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# Factors that influence the application of the concept of new green areas in residential areas using structural equation modeling-part least square (SEM-PLS)

**Nur Amalia, Albert Eddy Husin, Ferdiansyah Ibnu Prastowo**

Master of Civil Engineering, Mercu Buana University, Jakarta, INDONESIA
E-mail: mamalia22.na@gmail.com, albert_eddy@mercubuana.ac.id

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## ABSTRACT

Climate change and global warming or environmental damage and degradation have led to various natural disasters, social disasters and serious economic disasters. Global warming has increasingly affected not only our daily lives but also our business activities. Housing and settlements are one of the basic human needs that must be met to be able to live decently. However, human life and its business activities have not paid enough attention to environmental issues. Excessive exploitation of non-renewable energy beyond normal limits is also damaging to the environment. The application of the new green area concept is a consequence of the increase in the cost of green areas incurred by stakeholders so that residential areas become environmentally friendly, the concept of new green areas, Value Engineering (VE), Life Cycle Cost Analysis (LCCA) are the main factors that influence the improvement of cost performance of implementing the concept new green areas in residential areas in Indonesia, using structural equation model- partial least square (SEM-PLS) analysis. This research has an update related to the concept of applying new green areas to residential areas in Indonesia. The results of this study obtained "10 factors that affect the cost performance of new green areas in residential areas", namely Project Management, Infrastructure and Facilities Burdens, Infrastructure and Facilities Service Functions, Microclimate and Ecosystem Preservation, Environmentally Friendly Materials, Development, Cost Breakdown Structure, LCC Analysis, Evaluation, Value Engineering.

**Key word:** residential area; new green area; value engineering; life cycle cost analysis; SEM-PLS.

## INTRODUCTION

Climate change and global warming or environmental damage and degradation have led to various natural disasters, social disasters and serious economic disasters. Global warming has increasingly affected not only our daily lives but also our business activities. However, human life and its business activities have not paid enough attention to this environmental issue. Excessive exploitation of non-renewable energy beyond normal limits is also damaging to the environment. In this case, buildings are a contributor to global warming. Data from the World Green Building Council Indonesia shows that each building unit provides 33% CO2 emissions and consumes 17% clean water, 25% wood products, 30-40% raw material use and 40%-50% energy use for construction and operation. (Lnl et al., 2020)

The housing sector alone is responsible for 22% of the world's energy consumption and 17% of CO2 emissions (United Nations Environment Programme UNEP, 2017). Therefore, reducing the environmental impact of housing is essential to achieving a sustainable future (Molina et al., 2020).

To prepare green open space requires quite expensive and more profitable costs when optimizing land for sale or rent as a commercial area. So the alternative is to use the roof as landscaping and hardscape to meet the development of the site accordingly. The roof of the building can also be used for energy conservation by installing solar cells and saving the use of clean water by setting up rainwater reservoirs (La Roche & Berardi, 2014).

The environment is the fundamental building block of a city, and a good starting point for creating truly sustainable communities. Recognizing the importance of the environment as a frontline in the battle for sustainability, in several countries around the world, initiatives have been taken to pave the way to create a sustainable environment (Elgadi et al., 2016)

Handling increased costs on green projects can be reduced by the cost of investing in residual materials. *Value Engineering* (VE) provides very significant benefits in the civil engineering construction industry, especially in cost savings and in the area of increasing project benefits. VE is a systematic review of projects, products, or processes to improve performance, quality, and/or life cycle costs by a team of independent multi-disciplinary specialists (Berawi, 2004) in (Husin, 2019). *Life Cycle Cost Analysis* (LCC) in VE is based on value and is used to determine alternatives with the lowest cost (Husin, 2015). VE provides very significant benefits in the civil engineering construction industry, especially in cost savings and in the area of increasing project benefits. LCCA is a technical and economic optimization method whose main objective is to identify and select solutions that generate the highest revenue throughout the life of their service or, in other words, have the lowest life cycle costs (Marrana et al., 2017).

