Interrelation of Design Performance to Construction Performance

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ABSTRACT

Planning consultant play a very important role in the success of a project, the consultant task in general is to translate the wishes and needs of the client in the design process which is poured into document drawings, structural calculations, costs, time and other supporting documents. Then supervise and provide assistance to contractors in the construction implementation phase, careful planning at the beginning of the project will produce an accurate implementation guideline product which will greatly determine the success of a project. Direct interviews were used in this study as data collection, designing questionnaires and determining variables. Questionnaires were distributed to 37 respondents and analyzed using the SEM (Structural Equation Modeling) method. The results of the analysis of the SEM method for the Interrelation of Design Performance Against Construction Performance showed that construction performance was affected by 97.3% by design and intervening performance. Human Resources is the most influential indicator in performance and design results and indicators in the design performance variables and construction performance variables are the success criteria for the design or planning document.

INTRODUCTION

The success of a project is closely related to the planning consultant, the task of a consulting company is to guide the client in the early stages of planning and design to prepare for the next stage which is continued during the construction period of physical development [1]. The task of the consultant in general is to translate the wishes and needs of the client in the design process which is poured into documents and drawings, structural calculations, costs, time and other supporting documents to be followed up by the contractor in the construction phase. The final output of the planning stage at the beginning of the project is a product of careful implementation guidelines which will later determine the success of a project [2].

Based on Government Regulation No. 22 of 2020, the planning consultant acts as a consulting companion for the project owner, of course, must be able to understand and accommodate input from the project owner which will then be realized under the supervision of the project owner in order to achieve a design that suits the ideal [3].

Considerable risks are held in planning work in a project from various aspects, both material and non-material related to timeliness, labor needs, protecting the trust and credibility of the

company itself, as well as an extension of the service user itself [4].

Project consultants are a team that acts as a consulting forum for project implementation in the field, where their role starts from the planning stage to the construction implementation stage. The reality is that delays and quality deviations from a construction in the implementation stage are not only caused by natural factors, but also caused by other things such as administration, coordination, communication, and empowerment of labor as optimal human resources [5].

METHODS

This research took place in Padang City, West Sumatra Province. The data collection method used in this research starts from the Literature Study to discuss the factors that have an impact on the performance of parties in a construction project, especially the implementing contractor. Interviews were also conducted with relevant parties regarding the issue of the expertise of the implementing contractor during the physical implementation process of the building, what kind of products the consultant produces in the form of plan documents or factors that affect the work of the implementing contractor. Eight respondents were interviewed to emphasize the results of the literature study in the form of hypotheses which could then be proven through exact information in the preparation of a product-shaped questionnaire to complete the research variables.

The next method is Population and Sample Research, where the population is a generalization area consisting of objects or subjects with certain qualities and characteristics. Utilizing 37 construction workers, especially managing contractors who are in West Sumatra and are willing to contribute to filling out the questionnaire provided, while the sample is part of the number and characteristics possessed by the population. Steps to determine the sample size can be done with statistics or based on research estimates. A total of 37 samples used were taken from the population of construction workers and were considered to have represented the existing population. Library research, questionnaires, and interview techniques were applied to obtain related data and information. Determination of variables is taken from previous research factors while the results of interviews become variables and references, interviews and distribution of questionnaires are carried out in several building construction projects and 28 infrastructures in West Sumatra. the relationship between one variable and other variables in differentiated into 3 variables:

1. Independent Variable
   Independent variables or independent variables where this variable is the cause of the emergence and change of the dependent variable or dependent variable, the independent variable is Design Performance (DP) which is latent variable 1, which consists of:

Table 1. Research variables and indicators

No	Indicator	
	Independent Variable	
1	DP I	Design quality
2	DP II	Calculation of cost & structure estimates
3	DP III	Workmanship time
4	DP IV	Human resources
5	DP V	Unsuitable field conditions
6	DP VI	Communication between parties
7	DP VII	Organizational culture

