (Y) simultaneously. The sample for this study was obtained using a total sampling technique so that the sample size corresponds to the members of the population, namely as many as 30 construction companies registered with the Association of National Construction Executors (GAPENSI) in Banda Aceh, one of the provinces in Indonesia. Based on the analysis results, it was found that communication management simultaneously had an influence of 53.2% on the success of construction projects. In comparison, the other 46.8% was determined by variables not examined in this study.

1 Introduction

As a developing country, Indonesia continues to carry out construction work to support national development to meet various public infrastructure facilities such as educational institutions, hospitals, multi-story buildings, and other infrastructure needs. The uniqueness and complexity of construction projects require the involvement of many parties with continuous interactions related to project interests [1]. The main parties involved in the project include the owner (owner), contractors, and consultants. Each party establishes a legal and technical cooperative relationship with the suitability of the authority stated in the contract [2].

Communication in the project can be interpreted as exchanging information to create understanding between parties. Communication guarantees that all information can be conveyed to achieve project objectives [3]. Thus, communication management is needed to integrate interactions in construction projects effectively. Effectiveness in communication is achieved if the message can be conveyed clearly so that the recipient can understand the message's contents to provide feedback. Meanwhile, communication is said to be ineffective,

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and when the communication criteria are not met, it causes misunderstandings and failures in communication [4]. [5] states that effective communication can increase project success by up to 80%. The success of a construction project can be interpreted as the goal or criteria used to fulfill the triple constraint, namely the correct cost, the right time, and the excellent quality [6], [7]. Communication is considered to play an essential role in the success of the project because ineffective communication can cause conflicts that result in work delays, quality discrepancies, and cost overruns [8], [9].

Research conducted by [8] states that poor communication and coordination between parties is one of the leading indicators that can affect the quality performance of road construction projects in Aceh Province. Several other studies state that inappropriate communication is a factor causing problems and disputes in the construction industry around the world. Communication is essential in improving the quality of relationships, trust, and collaboration between construction project teams [10].

Alignment of the flow of information within the project team also requires the role of the project manager as a leader in implementing construction projects. The project manager must know how to communicate most effectively and efficiently to ensure that the entire project team is kept informed of the project's progress. Project managers spend > 90% of their time communicating project interests. Thus, communication skills are critical to be understood by project managers [11]. The project manager is considered the most essential construction project success factor, especially in the direction of communication-related to construction projects to achieve customer satisfaction in terms of cost, quality, and time [12].

Various factors related to communication need to be reviewed to have a positive impact on construction projects. The study's results [13] indicate several factors that can cause communication not to be appropriately conveyed, namely a lack of management and leadership skills, a lack of training and trained workers, a lack of support and communication facilities, and other factors. Ineffective communication can lead to cost overruns, time delays, high accident rates, quality discrepancies, and rework. Effective communication can make the distribution of information between stakeholders more equitable. Establishing good communication management, in particular, will increase the probability of project success [14]. Several studies state that improper communication is a factor causing problems and disputes in the construction industry around the world. Communication is essential in improving the quality of relationships, trust, and collaboration between construction project teams [10].

All information related to construction projects must be conveyed promptly and appropriately to all parties involved. *Communication* is a core competency that must be adequately implemented for all parties to achieve the same strategy, goals, and actions. Ineffective communication is prone to causing misunderstandings, so it becomes an obstacle to achieving successful construction projects. The purpose of this study is to analyze the influence of communication management on the success of construction projects simultaneously.

2 Literature Review

2.1 Project communication management

Communication management is one part of the competencies that project managers must possess. Not only to distribute information but also to collect, analyze and respond to information (feedback) at the initiative of stakeholders to overcome all contractual, social, and cultural barriers in project management [15]. In the project, *communication* is exchanging information to create an understanding between parties. Communication

guarantees that all information can be conveyed to achieve project objectives [3]. Some problems that often arise due to communication in a construction project include miscommunication, misconceptions, ambiguous understandings, barriers due to cultural diversity, conflicts, and other problems. In general, the stages of communication management go through 3 (three) stages planning, management, and control [15].