The purpose of the study in this case is to determine the relationship between the influence of the use and development of methods and analyze the factors that most influence the improvement of *green retrofitting* cost performance based on *Value Engineering* and *Life Cycle Cost Analysis* applied to the existing concrete industry, with a relationship structure model using *Structural Equation Modeling –Partial Least Square* (SEM-PLS). The selection of statistics using the SEM-PLS model is an advantage and is highly recommended when it has a limited number of samples while a complex model (Harahap, 2018)

**Table 1.** Minimum Sample Size for Level Difference with Minimum Path Coefficient and 80% Strength Test

| ℘ min | Significance level | | |
|---|---|---|---|
| | 1% | 5% | 10% |
| 0.05 – 0.1 | 1004 | 619 | 451 |
| 0.11 – 0.2 | 251 | 155 | 113 |
| 0.21 – 0.3 | 112 | 69 | 51 |
| 0.31 – 0.4 | 63 | 39 | 29 |
| 0.41 - 0.5 | 41 | 25 | 19 |

Source : (Hair Jr et al., 2021)

## RESEARCH METHODS

The study was conducted for 3 months around April 2022 - June 2022. The determination of respondents was taken from the directors, *general managers, heads of divisions* and several related divisions at the study site was carried out with the number of questionnaire distributions as many as 77 respondents who returned the questionnaire in full. Researchers use SEM PLS software version 3.0 to analyze the data and to determine the sample size it is necessary to know whether the data meets the requirements for the SEM-PLS model. Characteristics that need to be considered are sample size, data distribution shape, *missing values* and measurement scale. Minimum sample size taken based on different levels in *path coefficients* (*p* Min) and 80% statistical strength test (Hair Jr et al., 2021)

The minimum samplesize taken in this study was based on a *path coefficient* value of 0.25 and a statistical strength test of 80% at a *significant level* of 5% so that a minimum sample of 69 was obtained. The data information of the 77 respondents was obtained by 89% of the total 87 respondents.

Data collection techniques are the most strategic step in research (Sugiyono, 2010: 62), data collection is carried out with the Observation stage (Nawawi and Martini, 1992: 74), interviews (Sugiyono, 2010: 194), and documentation (Hamidi, 2004: 72), while primary data collection is carried out with the instrument validation stage, pilot survey, respondent data collection, questionnaire distribution, validation of questionnaire results and data input process and model simulation on SEM-PLS.

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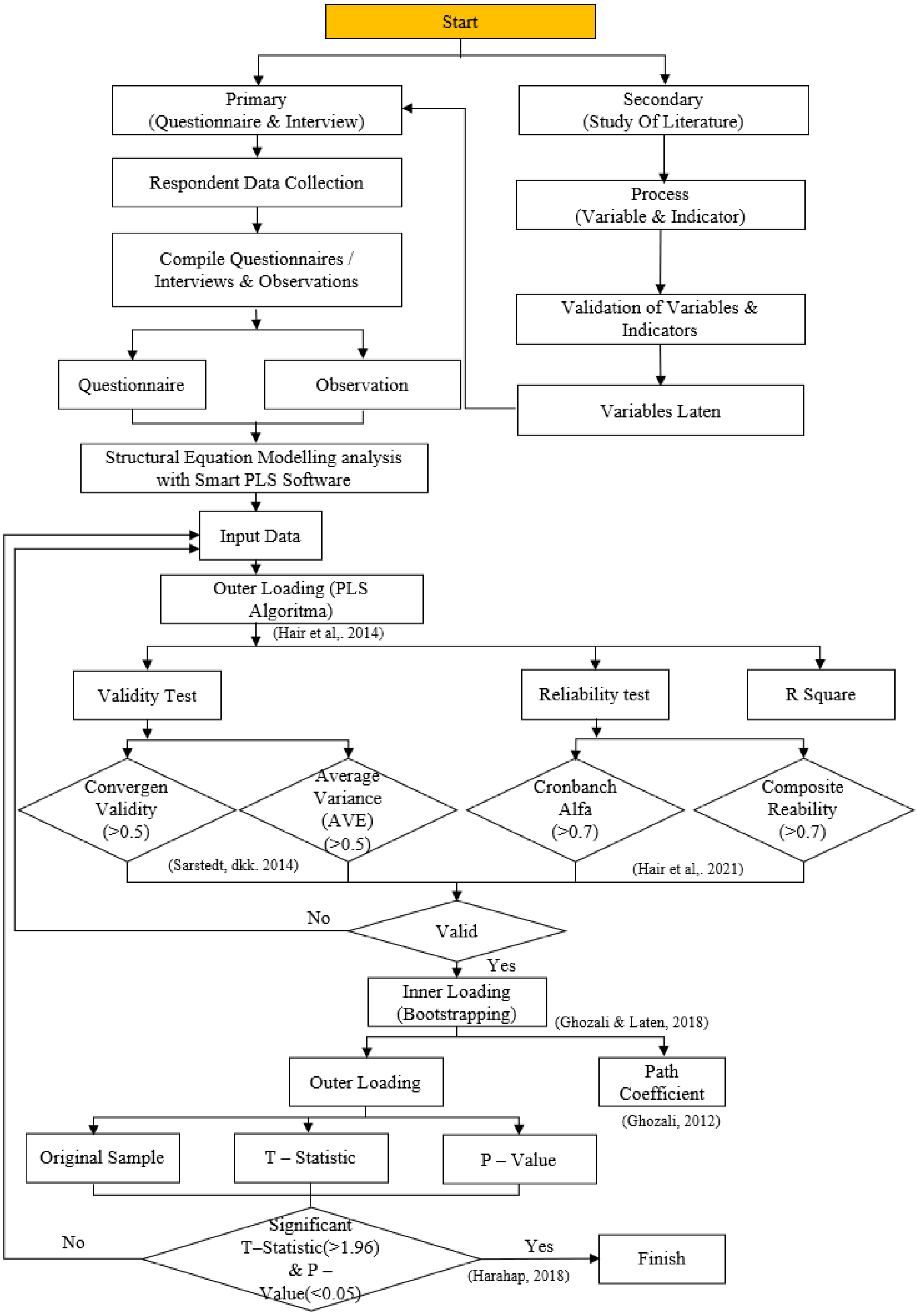