2. Intervening variables

Intervening variables are variables that can weaken and strengthen the relationship between variables, but cannot be measured & observed, mediating or intervening variables are located between the independent variable and the dependent so that the dependent variable cannot be directly affected by the independent variable. Intervening variables (ITV) become latent variables 2, 3 and 4 which consist of:

Table 2. Research variables and indicators

No	Indicator	
	Intervening Variable	
1	ITV I	Natural disasters
2	ITV II	Equipment and supplies
3	ITV III	Government policy

3. Dependent variable

The dependent variable or dependent variable where this variable is influenced or becomes the result of an independent variable, the dependent variable is Construction Performance (CP). As a dependent variable or variable that is influenced by indicators of the Construction Performance (CP) variable is as follows:

Table 3. Research variables and indicators

No	Indicator	
	Dependent Variable	
1	Y I	Cost
2	Y II	Quality
3	Y III	Delivery Time
4	Y IV	Satisfaction of the parties
5	Y V	Occupational health and safety

Data Analysis Technique is an activity after all respondent data is collected, the types of data used in this study are primary and secondary data with the following details:

Table 4. Data type

No	Data	Source
1	Primary	Interview and Questionnaire
2	secondary	Previous Research

A measurement scale is a means of determining the short length of intervals that have been determined in units of measuring instruments. This kind of measurement tool is less effective in qualitative research, but is an important factor in quantitative research which is commonly used to describe the nature of information in the values on a variable in order to relate these values to each other.

The measurement scale process is used to determine the value between variables and the value of the relationship between indicators and their variables. The SEM (Structural Equation Modeling) analysis method is used to examine how much influence design documents and other factors have on the implementation of a construction project. SEM is a multivariate statistical analysis method with measurement and structural models in which

there are 3 activities simultaneously, namely checking the validity and reliability of the instrument (confirmatory factor analysis), testing the relationship model between variables (path analysis), and getting a suitable model for prediction (structural model analysis and regression analysis).

The analysis technique in this SEM method uses smartPLS software. Data sets of variables, indicators, and questionnaire results are input into the smartPLS software where the SEM method is applied. Framing variables and indicators as well as interrelationships between variables and the relationship between indicators and variables. The stages in the SEM method will produce the desired output which will be displayed in the software by showing the interrelation values in the SmartPLS framework.

RESULTS AND DISCUSSION

Hypothesis Test Results

The results of hypothesis testing in SmartPLS software using the SEM method have 2 stages of evaluation summarized as follows:

1. Evaluation of Measurement Model
   Defining how each indicator relates to its latent variable, what is done in the Evaluation of Measurement Model is as follows:

Figure 1. Evaluation Measurement Model

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    a. Validity Test
   Validity is a measure that shows the level of validity of a test and in other words has a parallel between the test and the criteria, which in the SEM method using SmartPLS is to measure validity with the following stages:
   1. Convergent validity - Loading factor
      From the Loading Factor measurement, it can be seen the value that the Indicator has on its latent variable, declared valid if it has a value of> 0.7. The results of Loading Factor or Outer Loading in the form of FrameWork in SmarPLS are as shown below:
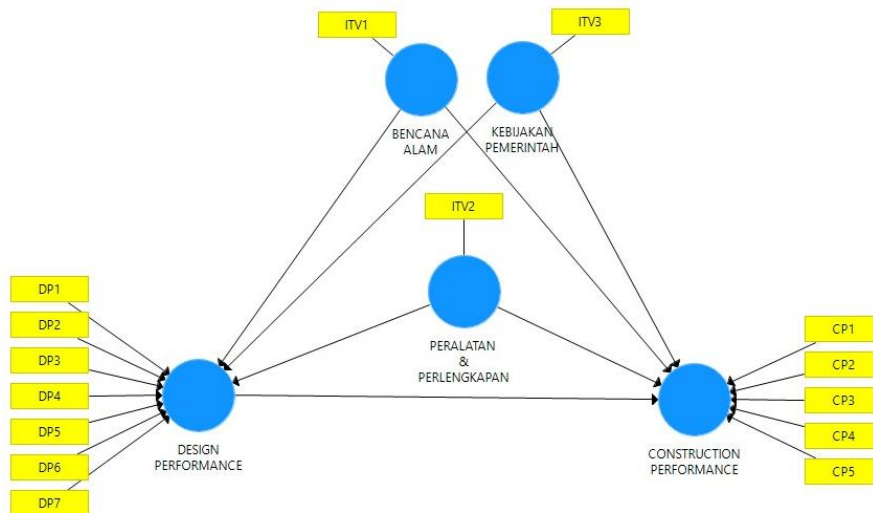
Figure 2. Frame Work and Indicator Values for Latent Variables
As well as the value between latent variables that affect