2.2 Project construction success

The success of construction projects is closely related to the essential functions of project management in managing all the resources needed [16]. In the short term, the success of a construction project can be measured based on a triple constraint [6].

1. Cost-effective: the project must be completed at a cost that does not exceed the budget. Budget planning and proper cost estimation are keys to project success.
2. Appropriate quality: the condition in which the project meets technical specifications, functions, and appearance. Quality management becomes a project success factor that will facilitate other success criteria.
3. On time: the timeliness of completing the project according to the schedule. Time is one of the most critical project success criteria to consider.

3 Method

This research is a quantitative study using two categories of data sources: primary data obtained from questionnaires to 30 respondents and secondary data obtained based on literature studies to prepare research variables. This study's respondents are project managers with experience in construction and are members of the GAPENSI association. Sampling using total sampling technique because of the number of samples ≤ 30 companies. Data is collected through direct dissemination to the respondent's office and via Google Forms. The research variables include the dependent variable (X) and the independent variable (Y), which can be seen in Table 1. For more details, the schema of the variable's. relationship shown in Figure 1.

Table 1. Research variables.

Variables	Factors	Indicators	
Communication management (X)	Management (X_1)	$X_{1.1}$	Clarity of duties of each department
		$X_{1.2}$	Project status updates
		$X_{1.3}$	Stakeholder engagement
		$X_{1.4}$	Scope and organizational structure
		$X_{1.5}$	Time
	Competence (X_2)	$X_{2.1}$	Skills
		$X_{2.2}$	Knowledge
		$X_{2.3}$	Attitude
		$X_{2.4}$	Technology
	Strategy (X_3)	$X_{3.1}$	Trust
		$X_{3.2}$	Context
		$X_{3.3}$	Content
		$X_{3.4}$	Clarity
		$X_{3.5}$	Continuity and consistency
		$X_{3.6}$	Ability
	Hierarchy (X_4)	$X_{4.1}$	Planning
		$X_{4.2}$	Management

Variables	Factors	Indicators	
		$X_{4.3}$	Controlling
	Communication technique (X_5)	$X_{5.1}$	Internals
		$X_{5.2}$	External
		$X_{5.3}$	Verbal
		$X_{5.4}$	Nonverbal
		$X_{5.5}$	Formal
		$X_{5.6}$	Informal
	Communication direction (X_6)	$X_{6.1}$	Vertical
		$X_{6.2}$	Horizontal
		$X_{6.3}$	Diagonal
	Environment (X_7)	$X_{7.1}$	Nationality and ethnicity
		$X_{7.2}$	Geographic dispersion
		$X_{7.3}$	Background
Construction project success (Y)	Cost (Y_1)		
	Quality (Y_2)		
	Time (Y_3)		

Sources : [17]

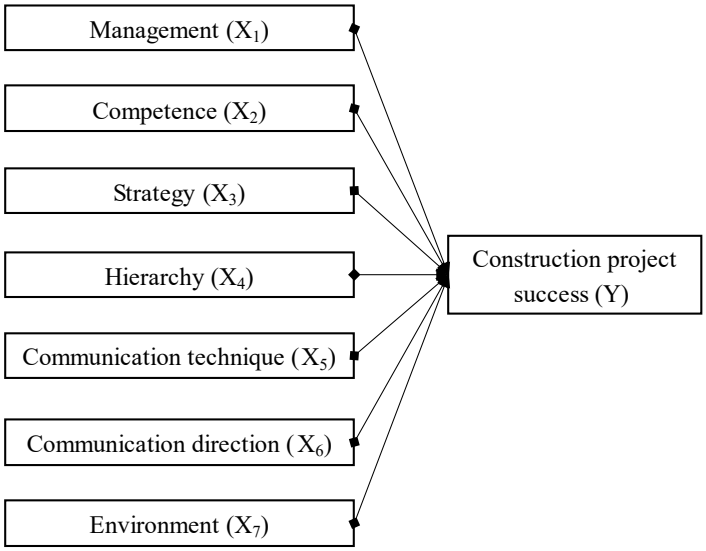

Fig. 1. Relationship of variables X and Y.

