Analysis the Influence of Manpower, Material, Machine, Method, Money and Environment on the Time Performance of Implementing Cold Storage Building Projects

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ABSTRACT

Cold Storage Building is a building specifically designed to maintain room temperature in very cold conditions which functions as a commodity preservation area so that it can be stored fresh for a long period of time. When constructing a Cold Storage Building, a very specialist construction process is required. Therefore, it must be carried out using a certain construction method (modular construction), using special Materials (sandwich panels), requiring several specialist subcons & a lackof experienced workers. These conditions make the challenge of building a Cold Storage Building more difficult, which can affect the time performance of the project. This research aims to analyze factors that can influence time performance in the implementation of the Cold Storage Building construction project using the Multiple Linear Regression Analysis method. Based on data analysis, the equation Y = 3.166 + 0.108 X1 + 0.208 X2 + 0.040 X3 + 0.112 X4 + 0.164 Based on the results of the Coefficient of Determination Test, simultaneously Manpower Factors (X1), Material Factors (X2), Machine Factors (X3), Method Factors (X4), Money Factors (X5) and Environment Factors (X6) have an influence contribution of 87.6 % of Time Performance (Y). Meanwhile, for the results of the most dominant factors analysis using Beta Standardized x Zero-Order, it was found that the Material Factors (X2) was the most dominant factors that could influence time performance with an influence value of 34.01%. Considerations in determining alternative solutions to improve time performance on Cold Storage Building construction projects are carried out on the most dominant factors, namely the Material Factors (X2).

Keywords: time performance; cold storage building; multiple linear regression analysis; SPSS.

INTRODUCTION

Cold Storage Building is a building specifically designed to maintain room temperature in very cold conditions. This building functions as an area for preserving commodities or raw Materials for food & beverage products so that they can be stored fresh for a long period of time to reduce wasted commodities. due to expiration. Buildings with these low temperatures can only function properly if they are tightly closed so that no air comes in or out, and if they are kept cool by using cooling equipment to let the cold air out. (Ismail C. Yilmaz and Deniz Yilmas, 2020).

When constructing a Cold Storage Building, a very specialist construction process is required. Therefore, it must be carried out using a certain construction method (modular construction), using special Materials (sandwich panels), requiring several specialist subcons & a lacks of experienced workers. These conditions make the challenge of building a Cold Storage Building more difficult researchers conducted a construction management performance review of 5 Cold Storage Building developments which function to maintain room temperatures between 0°C to minus 15°C, with a description of performance achievements as follows:

1. For performance reviews, costs have been met, because the construction of the Cold Storage Building uses a lump sum contract system which is fixed price, with the aim that the price & volume of work will not be changed at all, must refer to the contract documents that have been agreed during the phase construction tender clarification.

2. The quality performance review has been fulfilled, because when carrying out building commissioning testing, the owner has brought in experts/third parties who are authorized to carry out testing of the building's quality standards.
3. For performance reviews, time has not yet been achieved according to plan, from the 5 Cold Storage Building projects, an average delay of 27% of the total planning time was obtained.
Based on the problem phenomena that occurred in the Cold Storage Building construction project which was described previously, four problem formulations were obtained as follows:
1.What factors can influence time performance during the implementation of the Cold Storage Building construction project?
2. What is the most dominant factors that influences time performance in the implementation of the Cold Storage Building construction project?
3. How do the results of this research compare to the results of previous research?
4. What is the alternative solution for the most dominant factors that influence the performance of the Cold Storage Building construction project implementation time?

RESEARCH METHODS

Theoritical review

This research is included in the quantitative descriptive research method with the support of survey methods. Descriptive research is research conducted to determine the value of a variable using one or more variables without making comparisons or connecting them with other variables (Sugiyono. 2017). The survey method is research that takes samples from a population and uses a questionnaire as a data collection tool. The steps in the research process used by the authors are:

1. Research begins by determining the problem phenomenon.
2. Collect research data consisting of: Primary data, data obtained from field observations, questionnaires & interviews with research respondents & Secondary data, data obtained from literature studies.
3. Stage 1 questionnaire to validate research variables with expert experts. This stage 1 questionnaire contains a statement whether the research variables have an influence or no influence on the time performance of the Cold Storage Building construction project. If according to expert respondents there are variables outside the classification, these variables will be used as additional variables.
4. The stage 2 questionnaire was carried out to find out which variables have the most dominant influence on time performance by using a Likert scale assessment. Respondents can rate answers on a scale of 1 to 5 with the following description: (1) Strongly Disagree (2) Disagree (3) Doubtful (4) Agree (5) Strongly Agree
5. After obtaining the data from the second questionnaire, data analysis is carried out using SPSS software so that factors can be tested that influence the time performance of the Cold Storage Building construction project. The analysis that will be carried out is as follows: validity test, reliability test, classic assumption test, multiple linear regression analysis, ranking & determining dominant variables.
6. The stage 3 questionnaire is a questionnaire containing the conclusions of all analyzes distributed to expert experts. The results of this questionnaire are how the experts respond to the conclusions, whether they agree with the conclusions given or not.

