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# Sustainable Construction Framework Model on Development of Likupang Special Economic Zone

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# Sustainable Construction Framework Model on Development of Likupang Special Economic Zone

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**Abstract.** Infrastructure development must pay attention to basic aspects such as technical and social infrastructure. A special approach is needed to achieve sustainable development that adopts three main pillars in infrastructure development such as economic, environmental and social disparities. The absence of a holistic sustainable construction model requires a comprehensive solution by conducting an in-depth study to formulate the right model in implementing sustainable construction. The aim of this study is to build a holistic sustainable construction proposal model, which is expected to be a standard model so that it can be a guidance for stakeholders in implementing Sustainable Construction in the Likupang special economic zone (SEZ). This study used a quantitative method by structural equation modeling (SEM), as a multivariate analysis technique to examine the relation between complex variables and to obtain a comprehensive picture of the entire model. The sample used was 80 respondents. The results of this study indicate that the model built 56.8% has been fit and ready to be implemented. The results also show that economic and government factors have a positive and significant impact on sustainable construction. This study concludes that the model built is good and can be implemented in the Likupang SEZ.

**Keywords:** Construction, SEZ, Sustainable construction framework model

## 1. Introduction

Infrastructure development has developed rapidly, so that environmental issues due to global warming have become a priority aspect in the development process. The development of the Likupang SEZ is one of the central government's priority projects in the tourism sector, especially in the Eastern Indonesia region. Therefore, a model that can be implemented easily and in accordance with the technical, environmental, social and cultural context of the community is needed. The absence of this model has caused serious problems, so that the government through the Ministry of Public Works and Public Housing (PUPR) issued Ministerial Regulation Number 9 of 2021 about Guidelines for the Implementation of Sustainable Construction which is implemeted in sustainable construction.

Unfortunately, there are still constraints in the context of the implementation of sustainable construction that is diverse in society. Modeling of sustainable construction has been tried by considering some crucial factors, such as government, cost, knowledge and information, workforce, client and market factors. This model has been implemented in Malaysia [1]. The factor that needs to be more considered is the cultural factor as a factor that is trying to be included as an important factor in environmental sustainability by taking into account the factors of attitudes, company culture and social responsibility [2]. The solution to the absence of a holistic sustainable construction model has not been able to solve the problem comprehensively, especially local wisdom that is not paid attention to in the context of implementing sustainable construction. Hence, it is necessary to conduct an in-depth study by including cultural factors/local wisdom as a new factor forming the success of sustainable construction. The purpose of this study is to build a holistic proposal model, so that it can be a guidance for stakeholders in implementing sustainable construction in the Likupang SEZ.

## 2. Literature Review

### *2.1.The general concept of sustainable construction*

Sustainable construction is a concept developed to explain the responsibility of the construction industry in realizing sustainable development [3]. The emphasis of the concept of sustainable construction focuses on three main pillars, namely environmental friendliness, social life, and economic welfare [4]. Sustainable construction can be understood as responsible development and maintenance of environmental health that is built based on ecological principles and efficient use of resources [2]. The development of sustainable construction trends tends to focus on the relationship of construction stakeholders, human development and environmental aspects.

### *2.2 Management concept of Sustainable Project*

The concept of sustainable construction has 3 (three) main focus areas, namely the environment, social life, and economic welfare [5]. Each factor has its own variables according to the needs and conditions of the local community. Research related to the determinants of the success of construction project work is generally analyzed separately to determine the existence of a positive relationship between the object of influence and the affected [6]. Several studies have identified constraints on sustainable construction which include variables of government support and investment [1]. Human resource factors are included as a determining factor in the success of sustainable construction management [7].

## 3. Research Methodology

### *3.1 Flowchart*

The flowchart of this research begins by identifying the problems to be solved in this research. Problems are obtained by conducting initial observations and the results of literature studies as well as regulatory/policy studies. After the problem has been defined, the research is continued by conducting interviews with stakeholders. The interview technique uses a semi-structured interview technique to obtain research data. The data were analyzed using the Miles and Huberman Model, to confirm and verify the factors that influence the implementation of sustainable construction in the development of the Special Economic Zone (SEZ), Likupang.