Data collection was carried out by distributing questionnaires to respondents. The research questionnaire is closed, consisting of 3 parts: questionnaire A, containing data on the characteristics of the respondents, and questionnaires B and C, containing statements filled out based on the opinions of the research respondents regarding the research variables. The questionnaire used a Likert scale, the score shown in Table 2.

Table 2. Likert scale

Description	Value
Strongly Agree	5
Agree	4
Slightly Disagree	3
Disagree	2

Description	Value
Totally Disagree	1

Source : [18]

The data analysis technique uses two techniques, namely descriptive analysis to describe the percentage of respondent frequency and multiple linear regression analysis to explain the influence of communication management on the success of construction projects. Due to the data used in the ordinal scale questionnaire, the data must be transformed into interval data to fulfill the multiple linear regression test requirements. Thus, ordinal data is transformed into intervals using the MSI method.

3.1 Multiple linear regression analysis

Linear regression analysis typically aims to forecast the extent of change in the dependent variable when there is a change in the independent variable. In this context, this panel will utilize multiple linear regression analysis with the objective of assessing the influence of communication management on the success of construction projects. The general form of the linear regression equation can be observed in equation 1 [19].

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_7 X_7 \quad (1)$$

Information:
Y_i = Construction project success variables (Y).
X_1, X_2, …, X_7 = Communication management variables (X).
$\beta_0, \beta_1, \ldots, \beta_7$ = Linear regression coefficient.

Prior to conducting a multiple linear regression analysis, an initial classic assumption test was carried out, as it is a statistical prerequisite that needs to be fulfilled in the context of multiple regression analysis. These classic assumption tests encompass assessments for normality, multicollinearity, and heteroscedasticity.

3.1.1 Normality test

The normality test is conducted to assess whether the residual values of the data follow a typical distribution. An effective regression model exhibits residual values that are either normal or closely approximate a normal distribution. In this research, the One-Sample Kolmogorov-Smirnov test was employed, adhering to the specified criteria:

a. If the value of Sig. > 0.05, data is normally distributed.
b. If the value of Sig. < 0.05, data is not normally distributed.

3.1.2 Multicollinearity test

Multicollinearity is a situation characterized by a strong or almost perfect linear association among the independent variables within a regression model. Multicollinearity arises when one or more of the independent variables in the linear equation exhibit a perfectly linear relationship. Indicators of multicollinearity include examining the Variance Inflation Factor (VIF) and tolerance values. When the VIF value < 10 and the tolerance value > 0.1, multicollinearity is not present. However, if the VIF exceeds 10 and the tolerance is greater than 0.1, then multicollinearity is evident [20].

3.1.3 Heteroscedasticity test

The heteroscedasticity test was carried out to determine the residuals' variance for all regression model observations. In this research, the heteroscedasticity test was carried out by looking at the plot graphs between the predicted values of the dependent variable. In SPSS, it is called ZPRED and its residuals, or it is also called SRESID [21]. The basis for decision-making is:

a. If there are specific patterns on the plot graph, such as regular dots forming wave patterns, widening then narrowing, and other regular patterns, heteroscedasticity occurs in the regression model.
b. If there is no clear pattern and the points spread above and below the number 0 on the Y axis, there is no heteroscedasticity in the regression model.