Research Population

According to Sugiyono (2017), determining the general population is based on objects or subjects that have certain characteristics and traits determined by researchers to study them and draw conclusions from them. The respondents who will be used in this research are stakeholders who have more than 5 years of experience in implementing industrial building construction & have been directly involved in the process of implementing Cold Storage Building construction projects. Respondent profiles are grouped into 3 (three) groups, with descriptions in the following table:

Table 1. Profile and Number of Respondents

No	Description	Qtty	Percentage
1	**Profile based on Job Title**		
	Service Users	3	6%

No	Description	Qtty	Percentage
	Project Manager	5	12%
	Site Manager	5	12%
	Supervising consultants	10	24%
	Project Control	5	11%
	Site Supervisor	15	34%
	Total	43	100%
2	**Profile based on Work Experience**		
	More than 20 years	3	6%
	16 s/d 20 years	9	21%
	11 s/d 15 years	15	35%
	5 s/d 10 years	16	38%
	Total	43	100%
3	**Profile based on Last Education**		
	S2	2	4%
	S1	29	69%
	D4	3	6%
	D3	9	21%
	Total	43	100%

Source: Researcher's Process (2024)

Research Variable

According to Moh. Nazir (2005), Research variables are the symptoms that are the focus of the researcher's observations. Variables are the characteristics of a group of people or things that are different from each other. In this research the variables used consist of two variables, namely:

a. The independent variable (Xi) is a variable that influences or is the cause of changes or emergence of the dependent variable.
b. The dependent variable (Y.i) is the variable that is influenced or is the result of the existence of the independent variable. Research variables that have been validated by expert respondents can be seen in Table 2 below:

Table 2. Research Variables

No	Variable	Code	Indicator	Reference
1	**Manpower Factors (X1)**	X1.1	Lack of Stakeholder Expertise.	[1] [2] [3] [4] [7] [10] [11] [14] [15] [16] [17] [19] [20] [22] [24] [27] [28] [31]
		X1.3	Minimal Stakeholder Productivity.	
		X1.4	Poor Coordination Between Stakeholders.	
		X1.5	Lack of Number of Stakeholders.	
		X1.6	Stakeholders Experience Work Accidents.	
		X1.7	Undisciplined Stakeholders.	
2	**Material Factors (X2)**	X2.1	Lack of Material Amount.	[2] [3] [7] [4] [10] [11] [15] [17] [19] [20] [22] [24] [28] [29] [31]
		X2.2	Delay in Procurement of Materials.	
		X2.3	Material Scarcity.	
		X2.5	Material Damage in the Field.	
		X2.6	Lack of Material Amount.	
No	**Variable**	**Code**	**Indicator**	**Reference**
3	**Machine Factors (X3)**	X3.1	Machine/equipment maintenance is not carried out regularly.	[2] [3] [4] [7] [10] [11] [15]

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No	Variable	Code	Indicator	Reference
		X3.2	Delays in the Machine/Equipment Mobilization Process.	[16] [17] [19] [20] [22] [24] [31]
		X3.3	Machine/Equipment Damage.	
		X3.5	Limited Number of Machines/Equipment.	
		X4.1	Inappropriate Supervision Methods.	
4	**Method Factors (X4)**	X4.2	Inappropriate Construction Implementation Methods.	[3] [7] [10] [11] [19] [20] [22] [24] [29] [31]
		X4.3	Scheduling Method Error.	
		X4.4	Inappropriate K3 Methods.	
		X5.1	Delay in the Term Payment Process by Service Users/Owners.	
5	**Money Factors (X5)**	X5.3	Additional Fees for Additional Work.	[1] [2] [4] [10] [11] [15] [16] [17] [30]
		X5.4	There is an increase in Material prices.	
		X5.5	No Money Intensive If Completion of Contractor Work is Faster.	
		X6.1	Bad Weather Occurred During Construction.	
6	**Environment Factors (X6)**	X6.2	A Natural Disaster Occurred During Construction.	[2] [3] [4] [11] [14] [15] [16] [17] [20] [22] [24] [29] [30]
		X6.3	Access to the Project Location is Difficult.	
		X6.4	Difficult Terrain Conditions in the Project Area.	
		Y.1	Quality of Time Schedule Planning.	
7	**Time Factors (Y)**	Y.2	Suitability of Time Schedule Planning to Field Conditions.	[5] [9] [12] [21]
		Y.3	Timeliness of completion between sub-jobs.	
		Y.4	Unrealistic Time Schedule.	