The value of the indicator on the latent variable is in the form of a table in SmartPLS as below:

Figure 3. *Outer Loading*

From the values obtained, to see the valid model in the Frame Work, the red values are removed from the model, because they have a value of less than <0.7, as can be seen in the Frame Work image and the following table:
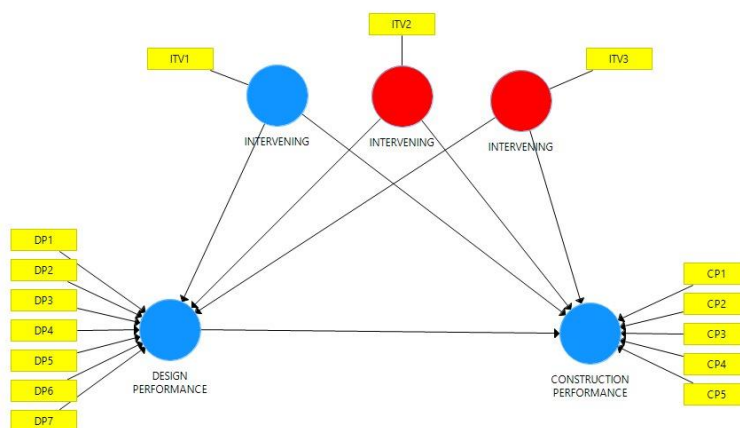

Figure 4. Valid Indicators

From the values obtained, to see the valid model in the Frame Work, the red values are removed from the model, because they have a value of less than <0.7, as can be seen in the Frame Work image and the following table:

	BENCANA_AL...	CONSTRUCTIO...	DESIGN PERFO...	KEBIJAKAN PE...	PERALATAN _...
CP1		0.721			
CP3		0.719			
CP4		0.878			
CP5		0.846			
DP1			0.732		
DP4			0.881		
ITV1	1.000				
ITV2					1.000
ITV3				1.000	

Figure 5. Valid Indicators

2. Convergent Validity - Average Variance Extracted (AVE)
   Average Variance Extracted (AVE) is the value owned by the variable, the following are the calculate results of the AVE analysis:

	Cronbach's Al...	rho_A	Composite Rel...	Average Varian...
BENCANA_AL...		1.000		
CONSTRUCTIO...		1.000		
DESIGN PERFO...		1.000		
KEBIJAKAN PE...	1.000	1.000	1.000	1.000
PERALATAN _&...	1.000	1.000	1.000	1.000

Figure 6. Average Variance Extracted Analysis (AVE)

The results of the AVE stage have a requirement to have a value above> 0.5 if there is a value below <0.5, it means that there are still invalid variables, the results of the model analysis have an AVE value greater than> 0.5.

3. Discriminant Validity - Fornell Larcker Criterion or HTMT
   This Fornell Larcker Criterion is the correlation value between the variable with the variable itself and the variable with other variables, assessing it by looking at the correlation of the variable with the variable itself cannot be smaller than the correlation value of the variable with other variables, the calculate results are as follows:

	BENCANA_AL...	CONSTRUCTIO...	DESIGN PERFO...	KEBIJAKAN PE...	PERALATAN _...
BENCANA_AL...					
CONSTRUCTIO...	0.603				
DESIGN PERFO...	0.515	0.783			
KEBIJAKAN PE...	0.134	0.237	0.398	1.000	
PERALATAN _&...	0.603	0.369	0.341	0.277	1.000

Figure 7. Discriminant Validity Value - Fornell Larcker Criterion or HTMT

From the table above, each variable has a decreasing value pattern and shows that each variable has a greater correlation value between itself than variable 1 with other variables.