**Figure 1**. Diagram of Simulation Stages of Research model with SEM-PLS

## RESULT AND DISCUSSION

Data analysis to determine and analyze the factors that most influence the improvement of cost performance of new green areas based on VE and LCCA applied to residential areas, factors and subfactors of variables tested using SEM- PLS consisting of 5 variables, 20 main factors and 76 sub factors are shown in the table.

**Table 2.** Key Success Factor

| *Var* | *Main Factor* | *Sub Factors* | | *Reference* |
|---|---|---|---|---|
| RESIDENTIAL AREA | CONTRACT DOCUMENTS (X1.1) | Technical Specifications | X.1 | (Imron & Husin, 2021) |
| | | BOQ | X.2 | (Imron & Husin, 2021) |
| | | Technical Drawings | X.3 | (Karolina et al., 2021) ; (Kineber et al., 2021); (Imron & Husin, 2021) |
| | | Job Location | X.4 | (Al-Hosani & Rashid, 2021) |
| | | Job Schedule | X.5 | (Al-Hosani & Rashid, 2021) |
| | PROJECT MANAGEMENT (X1.2) | Risk Management | X.6 | (Al-Hosani & Rashid, 2021) |
| | | Cost Control | X.7 | (Li et al., 2019) |
| | | Top Management Support | X.8 | (Al-Hosani & Rashid, 2021) |
| | | Project Manager Performance | X.9 | (Li et al., 2019) ; (W. Shen et al., 2017) |
| | | Effective Control Manpower | X.10 | (Gunduz & Almuajebh, 2020) |
| | | Effective Monitoring & Control | X.11 | (Al-Hosani & Rashid, 2021) ; (Gunduz & Almuajebh, 2020) |
| | | Effective Communication Systems | X.12 | (Al-Hosani & Rashid, 2021) |
| | | Effectivity of Decision Making | X.13 | (Gunduz & Almuajebh, 2020) |
| | | Financial Project | X.14 | (Gunduz & Almuajebh, 2020) |
| NEW GREEN AREAS | WELFARE OF THE LOCALS | Use of 20% of local materials (raw materials) for economic/industrial activities | X.15 | (Al-Hosani & Rashid, 2021) ; (Minister of PUPR Republic of Indonesia, 2021) |
| | | Planting activities of consumable crops | X.16 | (Minister of PUPR Republic of Indonesia, 2021) |
| | FUNCTIONS OF INFRASTRUCTURE AND FACILITIES SERVICES | Drainage network | X.17 | (Minister of PUPR Republic of Indonesia, 2021) ; (Tam & Zeng, 2013) |
| | | Power grid | X.18 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Information and communication networks | X.19 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Transit facilities (bus stops) or | X.20 | (Furlan & Sinclair, 2021) ; (Minister of PUPR Republic of Indonesia, 2021); (Tam & Zeng, 2013) |