Source: Processed from Research Journal Data (2024)

Relationship Between Research Variables

The relationship between variable X (Influence Factors) and variable Y (Time Performance) in this research is:

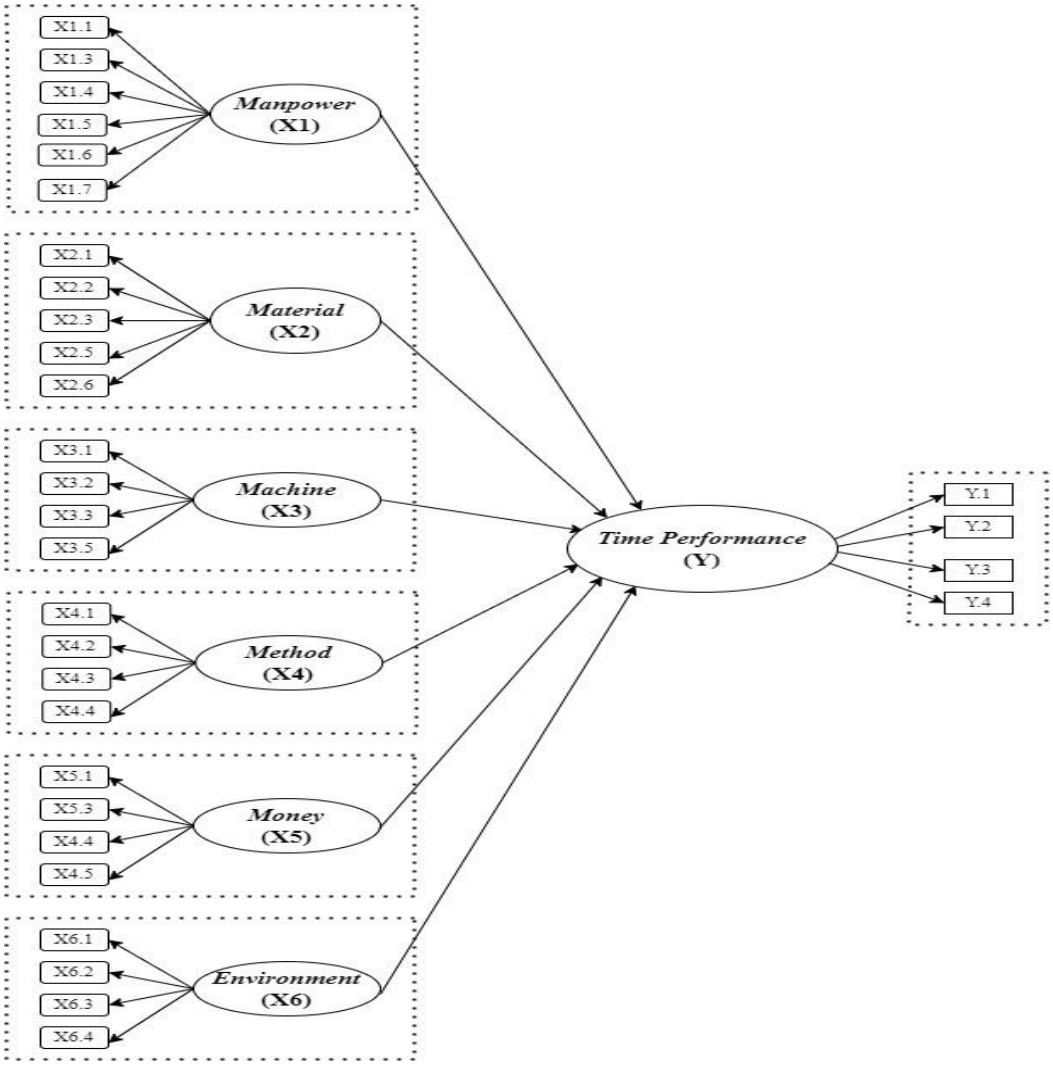

Figure 1. Relationship Between Variable X and Variable Y Source: Researcher's Process (2024)

Methods

From Figure 1, a research hypothesis can be obtained, with the following description:

a. Manpower factors (X1) influence time performance (Y) on the Cold Storage Building construction project.
b. Material factors (X2) influence time performance (Y) on the Cold Storage Building construction project.
c. Machine factors (X3) influence time performance (Y) on the Cold Storage Building construction project.
d. Method factors (X4) influence time performance (Y) on the Cold Storage Building construction project.
e. Money factors (X5) influence time performance (Y) on the Cold Storage Building construction project.
f. Environment factors (X6) influence the time performance (Y) of the Cold Storage Building construction project.
g. Manpower factors, Materials factors, machiness factors, methods factors, money factors & environment factos simultaneously influence time performance (Y) on the Cold Storage Building construction.

Research Sites

Validity Test

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Validity comes from the word validity and refers to the degree of accuracy and precision of a measuring instrument (test) in carrying out its measurement function. Data from the questionnaire results are tested for validity to measure whether a questionnaire is valid or not based on rcount (Pearson Correlation) with the provisions:

a. rcount > r table; means the questionnaire results are valid
b. rcount < r table; means the questionnaire results are invalid

Look for the r table value from the distribution table of r table values with a significance of 5%. With a value of N = 43, the value obtained is rtable = 0.301 The validity test in this study used SPSS software, with a description of the results as follows:

Table 3. Validity Test Results

Variable	Code	rcount	rtable	Conclusion
Manpower Factors (X1)	X1.1	0.615	0.301	Valid
	X1.3	0.459		Valid
	X1.4	0.444		Valid
	X1.5	0.467		Valid
	X1.6	0.494		Valid
	X1.7	0.698		Valid
Material Factors (X2)	X2.1	0.629		Valid
	X2.2	0.555		Valid
	X2.3	0.429		Valid
	X2.5	0.695		Valid
	X2.6	0.526		Valid
Machine Factors (X3)	X3.1	0.677	0.301	Valid
	X3.2	0.591		Valid
	X3.3	0.509		Valid
	X3.5	0.309		Valid
Method Factors (X4)	X4.1	0.562	0.301	Valid
	X4.2	0.512		Valid
	X4.3	0.354		Valid
	X4.4	0.782		Valid
Money Factors (X5)	X5.1	0.347	0.301	Valid
	X5.3	0.341		Valid
	X5.4	0.334		Valid
	X5.5	0.594		Valid
Environment factors (X6)	X6.1	0.564	0.301	Valid
	X6.2	0.577		Valid
	X6.3	0.619		Valid
	X6.4	0.318		Valid
Time Performance (Y)	Y.1	0.303	0.301	Valid
	Y.2	0.388		Valid
	Y.3	0.322		Valid
	Y.4	0.305		Valid

Source: Processed from Research Survey Data (2024)

Reliability Test

According to Sudjana (2005), the reliability of an assessment tool is the accuracy or consistency of the tool in assessing what is being assessed. This means that you will get relatively the same results every time you use this assessment tool. According to Imam Ghozali (2018), a questionnaire is said to be reliable if the Cronbach's alpha value is > 0.6 (Critical Value). The results of the reliability test using SPSS can be seen in the following table:

Table 4 Reliability Test Results

Variables	Code	Cronbach's Alpha	Conclusion
Manpower Factors (X1)	X1.1	0.615	Reliabel
	X1.3	0.459	Reliabel
	X1.4	0.444	Reliabel
	X1.5	0.467	Reliabel
	X1.6	0.494	Reliabel
	X1.7	0.698	Reliabel
Material Factors (X2)	X2.1	0.629	Reliabel
	X2.2	0.555	Reliabel
	X2.3	0.429	Reliabel
	X2.5	0.695	Reliabel
	X2.6	0.526	Reliabel
Machine Factors (X3)	X3.1	0.677	Reliabel
	X3.2	0.591	Reliabel
	X3.3	0.509	Reliabel
	X3.5	0.309	Reliabel
Method Factors (X4)	X4.1	0.562	Reliabel
	X4.2	0.512	Reliabel
	X4.3	0.354	Reliabel
	X4.4	0.782	Reliabel
Money Factors (X5)	X5.1	0.347	Reliabel
	X5.3	0.341	Reliabel
	X5.4	0.334	Reliabel
	X5.5	0.594	Reliabel
Environment factors (X6)	X6.1	0.564	Reliabel
	X6.2	0.577	Reliabel
	X6.3	0.619	Reliabel
	X6.4	0.318	Reliabel
Time Performance (Y)	Y.1	0.303	Reliabel
	Y.2	0.388	Reliabel
	Y.3	0.322	Reliabel
	Y.4	0.305	Reliabel

Source: Processed from Research Survey Data (2024)

Classic Assumption Test

According to Imam Ghozali (2018), the classical assumption test is carried out on the linear regression model used, so that it can be seen whether the regression model is good or not. The purpose of testing classical assumptions is to ensure that the resulting regression equation is correct, unbiased, and the estimates are consistent. Before carrying out regression analysis, the assumptions must first be tested. The assumptions that must be met for regression analysis are:

Normality Test

A regression model is said to have a normal distribution if the plotted data (dots) which represent the actual data follow a diagonal line. The following are the results of the Normality Test using SPSS software:

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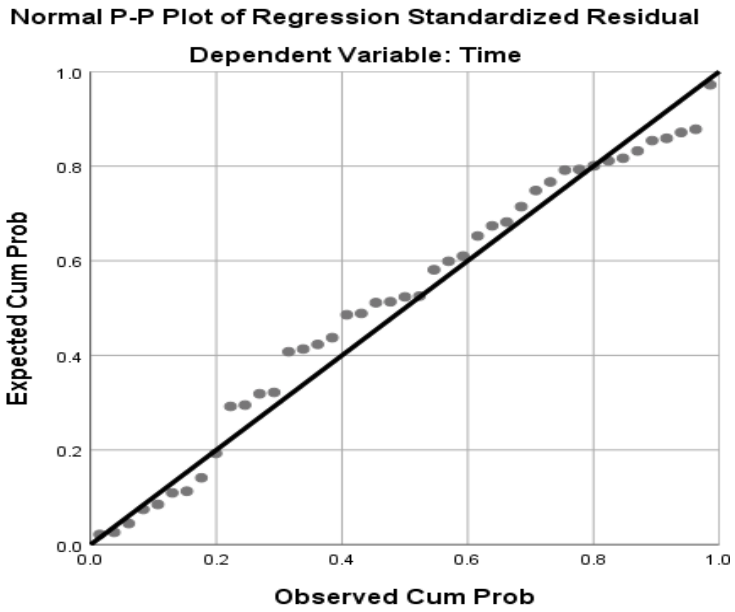

Figure 2. Normal P-P Plot of Regression Standardized Residual Source: Processed from Research Survey Data (2024)

From the above, it can be concluded that the residual data in this study is normally distributed, because the plot/points representing the data actually follow a diagonal line.