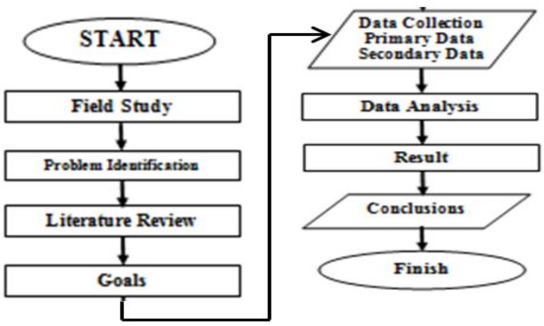


**Figure 1**. Research Flowchart

Data analysis activities consist of data reduction, data display, and conclusion drawing/verification. Data presentation is an effort to compile a set of information into a matrix or configuration that is easy to understand. An understandable data is the main key to analyze valid data.

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### 3.2 Data collection and Quantitative data analysis

At this stage, using an instrument in the form of a questionnaire, which involves respondents from service providers, namely Contractors and Consultants who have handled sustainable construction project work, the government (Central, North Sulawesi Province, Regency Government, and local government), Investors, Academics, and communities in the Likupang SEZ development environment.

The results of field data collection are then processed and analyzed. In data analysis, SEM (Structural Equotion Modeling) will be used. The results of data processing and analysis are used as recommendations for the design of models and strategies for implementing sustainable construction in the construction of the Likupang SEZ. Descriptive statistical analysis was conducted to obtain the results of the study of the factors that influence the implementation of sustainable construction in the construction of the Likupang SEZ. Furthermore, the analysis was carried out using the statistical technique of one way analysis of variance to examine these factors in the application of sustainable construction. The data obtained through questionnaires have been analyzed, the information obtained from the FGDs is then discussed in a comprehensive manner and the modeling is designed which will be used as a guide by the North Sulawesi provincial government in the implementation of SEZ development with a sustainable construction approach.

### 3.3 Research Design

This study focuses on the development of the Likupang SEZ which is designed with a sustainable construction approach by starting with several factors, namely social factors, economic factors, environmental factors, government support factors, business investment factors, human resource factors and cultural factors.

**Table 1.** Research Variables and References

| Variables | Definition | References |
|---|---|---|
| X1 | Economic Factor | Abd Jamil Fathi, 2016, Ismail et al; 2017, Teng, 2018, Ervianto, 2018, Shurrab; 2019, |
| X2 | Environmental Factor | Ismail et al; 2017, Ervianto,2018 Shurrab et al 2019, Li. X. et al, 2019, Ajibike et al, 2021. |
| X3 | Social Factor | Ismail et al; 2017, Teng, 2018, Shurrab; 2019, |
| X4 | Governmental Factor | Durdyev et al, 2018, Willar, et.al 2019 |
| X5 | Investment Factor | Durdyev et al, 2018, Sfakianaki; 2015 |
| X6 | Human Resource Factor | Sahadi. S dan Wibowo, A, 2015, Karunasena et al; 2016 |
| X7 | Cultural Factor | Fauzi; 2004, Froner; 2017 |
| Y | Sustainable Construction (SC) Factor | Araujo, et al 2020, Lima, et.al 2021, Murtagh, et al. 2020, Ajibike, et al 2021 |

The factors that become variables in this research model are determined in connection with the implementation of construction project development with a sustainable construction approach table 1. In this study, we will use the Structural Equation Modeling (SEM) equation, where the SEM model is a multivariate analysis technique used to examine the relationship between complex variables to obtain a comprehensive picture of the entire model. For this modeling using PLS-SEM (Partial Least Squares Structural Equation Modeling) program. Latent variables formed in PLS-SEM, the indicators are reflective and formative. Figure 2 shows a research model with reflective and formative indicators in relation to latent variables.