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| *Var* | *Main Factor* | *Sub Factors* | | *Reference* |
|---|---|---|---|---|
| | | bicycle parking lots | | |
| | | 10% area of regional facilities for MSMEs | X.21 | (Minister of PUPR Republic of Indonesia, 2021) ; (Baycan & Nijkamp, 2012) |
| | | Operation and maintenance of facilities and infrastructure | X.22 | (Pinto et al., 2021) ; (Minister of PUPR Republic of Indonesia, 2021);((Nuworsoo & Cooper, 2013) |
| | | Green line | X.23 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Sharing Path | X.24 | (Minister of PUPR Republic of Indonesia, 2021) ; (Oyebanji et al., 2017) |
| | MICROCLIMATE AND ECOSYSTEM PRESERVATION | Provision of Green Open Space (RTH) | X.25 | (Minister of PUPR Republic of Indonesia, 2021) ; (Moroke et al., 2019) |
| | | Land Conservation and Suitability | X.26 | (Minister of PUPR Republic of Indonesia, 2021) ; (Moroke et al., 2019) |
| | | Soil Pollution | X.27 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Natural Landscape Characters | X.28 | (Minister of PUPR Republic of Indonesia, 2021) |
| | THERMAL IMPACT ON THE REGION | Porous land | X.29 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Green vegetation | X.30 | (Minister of PUPR Republic of Indonesia, 2021) |
| | INFRASTRUCTURE AND FACILITIES LOAD | Alternative Water Sources | X.31 | (Assylbekov et al., 2021) ; (Minister of PUPR Republic of Indonesia, 2021) |
| | | Water Meter | X.32 | (Minister of PUPR Republic of Indonesia, 2021) ; (L. yin Shen et al., 2010) |
| | | Catchment Area | X.33 | (Minister of PUPR Republic of Indonesia, 2021) ; (L. yin Shen et al., 2010) |
| | | Wastewater Treatment | X.34 | (Minister of PUPR Republic of Indonesia, 2021) ; (Oyebanji et al., 2017) |
| | | Waste Storage | X.35 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |
| | | Communal Junk Composter | X.36 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |
| | | Garbage Collector | X.37 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |
| | | Landfills | X.38 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |
| | | Waste Recycling Buildings | X.39 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |

| ***Var*** | ***Main Factor*** | ***Sub Factors*** | | ***Reference*** |
|---|---|---|---|---|
| | | Waste Manager | X.40 | (Minister of PUPR Republic of Indonesia, 2021) ; (Sfakianaki, 2019) |
| | | Sources of Electrical Energy | X.41 | (Minister of PUPR Republic of Indonesia, 2021) |
| | | Facilities and Infrastructure | X.42 | (Pinto et al., 2021) ; (Minister of PUPR Republic of Indonesia, 2021) |
| | ENVIRONMENTALLY FRIENDLY MATERIALS | Used Materials / Materials | X.43 | (Minister of PUPR Republic of Indonesia, 2021) ; (Oluleye et al., 2020); (Oyebanji et al., 2017) |
| | | Latest source material | X.44 | (Minister of PUPR Republic of Indonesia, 2021) ; (Oluleye et al., 2020); (Oyebanji et al., 2017) |
| | | Materials affect health | X.45 | (Minister of PUPR Republic of Indonesia, 2021) ; (Oluleye et al., 2020); (Oyebanji et al., 2017) |
| VE | STAGES OF INFORMATION | Information and communication | X.46 | (Ariadi, 2017) |
| | | Data Analysis | X.47 | (Karolina et al., 2021) ; (Kineber et al., 2021); (Husin, 2019) |
| | | Supporting Rules | X.48 | (Al-Hosani & Rashid, 2021) |
| | | Structured planning | X.49 | (Chen et al., 2022) ; (Kineber et al., 2020) |
| | | Commitment | X.50 | (Ariadi, 2017) |
| | FUNCTIONAL STAGES | Analysis Functions | X.51 | (Chen et al., 2022) ; (Kineber et al., 2021); (Husin, 2019) |
| | | Development Phase | X.52 | (Karolina et al., 2021) ; (Husin, 2019) |
| | CREATIVE STAGES | Material Selection System | X.53 | (Husin, 2019) |
| | | Selection of working methods | X.54 | (Husin, 2019) ; (Ariadi, 2017) |
| | STAGES OF EVALUATION | Value Engineering Study Funding | X.55 | (Chen et al., 2022) ; (Ariadi, 2017) |
| | | Value Engineering Study Time | X.56 | (Ariadi, 2017) |
| | STAGES OF DEVELOPMENT | Selection of material alternatives | X.57 | (Husin, 2019) ; (Ariadi, 2017) |
| | | Cost Reduction | X.58 | (Chen et al., 2022) ; (Husin, 2019) |
| | PRESENTATION STAGES | Resources | X.59 | (Chen et al., 2022) ; (Husin, 2019) |
| | | Implementation Control | X.60 | (Chen et al., 2022) |
| | STAGES OF IMPLEMENTATION | Implementation | X.61 | (Chen et al., 2022) |
| | | Implementation Completion | X.62 | (Chen et al., 2022) |
| LIFE CYCLE | | Initial Cost | X.63 | (Kristianto & Damanik, 2018) |
| | | Energy Costs | X.64 | Kristianto & Damanik, 2018) |