Multicollinearity Test

Multicollinearity test to detect situations where there is a perfect or almost linear relationship between independent variables in a regression model. There are no symptoms of multicollinearity if the tolerance value is > 0.100 and the VIF value is < 10.00. The results of the multicollinearity test in this study are as follows:

Table 5. Multicollinearity Test Results

Variable	Tolerance	VIF	Conclusion
Manpower Factors (X1)	0.862	1.160	There were no symptoms of multicollinearity
Material Factors (X2)	0.927	1.079	There were no symptoms of multicollinearity
Machine Factors (X3)	0.728	1.375	There were no symptoms of multicollinearity
Method Factors (X4)	0.407	2.456	There were no symptoms of multicollinearity
Money Factors (X5)	0.606	1.650	There were no symptoms of multicollinearity
Environment Factors (X6)	0.438	2.282	There were no symptoms of multicollinearity

Source: Processed from Research Survey Data (2024)

From these results it can be concluded that there is no multicollinearity between independent variables in this research.

Heteroscedasticity Test

Heteroscedasticity test to detect situations when the residual variances for all observations in the regression model are not the same. If the scatterplot image does not have a clear pattern (wavy,

widening then narrowing) and the points are spread above and below the number 0 on the Y axis, this means that heteroscedasticity does not occur. The following are the results of the Heteroscedasticity Test in this study:

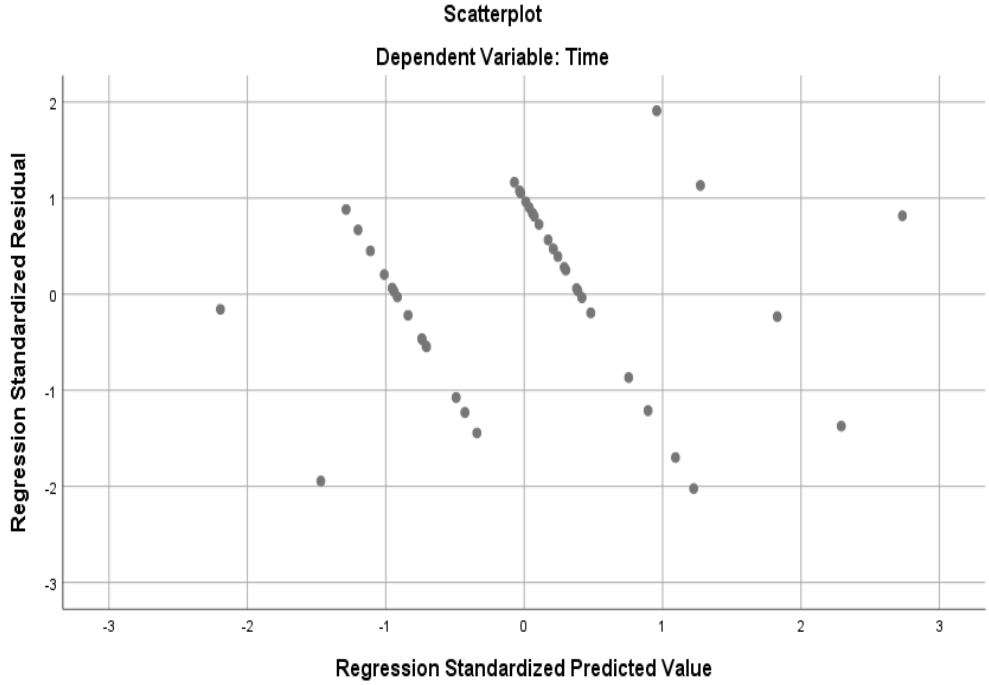

Figure 3. Scatterplots Source: Processed from Research Survey Data (2024)

From the scatterplot image, it can be concluded that hetroscedasticity does not occur, because the scatterplot image above does not show a clear pattern (wavy, widening then narrowing), and the points are spread above and below the number 0 on the Y axis.

Multiple Linear Regression Analysis

According to Ghozali (2018), multiple linear regression analysis is used to determine the direction and influence of the independent variable on the dependent variable. The stages of testing multiple regression analysis in this research are as follows:

T Test

The T test is used to test the significance level of the influence of each independent variable (Xi) on the dependent variable Y separately. The T test calculation is carried out with df = n – k, where n = number of questionnaire respondents and k is the number of variables, then the T table value is 2.0281 with a Sig value. 0.05. The following are the results of the T Test in this research:

Table 6. T Test Coefficients

Variable	B	Std. Error	Standarized Coefficients Beta	t	Sig.
(Constant)	3.166	0.870		3.638	0.001
X1	0.108	0.024	0.286	4.522	0.000
X2	0.208	0.025	0.505	8.287	0.000
X3	0.040	0.040	0.068	0.990	0.329
X4	0.112	0.038	0.272	2.953	0.006
X5	0.164	0.048	0.258	3.418	0.002
X6	0.061	0.043	0.126	1.419	0.165

Source: Processed from Research Survey Data (202

Based on the table 6, it can be concluded that:

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a. In the Manpower Factors variable (X1), the calculated T value = 4.522 > t table 2.0244 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the Manpower Factors (X1) has a significant effect on Time Performance (Y).
b. in the Material Factors variable (X2), the calculated T value = 8.287 > t table 2.0244 with a significance of 0.000 < 0.05. So Ha is accepted and H0 is rejected, meaning that the Material Factors (X3) has a significant effect on Time Performance (Y).
c. In the Machine Factors variable (X3), the calculated T value = 0.990 < t table 2.0244 with a significance of 0.329 > 0.05. So Ha is rejected and H0 is accepted, meaning that the Material Factor (X3) has no significant effect on Time Performance (Y).
d. In the Method Factor variable (X4), the calculated T value = 2.953 > t table 2.0244 with a significance of 0.006 < 0.05. So Ha is accepted and H0 is rejected, meaning that the Method Factor (X4) has a significant effect on Time Performance (Y).
e. In the Financial Factor variable (X5), the calculated T value = 3,418 > t table 2.0244 with a significance of 0.002 < 0.05. So Ha is accepted and H0 is rejected, meaning that the Method Factor (X4) has a significant effect on Time Performance (Y).
f. In the Environmental Factor variable (X6), the calculated T value = 1.419 < t table 2.0244 with a significance of 0.165 > 0.05. So Ha is rejected and H0 is accepted, meaning that the Method Factor (X4) has no significant effect on Time Performance (Y).

F Test

The F test aims to measure the significance of all the estimated regression equations. The F test calculation determines N2 using the formula N2 = n – k, then the F Table value is 2,368 with a Sig value. 0.05. The following are the results of the F Test analysis in this research:

Table 7. ANOVA F Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	23.715	6	3.952	42.409	.000[b]
	Residual	3.355	36	0.093		
	Total	27.070	42			

Source: Processed from Research Survey Data (2024)

Based on the table 7, it can be seen that the calculated F value = 42,409 > F table 2,368 with a significance value of 0.000 < 0.05. So Ha is accepted and HO is rejected, meaning that, together, Manpower Factors (X1), Material Factors (X2), Machine Factors (X3), Method Factors (X4), Money Factors (X5) & Environment Factors (X6) has a significant effect on Time Performance (Y). We can also conclude that the regression equation is good (good of fit) and the predicted value can explain the actual situation.

Multiple Linear Regression Equations

Conceptually, regression analysis is a simple method for testing the relationship between variables. The relationship between variables of interest is described in the form of an equation or model that connects the dependent variable (Y) and one or more independent variables (X).

Table 8. Regression Equation Coefficients

Variable	B	Std. Error	Standarized Coefficients Beta	t	Sig.
(Constant)	3.166	0.870		3.638	0.001
X1	0.108	0.024	0.286	4.522	0.000
X2	0.208	0.025	0.505	8.287	0.000
X3	0.040	0.040	0.068	0.990	0.329
X4	0.112	0.038	0.272	2.953	0.006
X5	0.164	0.048	0.258	3.418	0.002
X6	0.061	0.043	0.126	1.419	0.165

Source: Processed from Research Survey Data (2024)

Based on the B value in the table above, the multiple linear regression equation can be written as follows:

$$\mathbf{Y = 3.166 + 0.108\ X_1 + 0{,}208\ X_2 + 0{,}040\ X_3 + 0{,}112\ X_4 + 0{,}164\ X_5 + 0{,}061\ X_6}$$

This equation explains that Manpower Factors (X1), Material Factors (X2), Machine Factors (X3), Method Factors (X4), Money Factors (X5) and Environment Factors (X6) influence the performance of implementation time (Y) on Cold Storage Building constructions.

Coefficient of Determination Test

The coefficient of determination aims to see how much partial influence an independent variable has on the dependent variable. The coefficient of determination is the square of the correlation coefficient as a measure of the ability of each variable used. The coefficient of determination has a value between 0 and 1. A value close to 1 means that the independent variable provides almost all the information needed to predict the dependent variable. The results of the analysis of the coefficient of determination are as follows:

Table 9. Model Summary Coefficients of Determination Test

R	R Square	Adjusted R Square	Std. Error of the Estimate
.936[a]	0.876	0.855	0.305

Source: Processed from Research Survey Data (2024)

Based on the analysis results from the coefficient of determination test which can be seen in the dataity table. The table explains that the R Square value is 0.876, so the influence of the independent variables (Manpower Factors, Material Factors, Machine/Equipment Factors, Method Factors, Money Factors & Environment Factors) on the dependent variable (time performance of Cold Storage Building construction) is 87.6 The remaining % of 12.4% is influenced by other factors outside this research.

Ranking and Determining Dominant Variables

According to Ghozali (2018), the dominance variable test is used to find out how much influence the independent variable has on the dependent variable. Use the beta coefficient (Beta Coefficient) to determine which independent variable has the greatest influence (dominates) on the value of the dependent variable.