4. Cross Loading

Cross Loading is the correlation value between the indicator and the variable, where the value of the indicator that should measure the variable must be greater than the correlation between the indicator and other variables.

	BENCANA_AL...	CONSTRUCTIO...	DESIGN PERFO...	KEBIJAKAN PE...	PERALATAN _...
CP1	0.347	0.721	0.611	0.299	0.234
CP3	0.387	0.719	0.577	0.132	0.256
CP4	0.574	0.878	0.659	0.094	0.345
CP5	0.582	0.846	0.643	0.288	0.323
DP1	0.269	0.641	0.732	0.241	-0.070
DP4	0.528	0.643	0.881	0.386	0.522
ITV1	1.000	0.603	0.515	0.134	0.603
ITV2	0.603	0.369	0.341	0.277	1.000
ITV3	0.134	0.237	0.398	1.000	0.277

Figure 8. Cross Loading Analysis

It can be seen from the Cross Loading Analysis table above that the value of the variable with its own indicator is greater than the value of the variable against other indicators, such as the value of the CP variable against its indicators CP 4 and CP 5 is 0.878 and 0.846, then the value of this CP variable against indicators from other variables, namely against indicators from variable DP 1 of 0, 641 and against the indicators of the ITV 1 and ITV 2 variables of 0.603 and 0.369, so the value of the CP variable against its own indicators, which are CP 4 and CP 5, is greater than the value of the CP variable against the indicators of the DP and ITV variables, as well as the value of the DP and ITV variables.

b. Reliability Test
    The reliability test is to test whether the data is reliable, powerful or in accordance with the field, provided that the calculated value for Composite Reability and Cronbach's Alpha must be above> 0.7.

	Cronbach's Al...	rho_A	Composite Rel...	Average Varian...
CONSTRUCTIO...	0.823	0.830	0.918	0.849
DESIGN PERFO...	1.000	1.000	1.000	1.000
INTERVENING	0.752	0.788	0.888	0.799

Figure 9. Reliability Test Analysis

From the table above, it can be seen that the Cronbach's Alpha and Composite Reliability values are green, which means that the value is greater than> 0.7. Here the Evaluation of Measurement Model stage has been completed, judging from the value that has been obtained from each stage in the SEM method using SmartPLS, the indicators have been able to measure the variables that should be measured and can proceed to the next stage, where the next stage is Evaluation of Structural Model.

2. Evaluation of Structural Model
    Evaluation of Structural Model is to view and analyze data from existing values, where the results and discussion and stages of this evaluation are as follows:
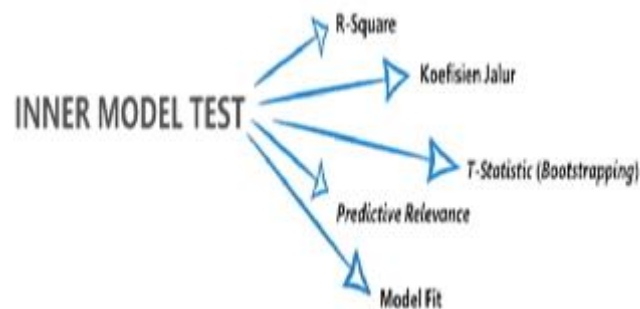

Figure 10. Evaluation Structural Model Evaluation

a. R-Square
    R-Square is a value that is only owned by the Construction Performance (CP) variable or the Dependent variable or the variable being influenced. Which R-Square will show how much the value of the Independent variable (Design Performance) and the Intervening variable (ITV) affects the Dependent variable (CP), the analysis results are as follows:

R Square

	R Square	R Square Adjus...
CONSTRUCTIO...	0.692	0.674
DESIGN PERFO...	0.281	0.260