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| *Var* | *Main Factor* | *Sub Factors* | | *Reference* |
|---|---|---|---|---|
| | COST BREAKDOWN STRUCTURE | Replacement Cost | X.65 | (Saad et al., 2022) |
| | | Operational and Maintenance Costs | X.66 | (Saad et al., 2022) |
| | LCC ANALYSIS | Analysis Period | X.67 | Fabricky, W.j., and Benjamin S. Blanchard 1991 |
| | | Present Time / YEAR TO | X.68 | (Fuller & Petersen, 1996) |
| | LCC MODELING | Modeling Without Residual Values | X.69 | (Fuller & Petersen, 1996) |
| | | Modeling with residual values | X.70 | Sandhu, M. A., Shamsuzzoha, A., & Helo, P. (2018) |
| COST (Y) | INTERNAL | Material costs | Y.1 | (Chen et al., 2022) |
| | | Labor costs | Y.2 | (Chen et al., 2022) |
| | | Cost of equipment | Y.3 | (Samani et al., 2018) |
| | | CSR Costs | Y.4 | (Plebankiewicz, 2018) |
| | EXTERNAL | Material Price Fluctuation | Y.5 | (Plebankiewicz, 2018) |
| | | Environmental Costs | Y.6 | (Plebankiewicz, 2018) |

PLS-SEM is very appropriate to be used in research aimed at developing theories. (Haryono, 2014). In SEM, there are three (three) simultaneous activities: confirming the validity and reliability of the instrument (confirmatory factor analysis), testing the relationship model between variables (path analysis), and obtaining a suitable model for prediction (structural model and regression analysis). *Second order confirmatory factor analysis* is a form of model in SEM measurement consisting of 2 levels that shows the relationship between latent variables at the first level as indicators of a second-level latent variable (Gaussian, 2015). Structural model in this study can be seen in figure 3.