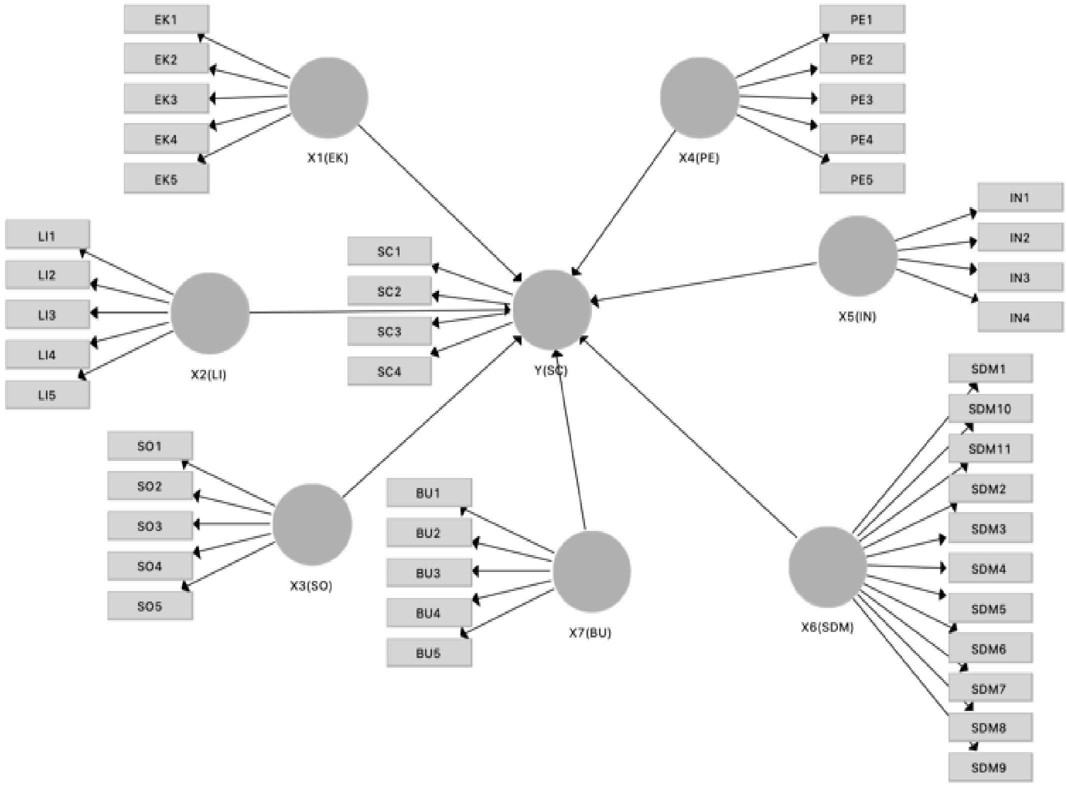


**Figure 2**. Research Model Design

3.4 Population and Sample

The population in this study is each element of the construction project Stakeholder in the construction of the Likupang SEZ. Namely contractors, consultants, government, investors, academics and the public. While the sampling in this study was done by stratified random sampling method. Stratified random sampling is a sampling process through the process of dividing the population into groups, selecting a simple random sample from each group, and combining them into a sample to estimate the population parameters. The samples in this study are Service Providers (Contractors and Consultants) who have handled projects with a sustainable construction approach, the Government (District, Province and Central), investors, academics and the community (around SEZ and the general public).

4. Results and Discussion

*4.1 Validity and Reliability Calculation Results*

The results of the calculation of validity were carried out using the convergent validity test (average variance extracted (AVE)). This technique is using to measure the AVE value with the measurement value must reach the value of each variable, which is ≥ 0.5. See Table 2.

**Table 2.** Average Variance Extracted Value

| Variables | Cronbach's Alpha values | rho_A values | Composite reliability values | AVE values |
|---|---|---|---|---|
| X1 (Ec) | 0.833 | 0.838 | 0.888 | 0.666 |
| X2 (Env) | 0.895 | 0.918 | 0.922 | 0.702 |
| X3 (Soc) | 0.784 | 0.702 | 0.859 | 0.604 |
| X4 (Gov) | 0.865 | 0.883 | 0.902 | 0.648 |
| X5 (In) | 0.857 | 0.874 | 0.902 | 0.697 |
| X6 (Hr) | 0.927 | 0.934 | 0.940 | 0.662 |
| X7 (Cul) | 0.791 | 0.816 | 0.877 | 0.704 |
| Y (Sc) | 0.831 | 0.832 | 0.887 | 0.664 |