Figure 11. R - Square Analysis

When the R-Square stage has been calculated, the value of the DP variable affecting the CP variable is 0.692 and then converted to a percentage as follows:

$$0,692 \times 100 = 69,2\ \%$$
$$100\ \% - 69,2\ \% = 30,8\ \%$$

The ITV variable affecting the CP variable is 0.281, converted to a percentage:

$$0,281 \times 100 = 28,1\ \%$$
$$100\ \% - 28,1\ \% = 71,9\ \%$$

So the CP variable is influenced by 97.3% by DP and ITV, the remaining 2.7% is likely to be influenced by variables that are not taken as indicators that affect the CP variable, such as illegal fees, job monopoly and so on.

b. Path Coefficients
    The path coefficient value is to show the direction of the variable relationship has a positive or negative direction, the way of analysis is that the value in the range 0 to 1 means that the variable has a positive relationship and if the value is in the range 0 to - 1 means that the variable has a negative relationship, the value obtained is as follows:

Table 5. Path Coefficient Analysis

	Y (INTENTION TO APPLY)
X (Design Performance)	0,678
Z (Intervening Variable)	0,242

NEGATIF   POSITIF

- 1   0   1
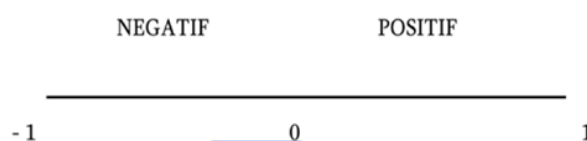
So the path coefficient analyst value states that all hypotheses or relationships of CP and ITV variables have a positive influence on CP (Construction Performance).

c. T-statistics (bootstrapping) or significance

T-statistics (bootstrapping) must have a value above> 1.96. The analysis results are as follows:

Path Coefficients

	Original Sampl...	Sample Mean (...	Standard Devia...	T Statistics (|O/...	P Values
DESIGN PERFORMANCE -> CONSTRUCTION PERFORMANCE	0.678	0.694	0.126	5.385	0.000
INTERVENING -> CONSTRUCTION PERFORMANCE	0.242	0.224	0.136	1.777	0.076
INTERVENING -> DESIGN PERFORMANCE	0.530	0.576	0.100	5.274	0.000

Figure 12. T-statistics (bootstrapping) or significance analysis

T-statistics values were obtained as follows:
- DP to CP = 5.385 > 1.96
- ITV to CP = 1.777 (insignificant but positive effect)
- ITV on DP = 5.274 > 1.95

So it can be concluded that the relationship between the DP variable and CP has a significant and positive effect on CP, the relationship between ITV and DP also has a significant and positive effect on CP, but there is a positive but insignificant relationship between ITV and CP because it has a value below <1.96.

d. Predictive Relevance

This Predictive Relevance value serves to show how good the resulting observation value is, where the value must be greater than> 0, the analysis results are as follows:

Construct Crossvalidated Redundancy

	SSO	SSE	Q^2 (=1-SSE/SSO)
CONSTRUCTION PERFORMANCE	185.000	113.871	0.384
DESIGN PERFORMANCE	259.000	240.393	0.072
INTERVENING	111.000	111.000	

Figure 13. Predictive Relevance Analysis

The results obtained are 0.384 and 0.072> 0, so it can be concluded that the observation value of the model being studied can be said to be good.

e. Model Fit

Model Fit is a value to show how good the value of the model being studied is, the results of the analysis are as follows:

Model_Fit

	Fit Summary	rms Theta	
		Saturated Model	Estimated Mo...
SRMR		0.133	0.133
d_ULS		2.107	2.107
d_G		1.089	1.089
Chi-Square		170.755	170.755
NFI		0.453	0.453

Figure 14: Model Fit Analysis

It can be seen that the NFI value gets a value of 0.453 which will be percented to 45.3% (multiplied by 100) so that the model under study is 45.3% fit or the model under study can be said to be quite good.