3.1.4 Determination coefficient

After the classical assumption test is fulfilled, the data is valid so that multiple linear regression analysis can be directly carried out to see the regression equation and the magnitude of the influence of all independent variables on the dependent variable, which is defined as the coefficient of determination (R2). The coefficient of determination is calculated based on equation 2.

$$R^2 = r_{xy} \times 100\% \quad (2)$$

Information:
R^2 = Determination coefficient
r_{xy} = *Product Moment* correlation coefficient

The determination coefficient is used to estimate the magnitude of communication management's influence on a construction project's success. This coefficient describes the proportion of the total dependent variable that the independent variables can explain. If R^2 is close to 0, then the ability of the independent variables to explain the dependent variable is minimal. Conversely, the closer to the value 1, the more accurate the ability of the independent variables to explain the dependent variable

3.2 Hypothesis test

In this study, hypothesis F was tested to see the simultaneous effect of the independent variables on the dependent variable. The form of the F test equation can be seen in equation 3.

$$F = \frac{R^2/K}{(1-R^2)/(n-K-1)} \quad (3)$$

Information:
F = F value
R^2= Determination coefficient
K = Number of independent variables
n = Number of samples

This hypothesis test is based on the F and Sig values. Obtained from the SPSS output. F test steps can be described as follows:

Null hypothesis, $H_o \rightarrow \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$. It means that there is no influence between management, competency, strategy, hierarchy, communication

techniques, communication direction, and the environment on the success of construction projects simultaneously.

Alternative hypothesis, $H_a \rightarrow \beta_1 \neq 0;\ \beta_2 \neq 0;\ \beta_3 \neq 0;\ \beta_4 \neq 0;\ \beta_5 \neq 0; \beta_6 \neq 0;\ \beta_7 \neq 0$. It means that there is an influence between management, competence, strategy, hierarchy, communication techniques, the direction of communication, and the environment on the success of a construction project simultaneously.

Reject or accept the hypothesis. If the value of $F > F_{table}$ and the value of Sig. <0.05, then H_a is accepted, and H_0 is rejected. Shows that the independent variable influences the dependent variable simultaneously. Conversely, if the value of $F < F_{table}$ and Sig. > 0.05, then H_0 is accepted, and H_a is rejected. Shows that the independent variable does not affect the dependent variable simultaneously.

4 Results

Questionnaires were distributed to 30 respondents by visiting the respondent's office directly or via Google Forms. Based on the descriptive analysis results, the frequency and percentage of the characteristics of the respondents were obtained, as shown in Table 3.

Table 3. Respondent characteristics

Description	Frequency	Percentage	Description	Frequency	Percentage
Age			**Group**		
25 - 34 yo	5	17%	Contractor	30	100%
35 - 44 yo	6	20%	**Position**		
45 - 54 yo	10	33%	Project Manager	30	100%
> 54 yo	9	30%	**Qualification**		
Gender			B	9	30%
Male	29	97%	M	15	50%
Female	1	3%	K	6	20%
Tertiary Education			**Experience in construction**		
D-III	2	7%	3 - 5 years	1	3%
S1/D4	26	87%	6 - 8 years	3	10%
S2	2	7%	> 8 years	26	87%
S3	0	0%			

The classical assumption test is also carried out as a condition that must be met before carrying out the regression analysis. The normality, multicollinearity, and heteroscedasticity tests were carried out in this study. The normality test in this study uses the Kolmogorov-Smirnov test as a more straightforward test. Based on the SPSS output in Table 4, it can be seen that the Kolmogorov-Smirnov value is 0.125 < 0.138 with a significance value of 0.148 > 0.05. It shows that the data in the study is normally distributed, so the data is feasible for use in multiple linear regression analysis.

Table 4. Normality test results.

Description		Value
N		30
Most Extreme Differences	*Absolute*	0.138
	Positive	0.125
	Negative	-0.138
Test Statistic		0.138
Asymp. Sig. (2-tailed)		0.148

The multicollinearity test was conducted to see the attachment between the independent variables. Based on the results of the analysis in Table 5, it was found that all independent variables, namely management (X_1), competence (X_2), strategy (X_3), hierarchy (X_4), communication techniques (X_5), communication direction (X_6), and environment (X_7) have a tolerance value > 0.10 and a VIF value < 10. This indicates that there is no correlation between the independent variables, so there is no multicollinearity problem between the independent variables, and the regression model is good.