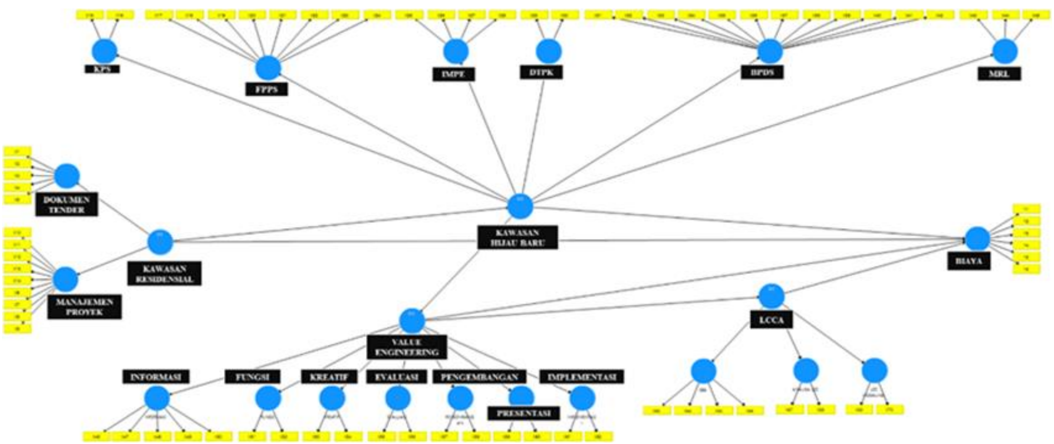


**Figure 3**. Structural model and Latent intervariable relationship path model

**Evaluation of Measurement Model *( Outer Loading – PLS algorithm)***

Measurement of indicators (Outer Model) is carried out by looking at *Convergent validity, Construct Reliability, Average Variance Extracted-AVE, Discriminant validity and cross loading.* The model between latent variables and indicators and the median variable of the study uses a reflective model. The reflective model is the causal direction of latent variables to indicators thus the indicators are a reflection of variations of latent variables (Iii, 2017).

**Table 3.** Reflective Model Measurement Criteria

| Criterion | Description |
|---|---|
| AVE (Average variance Extarcted) | The Extreme Variance value > 0.5, is valid as convergent validity. (Hair et al., 2014). |
| Composite reliability | Composite reliability measures internal consistency and its value should be > 0.6. (Hair et al., 2014). (Jonathan, 2010) |
| Indicator reability | Loading the outer absolute default with a value of > 0.7. (Sarwono & Narimawati, 2015) |
| Outer Loading | Outer loading values > 0.7 are acceptable. While the outer loading value of < 0.5 is always eliminated from the analysis process, Chin (1998) in Ghozali (2012 : 25), . (Sarwono & Narimawati, 2015) |
| Cross Loading | Another measure of the validity of the deskriminan, is used to check the validity of the description. |

*Outer loading* is a value that describes the relationship (correlation) between an indicator and its latent variables. *Outer loding* is the result of a single regression of each constructive indicator. *Loading* factor is a major concern in measurement models both reflectively and formatively (Hair et al., 2014)

**Table 4.** Outer Loading

| Indicators | Value Outer Loading | Validity S > 0.5 | Indicators | Value Outer Loading | Validity S > 0.5 |
|---|---|---|---|---|---|
| X1 | 0,87 | valid | X42 | 0,89 | valid |
| X2 | 0,88 | valid | X43 | 0,97 | valid |
| X3 | 0,71 | valid | X44 | 0,95 | valid |
| X4 | 0,84 | valid | X45 | 0,88 | valid |
| X5 | 0,87 | valid | X46 | 0,72 | valid |
| X6 | 0,80 | valid | X47 | 0,58 | valid |
| X7 | 0,56 | valid | X48 | 0,81 | valid |
| X8 | 0,73 | valid | X49 | 0,82 | valid |
| X9 | 0,92 | valid | X50 | 0,81 | valid |
| X10 | 0,90 | valid | X51 | 0,99 | valid |
| X11 | 0,94 | valid | X52 | 0,99 | valid |
| X12 | 0,87 | valid | X53 | 1,00 | valid |
| X13 | 0,86 | valid | X54 | 1,00 | valid |
| X14 | 0,90 | valid | X55 | 0,99 | valid |
| X15 | 0,99 | valid | X56 | 0,99 | valid |
| X16 | 0,99 | valid | X57 | 0,97 | valid |
| X17 | 0,95 | valid | X58 | 0,97 | valid |
| X18 | 0,94 | valid | X59 | 0,97 | valid |
| X19 | 0,93 | valid | X60 | 0,97 | valid |

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| Indicators | Value Outer Loading | Validity S > 0.5 | Indicators | Value Outer Loading | Validity S > 0.5 |
|---|---|---|---|---|---|
| X20 | 0,79 | valid | X61 | 1,00 | valid |
| X21 | 0,95 | valid | X62 | 1,00 | valid |
| X22 | 0,95 | valid | X63 | 0,76 | valid |
| X23 | 0.92 | valid | X64 | 0,92 | valid |
| X24 | 0,82 | valid | X65 | 0,95 | valid |
| X25 | 0.80 | valid | X66 | 0,86 | valid |
| X26 | 0,96 | valid | X67 | 0,92 | valid |
| X27 | 0,96 | valid | X68 | 0,92 | valid |
| X28 | 0.94 | valid | X69 | 0,99 | valid |
| X29 | 0,99 | valid | X70 | 0,99 | valid |
| X30 | 0,99 | valid | Y1 | 0,98 | valid |
| X31 | 0,86 | valid | Y2 | 0,98 | valid |
| X32 | 0,94 | valid | Y3 | 0,97 | valid |
| X33 | 0,90 | valid | Y4 | 0,98 | valid |
| X34 | 0,93 | valid | Y5 | 0,96 | valid |
| X35 | 0,87 | valid | Y6 | 0,93 | valid |
| X36 | 0,68 | valid | | | |
| X37 | 0,67 | valid | | | |
| X38 | 0,70 | valid | | | |
| X39 | 0,72 | valid | | | |
| X40 | 0,86 | valid | | | |
| X41 | 0,91 | valid | | | |