The results of calculating the AVE value show that all the calculated factors have a value greater than 0.5. The result of calculating Discriminant Validity (Cross Loading) correlation between indicators and variables shows that the calculated value of the variable is greater than the arithmetic value of the variable indicator itself and is also greater than the calculated value of the other variables. Thus, it can be said that the validity of the indicators of each variable is valid. The results of the calculation show that the validity of the Discriminant Validity (Cross Loading) has met the requirements. The calculated reliability value (Composite Reliability and Cronbach's Alpha) is the efficacy of the instrument in measuring the indicator value.

The results of the Discriminant Validity (Fornell Lacker Criterion) calculation are carried out to determine the value of the Discriminant Validity (Fornell Lacker Criterion) validity, which is the correlation value between the variable itself and variables with other variables, cannot be smaller than other variables. The valid value must be greater between the value of the variable itself and other variables. The results are seen in table 3.

**Table 3.** Discriminant Validity (Fornell Lacker Criterion) Calculation Results

| Variables | X1 (Ec) | X2 (Env) | X3 (Soc) | X4 (Gov) | X5 (In) | X6 (Hr) | X7 (Cul) | Y (Sc) |
|---|---|---|---|---|---|---|---|---|
| X1 (Ec) | 0.816 | | | | | | | |
| X2 (Env) | 0.649 | 0.838 | | | | | | |
| X3 (Soc) | 0.537 | 0.578 | 0.777 | | | | | |
| X4 (Gov) | 0.562 | 0.782 | 0.605 | 0.805 | | | | |
| X5 (In) | 0.610 | 0.663 | 0.692 | 0.725 | 0.835 | | | |
| X6 (Hr) | 0.646 | 0.757 | 0.598 | 0.701 | 0.698 | 0.813 | | |
| X7 (Cul) | 0.439 | 0.526 | 0.434 | 0.523 | 0.482 | 0.652 | 0.839 | |
| Y (SC) | 0.512 | 0.481 | 0.400 | 0.568 | 0.444 | 0.568 | 0.543 | 0.815 |

The results of the calculation show that the value of Counting Discriminant Validity (Fornell Lacker Criterion) has fulfilled the requirements of all the calculated variables. The validity value is also continued by calculating the value of Discriminant Validity (Cross Loading) which is a validity test between the indicator values that measure the variable itself and the indicator values of other variables. The validity value must be greater than the indicator with other variables. The calculated reliability value (Composite Reliability and Cronbach's Alpha) is the efficacy of the instrument in measuring the indicator value. Count Reliability Value (Composite Reliability and Cronbach's Alpha) must be > 0.7, can be seen in Table 4

**Table 4.** Reliability Calcualtion Results (Composite Reliability and Cronbach's Alpha)

| Variables | Cronbach's Alpha values | rho_A values | Composite reliability values | AVE values |
|---|---|---|---|---|
| X1 (Ec) | 0.833 | 0.838 | 0.888 | 0.666 |
| X2 (Env) | 0.895 | 0.918 | 0.922 | 0.702 |
| X3 (Soc) | 0.784 | 0.702 | 0.859 | 0.604 |
| X4 (Gov) | 0.865 | 0.883 | 0.902 | 0.648 |
| X5 (In) | 0.857 | 0.874 | 0.902 | 0.697 |
| X6 (Hr) | 0.927 | 0.934 | 0.940 | 0.662 |
| X7 (Cul) | 0.791 | 0.816 | 0.877 | 0.704 |
| Y (SC) | 0.831 | 0.832 | 0.887 | 0.664 |

The calculation results have shown that the calculated reliability value (Composite Reliability and Cronbach's Alpha) is greater than 0.7 so that it can be said that the instrument is reliable and effective for use in research.

## 4.2 Model Evalution

### *4.2.1.* Model evaluation: Inner Model Test (R-Square)

The results of the model evaluation are carried out by calculating the following indicators.