Table 5. Multicollinearity test results.

Variables	*Collinearity Statictics*		Description
	Tolerance	VIF	
Management (X_1)	0.342	2.928	No multicollinearity
Competence (X_2)	0.331	3.020	
Strategy (X_3)	0.144	6.963	
Hierarchy (X_4)	0.142	7.019	
Communication techniques (X_5)	0.170	5.888	
Communication direction (X_6)	0.137	7.291	
Environment (X_7)	0.330	3.028	

Furthermore, a heteroscedasticity test was carried out, which aims to test the variance of the regression model of the residual variance between observations. This test can be carried out using several methods; the Scatterplot chart was used in this study. Figure 2 shows no specific pattern, and the points spread above and below the number 0 on the Y axis. It shows that there is no heteroscedasticity in the regression model, and the regression model is good.

Based on the classical assumption test that has been done before, it was found that the regression model in this study was feasible. Thus, multiple linear regression analysis can be continued to obtain the influence of communication management on the success of construction projects. The Sig value determines the influence between variables. < 0.05; effect simultaneously through the F test; and the percentage of influence expressed through the coefficient of determination.

In the regression analysis, there are two forms of influence: positive and negative. Mathematically, a positive sign means that any change in one of the independent variables will change the dependent variable in the same direction, assuming that the other independent variables remain constant. On the other hand, a negative sign means that any change in one of the independent variables results in a change in the dependent variable in the opposite direction, assuming the other variables are constant.

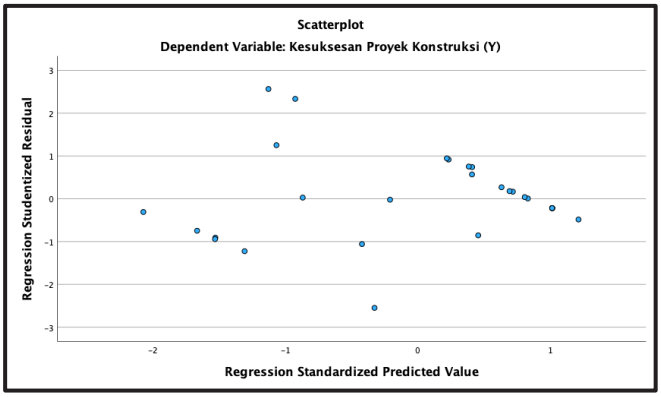

Fig. 2. Heteroscedasticity test results.

The analysis results in Table 6 obtained the variable regression coefficient, as shown in Equation 4. It can be seen that management (X_1), strategy (X_3), hierarchy (X_4), communication techniques (X_5), and environment (X_7) have a positive influence on the success of construction projects (Y). Meanwhile, competence (X_2) and direction of communication (X_6) have a negative influence on the success of construction projects (Y).

Table 6. Multiple linear regression results.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.320	0.861		1.532	0.140
	Management (X_1)	0.326	0.236	0.300	1.381	0.181
	Competence (X_2)	-0.138	0.253	-0.121	-0.546	0.590
	Strategy (X_3)	0.340	0.332	0.343	1.024	0.317
	Hierarchy (X_4)	0.096	0.297	0.108	0.322	0.750
	Communication techniques (X_5)	0.379	0.264	0.442	1.434	0.166
	Communication direction (X_6)	-0.295	0.271	-0.373	-1.087	0.289
	Environment (X_7)	0.109	0.176	0.136	0.617	0.544
a. Dependent Variable: Project construction success (Y)						

$$Y = 1{,}320 + 0{,}326X_1 - 0{,}138X_2 + 0{,}340X_3 + 0{,}096X_4 + 0{,}379X_5 - 0{,}295X_6 + 0{,}109X_7 \quad (4)$$

The F hypothesis test aims to show the effect of the independent variable simultaneously on the dependent variable, which is indicated by the value of Fcount > Ftable and the value of Sig. < 0.05. The Ftable value used in this study is 2.488. The results of hypothesis F testing on the success of construction projects are shown in Table 7.