Measurement of the interrelation of indicators with other variables with the SEM method using smartPLS software obtained results as shown below:
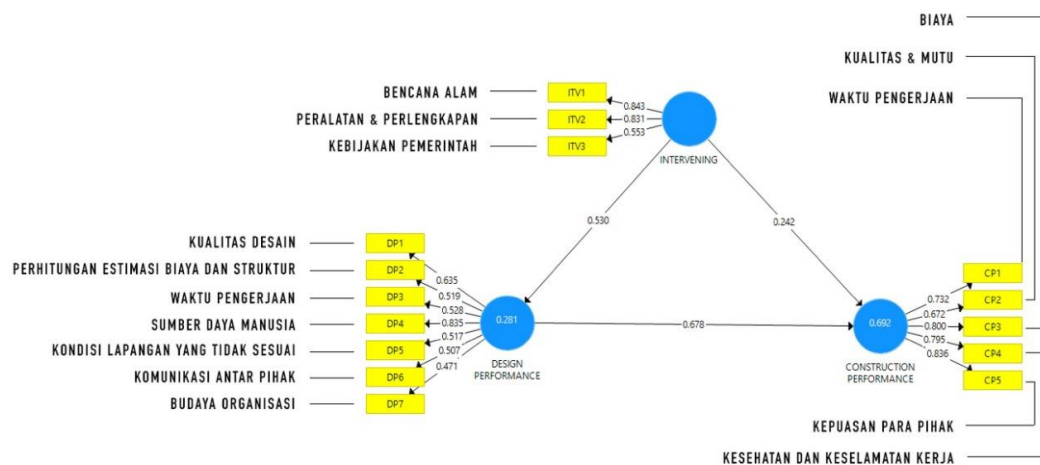

Figure 15: Interrelation of indicators of variables

Judging from the influence of indicators on the variables can be seen in the figure above which there are 3 variables, namely the construction performance variable (Construction Performance), the design performance variable (Design Performance) and for the Intervening variable. In the Construction Performance variable, the satisfaction of the parties is the most influential indicator with a value of 0.836 then cost is the second influential indicator with a value of 0.800 followed by occupational health and safety with a value of 0.795 then processing time with a value of 0.732 then quality and quality with a value of 0.672.

In the Design Performance variable, human resources are the most influential indicator on design performance with a value of 0.835 then design quality with a value of 0.635 then processing time with a value of 0.528 then calculation of cost estimates and structures with a value of 0.519 then inappropriate field conditions with a value of 0.517 then communication between parties with a value of 0.507 and followed by organizational culture with a value of 0.471. For the Intervening variable, natural disasters are the most influential indicator with a value of 0.843, followed by equipment and supplies with a value of 0.831 and government policies with a value of 0.553.

Then R-square analysis with the results When the R-Square stage has been calculated, the value of the Design Performance variable affects Construction Performance by 0.692 and then converted to a percentage to get a value of 69.2% and the intervening variable affects the Construction Performance variable by 0.281, percented to 28.1%.

Construction Performance is influenced by 97.3% by 2 variables Design Performance and intervening, the remaining 2.7% may be influenced by variables that are not taken as indicators that affect Construction Performance variables, such as illegal levies, monopoly work and so on.

CONCLUSION

The SEM (Structural Equation Modeling) analyst study on the influence or impact of Design Performance and Intervening on Construction Performance with the SEM method using smartPLS software is as follows:

1. Construction Performance (CP) is influenced by 97.3% by Design Performance (DP) and Intervening (ITV) which is influenced by Design Performance (DP) by 69.2% and by Intervening (ITV) by 28.1%. Can be seen in the results of the R-square stage.
2. (DP IV) Human Resources (HR) is the indicator that has the greatest effect on the Design Performance (DP) variable. Can be seen in the framework value between indicators and variables.
3. Indicators in the Design Performance (DP) variable and indicators in Construction Performance (CP) become criteria for the success of design or planning documents.

Data analysis concluded the following:

1. The rest of the percentage value that affects Construction Performance (CP) of 2.7% is most likely in indicators that are not inputted because they are not well observed and not in the literature study.
2. (DP VII) Organizational culture is the least influential indicator in the variable Design Performance (DP).

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