The value of the Inner Model Test (R-Square) is a value that is only owned by the Y variable (Sustainability Construction). This value is a value that shows how much the independent variable (X1-X7) affects the dependent variable Y. The results show that the value of Y = 0.457 x 100% = 45.7% is influenced by X1-X7. See table 5.

**Table 5.** Inner Model Test (R-Square) Values

| | **R square** | **R Square Adjusted** |
|---|---|---|
| **Y (SC)** | 0.457 | 0.405 |

### *4.2.2. Model evaluation: Inner Model Test (Path Coefficients)*

The value of the Inner Model Test (Path Coefficients) is a value that shows the direction of the relationship between positive or negative variables. The results of this calculation show the direction of the influence of each variable X on the Y variable (Continuous Construction). The acceptance value is at zero. If it is greater than 0 to 1, it means that it shows the direction of a positive influence, whereas if it is less than 0 to – 1, it means that it has a negative influence, it can be seen in table 6.

**Table 6.** Inner Model Test (Path Coefficients) Values

| Variable | X1 (Ec) | X2 (Env) | X3 (Soc) | X4 (Gov) | X5 (In) | X6 (Hr) | X7 (Cul) | Y (Sc) |
|---|---|---|---|---|---|---|---|---|
| X1 (Ec) | | | | | | | | 0.256 |
| X2 (Env) | | | | | | | | -0.192 |
| X3 (Soc) | | | | | | | | -0.008 |
| X4 (Gov) | | | | | | | | 0.403 |
| X5 (In) | | | | | | | | -0.131 |
| X6 (Hr) | | | | | | | | 0.189 |
| X7 (Cul) | | | | | | | | 0.264 |
| Y (SC) | | | | | | | | |

The results of this study conclude the direction of the influence of the variables as follows:

X1 (Economy) has a Positive effect on Y (Sustanability Construction)
X2 (Environment) has a negative effect on Y (Sustanability Construction)
X3 (Social) has a negative effect on Y (Sustanability Construction)
X4 (Government) has a Positive effect on Y (Sustanability Construction)
X5 (Investment) has a negative effect on Y (Sustanability Construction)
X6 (Human Resources) has a Positive effect on Y (Sustanability Construction)
X7 (Culture) has a Positive effect on Y (Sustanability Construction)

These results indicate that the variables of the economy, government, human resources and culture show a positive influence on sustainable construction. While the environmental, social and investment variables show a negative influence.

### *4.2.3. Model evaluation: Inner Model Test (Significancy T-STATISTIC)*

The result of calculating the value of the Inner Model Test Evaluation (Significancy T-STATISTIC) is a calculation result that shows the significance value of a variable. The acceptance value is the significance level used alpha = 0.05 or the T-Statistic value > 1.96 = SIGNIFICANT. See Table 7.

**Table 7.** Inner Model Test (Significancy T-STATISTIC) Values

| | Original Sample (0) | Sample mean (M) | Standard Deviation (STDEV) | T Statistics (O/STDEV) | P Values |
|---|---|---|---|---|---|
| X1(Ec)->Y(Sc) | 0.256 | 0.254 | 0.116 | 2.203 | 0.028 |
| X2(Env)->Y[Sc) | -0.191 | -0.160 | 0.197 | 0.972 | 0.331 |
| X3(SocI->Y(Sc) | -0.008 | 0.004 | 0.166 | 0.047 | 0.963 |
| X4(Gov)->Y{Sc) | 0.403 | 0.376 | 0.199 | 1.016 | 0.043 |
| X5[1n)->YiScI | -0.131 | -0.130 | 0.143 | 0.916 | 0.360 |
| X6[Hr)->Y(Sc) | 0.189 | 0.193 | 0.175 | 1.078 | 0.282 |
| X7(Cul)-> Y(Sc) | 0.264 | 0.249 | 0.139 | 1.598 | 0.058 |

*4.2.4. Model Evaluation: Inner Model Test (Predictive Relevance)*

The results of the Inner Model Test (Predictive Relevance) are values to show how well the observations are made. The results of the Inner Model Test Predictive Relevance are calculated using blindfolding in PLS. Inner Model Test Predictive Relevance has an acceptance value of good observation value if > 0 it can be said that the observation is good. See Table 7. The results of the calculation show that the results of the Inner Model Test Predictive Relevance show the value so the conclusion of the observation is 0.237. This means that the observations that have been made in this study can be said that the observations are good.