Table 7. F hypothesis results.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.347	7	1.192	5.717	<.001[b]
	Residual	4.589	22	.209		
	Total	12.936	29			

The calculated F value was 5.717 > 2.488 with a Sig. 0.000 < 0.05, shown in Table 7. It shows that the variables; management (X1), competency (X2), strategy (X3), hierarchy (X4), communication techniques (X5), the direction of communication (X6), and environment (X7) as independent variables simultaneously influence success construction project. Thus, if all communication management variables (X) are jointly applied to a contractor company, this can support the success of a construction project, especially in terms of time.

The coefficient of determination shows the magnitude of the influence exerted by the independent variable on the dependent variable. The R Square value ranges from 0 to 1; the closer to 1, the stronger the power of the independent variable in explaining the dependent variable and vice versa. The magnitude of the communication management determination coefficient on the success of construction projects is shown in Table 8.

Table 8. Determination coefficient (R^2).

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.803[a]	0.645	0.532	0.45671

Based on Table 8, it founds the adjusted R Square value (R^2) is 0.532. It means 53.2% of the success of construction projects (Y) is influenced by communication management (X), while the other 46.8% is influenced by other variables not examined in this study.

In line with [22], it states that project communication factors have a very high partial relationship to the achievement of time performance in Banda Aceh City. This is because communication is the core thing that can help the flow of information in construction projects. The smooth flow of communication must also be supported by the accuracy and clarity of the information conveyed so that it can support project success in achieving construction projects that are cost-effective, quality-correct, and timely [23].

The simultaneous hypothesis test results were obtained as shown in Table 7, which obtained a Fcount value of 5.179 > 2.488 with a Sig. 0.000 < 0.05. It states that Ha is accepted and H0 is rejected, which means that there is an influence between management, competence, strategy, hierarchy, communication techniques, the direction of communication, and the environment on the success of a construction project simultaneously.

Communication can be unsuccessful if effectiveness is not achieved in the communication process. Several studies suggest that poor communication can lead to misunderstandings of information and repetition of work on construction projects. Project failure can be directly attributed to poor communication during the project. It impacts cost overruns, excess time, and disputes between project teams. Causes of poor communication include incomplete, inadequate, and inadequate information against the project team's needs. According to [23] wrong and distorted information can affect the work that is taking place at the project site so that it has a sizable impact on construction projects.

As much as 90% of the project manager's time is spent communicating between project teams, such as conducting meetings, analyzing reports, and other project interests. Thus, it is crucial to increase the understanding of project managers' understanding of communication management because this can positively influence stakeholders for the smooth flow of information on construction projects. The most effective and efficient communication is essential for project managers to know to align information on construction projects so that it can reach the right party without any obstacles. It is also considered one of the keys to increasing the success of construction projects [24], [25].

5 Conclusion

This study aims to assess the importance of communication management as a support for the success of construction projects based on the perception of project managers as leaders in the implementation of construction projects. It concerns a project manager's ability to align information related to project interests so that it can be distributed evenly to the proper parties, thereby avoiding misinformation as one of the causes of project failure. However, in Indonesia, a developing country with a lot of infrastructure development, this communication management capability needs to be more appropriately implemented. Communication needs to be understood by the project manager and the entire project team so that communication effectiveness can be achieved. Thus, the flow of project information can take place smoothly, and no party lacks information regarding project interests. It is crucial to increase the understanding of the entire project team, especially project managers, regarding communication management, so this research is expected to be a reference to provide an overview regarding the importance of the influence of communication management in a construction project as a support for project success.

Some research limitations and recommendations for further research include the following: this study only involved project managers from one association in an area, so these findings may not reflect the overall view of project managers in Indonesia. Future research is also expected to be able to add other variables not examined in this study, such as communication barriers obtained directly based on observations at the project site. The findings from this study can be used as a reference for further research to discuss the importance of communication management in a construction project, especially in developing countries.

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