Beta Coefficient is also called Standardized Coefficient, an independent variable can be stated to have a dominant influence on the dependent variable (Y) if it has a Standardized Coefficient value that is greater than the other independent variables. The standardized coefficient based on the results of the analysis in this research can be seen as follows:

Table 10. Ranking of Dominant Variables

Variable	Beta Standarized (a)	Zero-Order (b)	(a) x (b)	% Dominant
Manpower Factors (X1)	0.286	0.513	0.147	14.67
Material Factors (X2)	**0.505**	**0.673**	**0.340**	**34.01**
Machine Factors (X3)	0.068	0.385	0.026	2.62
Method Factors (X4)	0.272	0.635	0.173	17.26
Money Factors (X5)	0.258	0.541	0.139	13.95
Environment Factors (X6)	0.126	0.406	0.051	5.11

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Variable	Beta Standarized (a)	Zero-Order (b)	(a) x (b)	% Dominant
		∑	0.876	87.6 %

Source: Processed from Research Survey Data (2024)

Based on the analysis of the research that has been carried out, it can be concluded that the Material Factors variable (X2) is the dominant factors in influencing the implementation time performance of the Cold Storage Building construction project at 34.01%. Based on the analysis, the ranking of the variables that most influence the implementation time performance of the Cold Storage Building construction project is obtained, namely as follows:

1st Rank Material Factors (X2)

2nd Rank Method Factors (X4)

3rd Rank Money Factors (X5)

4th Rank Manpower Factors (X1)

5th Rank Environment Factors (X6)

6th Rank Machine or Equipment Factors (X3)

Alternative Solutions to Improve Performance Time for Cold Storage Building Project Implementation

Based on the research results, it is known that the most dominant factors influencing the performance of the Cold Storage Building construction project implementation time is the Material factors. In order to significantly improve time performance in the implementation of the Cold Storage Building construction project, alternative solutions are needed for the indicators contained in these dominant factors. Alternative solutions that can be implemented include:

Lack of Material Amount (X2.1)

The cause of the shortage of Materials is due to a volume deviation between the bill of quantity in the tender document and the actual conditions during the construction implementation phase. According to Abdullah et al, (2023), an alternative solution that can be taken to deal with this problem is that the contractor is required to carry out an initial mutual check (MC-0), namely recalculating all work components in order to obtain the actual work volume in the field. This is to ensure harmony between bill of quantity calculations and work drawings & actual field conditions.

Delay in Procurement of Materials (X2.2)

There are construction Materials whose stock is empty & need to be indented. An alternative solution that can be applied regarding the problem of delays in Material procurement is that after determining the winning contractor for the tender, the winning contractor can immediately carry out the Material approval process with the consultant team & owner while waiting for the construction implementation contract administration process. By speeding up the Material approval process, it is hoped that the pre-order process for construction Materials can be accelerated so that they can be immediately brought to the project site. This action to speed up the pre-order process for construction Materials to resolve Material procurement problems supports research conducted by Fawwaz et al (2021).

Material Scarcity (X2.3)

Cold Storage Building uses special Materials, namely sandwich panels. This sandwich panel Material is a Material that is rarely available on the market. To overcome the problem of scarcity of sandwich panel Materials, it would be best for the service user/owner to consider procuring Material supply by owner according to the quantity that has been issued by the planning consultant. So that

the implementing contractor does not experience difficulties in procuring Materials & only carries out work on installing sandwich panel Materials while the construction implementation phase is underway. The solution related to prior communication between the owner & planner to the Material vendor to resolve the problem of Material scarcity is in line with research conducted by Ariyanto et al, (2019).

Material Damage in the Field (X2.5)

According to research conducted by Qowim et al, (2021), an alternative solution to Material damage in the field can be overcome by applying a systematic approach to housekeeping practices in the Material storage warehouse area. One method that can be applied is the 5S method. The name 5S itself is an abbreviation of 5 words in Japanese that begin with the letter S, namely Seiri (compact), Seiton (neat), Seiso (clean), Seiketsu (careful), Shitsuke (diligent). 5S is a philosophy and way for an organization to organize and manage work space or work areas intensively with the aim of efficiency by reducing waste, whether in the form of Materials, equipment and time. Qowim et al, (2021) prove that the application of 5S in storage warehouse housekeeping practices can maintain the quality of Materials stored in the warehouse area.

Steel Column and Sandwich Panel Floor Work Awaits Concrete age of 7 days (X2.6)

Based on the results of expert recommendations, there are additional factors that can influence the performance of the Cold Storage Building construction project implementation time, namely the factors that work is delayed due to waiting for the concrete to age up to 7 days. The following is an illustration of a sandwich panel component in a Cold Storage Building:

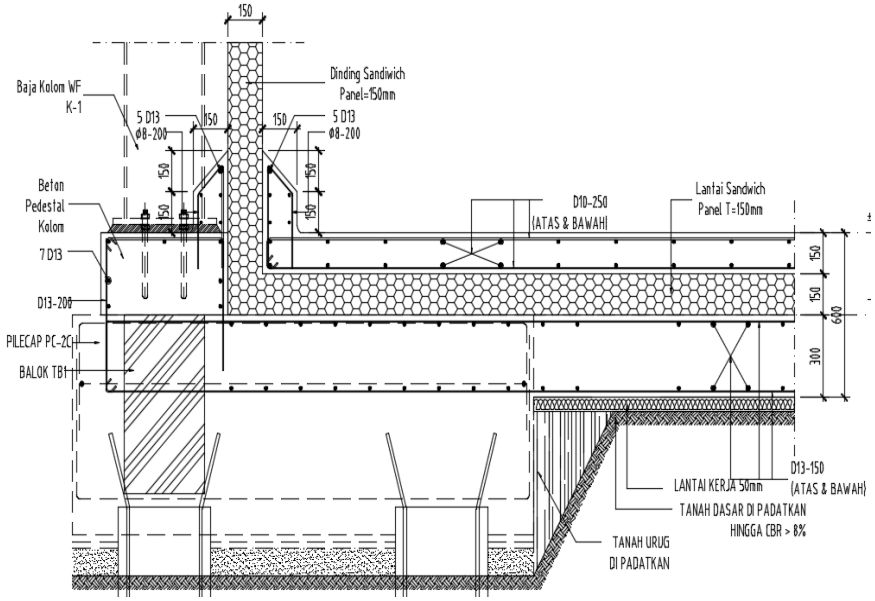

Figure 4. Sandwich Panel Installation DED Source: Cold Storage Building Project Document (2024)

Based on the illustration above, there are sandwich panel walls & sandwich panel floors flanked by 2 layers of concrete plate structure, with the following description:

a. First layer concrete slab structure with a thickness of 0.15 m at an elevation of 0.00 m to an elevation of 0.15 m.
b. Second layer concrete slab structure with a thickness of 0.3 m at an elevation of 0.30 m to an elevation of 0.6 m.

Sandwich panel & steel column floor work cannot be carried out before the second layer of concrete slab structure & pedestal column concrete structure are cast simultaneously until they are 7 days old. This happened because we had to wait to achieve the minimum concrete compressive strength target

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of 20 MPa on the 7th day after casting. To shorten the duration of idle time/work delay time, it is best to replace the readymix concrete Material in the second layer concrete slab structure & pedestal column concrete structure with fastract concrete Material. The results of research conducted by Suhaimi et al, (2020) show that using fast track concrete using a combination of sikagrout and accelerator Materials can achieve a concrete compressive strength of 20 Mpa in just 24 hours/1 day, so it can be concluded that the use of fast track concrete Material has an impact on work time efficiency.

CONCLUSION

The conclusion of the research entitled Analysis of the Influence of Manpower, Material, Machine, Method, Money & Environment on the Time Performance of the Cold Storage Building Construction Project which has been carried out and analyzed, can be concluded as follows: 1) based on the results of the F-Test analysis and the Coefficient of Determination Test, it is obtained how simultaneously/together Manpower Factors (X1), Material Factors (X2), Machine/Equipment Factors (X3), Method Factors (X4), Money Factors (X5) and Environment Factors (X6) have an influence contribution of 87.6% on time performance in the implementation of the Cold Storage Building construction project, 2) based on the results of the variable ranking analysis using multiple linear regression equations & beta coefficient values, it can be concluded that the Material Factors variable (X2) is the dominant factors in influencing the implementation time performance of the Cold Storage Building construction project, namely 34.01%, 3) research that has been carried out states that all research variables, namely Manpower Factors (X1), Material Factors (X2), Machine/Equipment Factors (X3), Method Factors (X4), Money Factors (X5) and Environment Factors (X6) can affecting the performance of the Cold Storage Building construction project implementation time. This is almost in line with previous research work (Song & Wei, 2022) with the title "Quality Risk Management Algorithm for Cold Storage Construction Based on Bayesian Networks" which observed construction management performance in terms of quality in the implementation of Cold Storage Building construction projects. that Man Factors, Material Factors, Machine Factors, Method Factors and Environment Factors influence quality performance in the implementation of the Cold Storage Building construction project. The difference between this research and research conducted by (Song & Wei, 2022) is that this research adds Money factors (X5) which are proven to influence the performance of implementation time on the Cold Storage Building construction, 4) alternative solutions to significantly improve time performance in the implementation of the Cold Storage Building construction project are carried out using the variable indicators contained in the Material Factors (X2) as the most dominant factors. Alternative solutions that can be implemented include: a) lack of material amount (X2.1)-Contractors are required to carry out an initial mutual check (MC-0), namely recalculating all work components in order to obtain the actual work volume in the field. This is to ensure harmony between bill of quantity calculations and work drawings & actual field conditions, b) delay in procurement of materials (X2.2)- after determining the winning contractor for the tender, the winning contractor can immediately carry out the Material approval process. By speeding up the Material approval process, it is hoped that it can speed up the arrival of construction Materials to the project site, c) material scarcity (X2.3)- the service user/owner can consider procuring Material supply by owner for sandwich panel Material. This is to prevent a shortage of sandwich panel Material while construction is underway, d) material damage in the field (X2.5)- material damage in the field can be overcome by implementing systematic housekeeping practices in the Material storage area. One method that can be applied is the 5S method. 5S is a philosophy and way for an organization to organize and manage work space or work areas intensively with the aim of efficiency by reducing waste, both in the form of Materials, equipment and time, e) steel column and sandwich panel floor work Awaits concrete age of 7 days (X2.6)- to shorten the duration of idle time/work delay time, it is best to replace the ready mix concrete Material in the second layer concrete slab structure & pedestal column concrete structure with fast track concrete Material which can reach a concrete compressive strength of 20 MPa in just 24 hours/1 day.

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