**Table 8.** Inner Model Test (Predictive Relevance) Values

| Variables | SSO | SSE | $Q^2$ (=1-SSE/SSO) |
|---|---|---|---|
| X1 (Ec) | 324.000 | 324.000 | |
| X2 (Env) | 405.000 | 405.000 | |
| X3 (Soc) | 324.000 | 324.000 | |
| X4 (Gov) | 405.000 | 405.000 | |
| X5 (In) | 324.000 | 324.000 | |
| X6 (Hr) | 648.000 | 648.000 | |
| X7 (Cul) | 243.000 | 243.000 | |
| Y (SC) | 324.000 | 247.125 | 0.237 |

*4.2.5. Model Evaluation: Inner Model Test (Model Fit)*

The Inner Model Test (Fit model) is a value to show how well the model under study is. Acceptance value is measured using Value seen in NFI on PLS. See Table 9.

**Table 9.** Inner Model Test (Fit Model) Values

| | Saturated Model | Estimated Model |
|---|---|---|
| SRMR | 0.092 | 0.092 |
| d_ULS | 5.948 | 5.948 |
| d_G | 3.595 | 3.595 |
| Chi_Square | 1266.411 | 1266.411 |
| NFI | 0.568 | 0.568 |

The calculation results show that the Model Fit value is the NFI value = 0.568. This means that the NFI value shows that the built model is good. The percentage of the model built is obtained with NFI x 100%, NFI = 0.568 x 100% = 56.8% Fit model. This means that the sustainable construction model that has been built has 56.8% declared fit and can be implemented in sustainable construction in the Likupang SEZ. The results of this study have resulted in a model built to test whether the model that has been built is good or not. To measure the model, researchers used the Inner Model Test (Model Fit). See Figure 3.

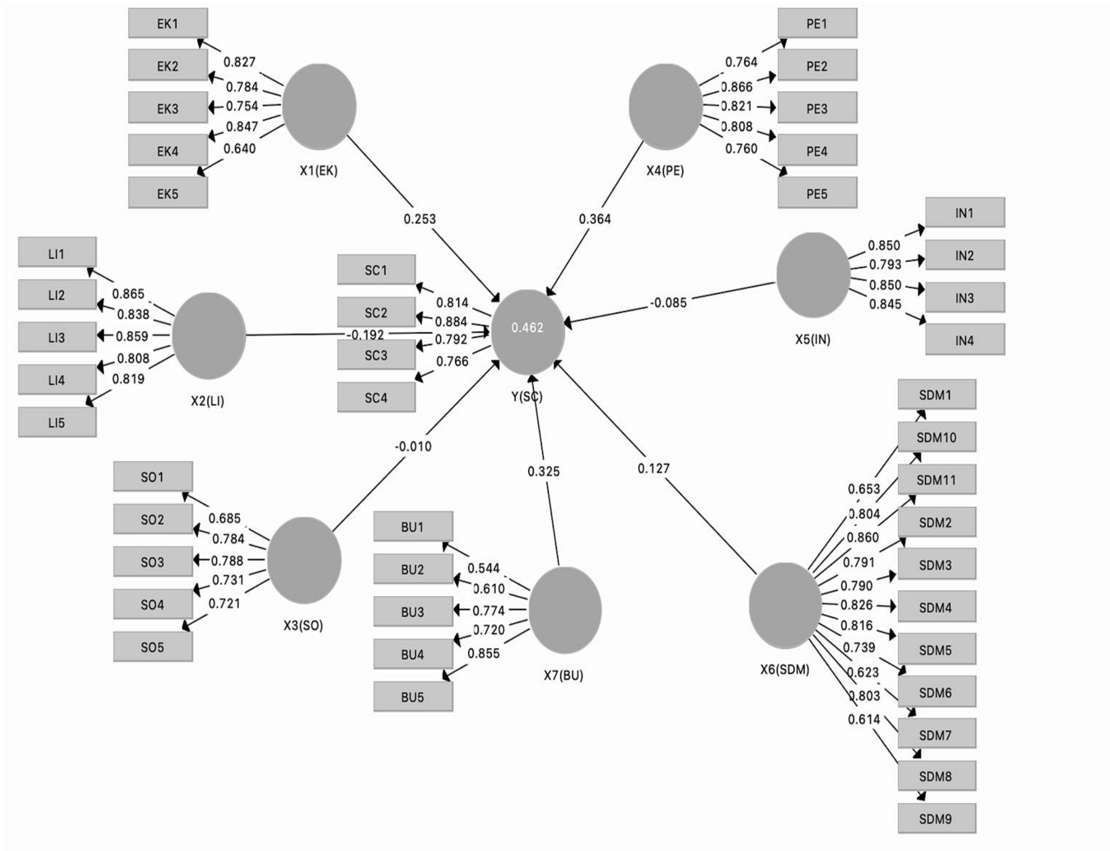


**Figure 3**. Sustainable Construction Fit Model

## 5. Conclusion

This study concludes that the resulting model has met the requirements as a good model and can be used in the development of sustainable construction. The proof results show that 56.8% of the model produced is good to use. The factors that influence the model have contributed to the development of the model. Several factors have been shown to have a positive and significant effect, such as economic and government factors, as well as human resource factors and cultural factors that have a positive effect. Meanwhile, environmental, social and investment factors have a negative influence on the sustainable construction model in the Likupang SEZ. The results of this research conclude that the model that has been produced can be implemented in the development of the Likupang SEZ directly by paying attention to the factors that have a positive influence and stakeholders need to develop a mature strategy in anticipating factors that have a negative influence and maximizing the factors that contribute positively.

## References

[1] Durdyev S., S. Ismail, A. Ihtiyar, N. F. S. Abu Bakar, and A. Darko, "A partial least squares structural equation modeling (PLS-SEM) of barriers to sustainable construction in Malaysia," *J. Clean. Prod.*, **vol. 204**, pp. 564–572, 2018, doi: 10.1016/j.jclepro.2018.08.304.

[2] Ajibike W., A , Adeleke A. Q., F. Mohamad, J. A. Bamgbade, M. N. M. Nawi, and T. D. Moshood, "An evaluation of environmental sustainability performance via attitudes, social responsibility, and culture: A mediated analysis," *Environ. Challenges*, **vol. 4**, no. March, p. 100161, 2021, doi: 10.1016/j.envc.2021.100161.

[3] Araújo A. G, Pereira Carneiro A. M, and R. P. Palha, "Sustainable construction management: A systematic review of the literature with meta-analysis," *J. Clean. Prod.*, **vol. 256**, p. 120350, 2020, doi: 10.1016/j.jclepro.2020.120350.

[4] Lima L, E. Trindade, L. Alencar, M. Alencar, and L. Silva, "Sustainability in the construction industry: A systematic review of the literature," *J. Clean. Prod.*, **vol. 289**, p. 125730, 2021, doi: 10.1016/j.jclepro.2020.125730.

[5] Murtagh N, L. Scott, and J. Fan, "Sustainable and resilient construction: Current status and future challenges," *J. Clean. Prod.*, **vol. 268**, p. 122264, 2020, doi: 10.1016/j.jclepro.2020.122264.

[6] Udomsap A. D., and P. Hallinger, "A bibliometric review of research on sustainable construction, 1994–2018," *J. Clean. Prod.*, **vol. 254**, p. 120073, 2020, doi: 10.1016/j.jclepro.2020.120073.

[7] Sahadi S., and M. Agung Wibowo, "Ketepatan Klasifikasi pada Pengelompokan Manajer Proyek Konstruksi Berdasarkan Faktor Pengembangan Sumber Daya Manusia Menggunakan Analisis Diskriminan," *Media Komun. Tek. Sipil*, **vol. 20**, no. 2, 2015, doi: 10.12777/mkts.20.2.119-124.