*The Convergen validity* value on all indicators in the table is obtained > 0.5 then it can be concluded that all indicators are accepted and maintained for subsequent processes

***Validity and Reability Test***

Validity is the accuracy of an instrument when taking measurements. In data collection instrument testing, validity is differentiated into faktor validity and item validity. While Reability is used to determine the consistency of measuring instruments, whether the tool used in measurements is reliable and consistent if the measurement is repeated (Dewi, 2018).

The validity test can be accepted or said to be valid if the *Average Variance Extarcted* (AVE) value is > 0.5, because if the AVE > 0.5 indicates that the variable late/median construct describes more than half of the indicator variants (Hair et al., 2014). The result of the variable reliability test is if it is said to be reliable to give the *Cronbanch Alfa* greater than 0.7, *Composite Reability* greater than 0.7 (as the standard value for the reliability of generally accepted research instruments) (Jonathan, 2010).

**Table 5.** AVE and CR Values

| Variable | Composite Reabilility (> 0.7) | Average Variance Extracted (AVE) (> 0.5) |
|---|---|---|
| LCC ANALYSIS | 0,92 | 0,84 |
| COST | 0,99 | 0,94 |
| BPDS (INFRASTRUCTURE AND FACILITIES LOAD) | 0,96 | 0,68 |

| Variable | Composite Reabilility (> 0.7) | Average Variance Extracted (AVE) (> 0.5) |
|---|---|---|
| CBS (COST BREAKDOWN STRUCTURE) | 0,93 | 0,76 |
| TENDER DOCUMENTS | 0,90 | 0,64 |
| DTPK (THERMAL IMPACT ON THE REGION) | 0,99 | 0,98 |
| EVALUATION | 0,99 | 0,98 |
| FPPS (INFRASTRUCTURE AND FACILITIES SERVICE FUNCTION) | 0,97 | 0,80 |
| FUNCTION | 0,99 | 0,99 |
| IMPE (MICROCLIMATE AND ECOSYSTEM PRESERVATION) | 0,93 | 0,78 |
| IMPLEMENTATION | 1,00 | 1,00 |
| INFORMATION | 0,86 | 0,56 |
| KPS (WELFARE OF LOCAL RESIDENTS) | 0,99 | 0,98 |
| CREATIVE | 1,00 | 0,99 |
| New Green Area | 0,98 | 0,59 |
| Residential Area | 0.96 | 0,61 |
| LCC MODELING | 0,99 | 0,98 |
| LCCA | 0,93 | 0,62 |
| PROJECT MANAGEMENT | 0.95 | 0,61 |
| MRL (ENVIRONMENTALLY FRIENDLY MATERIAL) | 0.95 | 0,70 |
| DEVELOPMENT | 0.97 | 0,87 |
| PRESENTATION | 0.97 | 0,95 |
| Value Engineering | 0.96 | 0,58 |

Source: Self-Processed Products

The results in the table can be concluded that:

- The results of the AVE value show that the latent and median variables obtained a value of > 0.5, thus indicating that the *convergent variables* are valid and adequate
- *Composite Reability* and Cronbach's alpha value obtained > 0.7, so that instrument reliability can be trusted and accepted

***Structural Model Evaluation (Inner Loading – Bootstrapping)***

To test the value of structural *models (inner* models) or models that connect between constructs (*latent variables)* are then analyzed using *Bootsrapping* or with other definitions to perform hypothesis tests (Hair et al., 2014). In general, the shape of the structural model can be seen in figure 4 and then bootsrapping test is carried out.
Examining the colinearity between constructs and the predictive power of the modelis the first step in the evaluation of structural models, then use the criteria of checking the coefficient of determination (R 2), *cross-validated redundancy (Q* 2), *effect size (f $^{2}$), and path coefficients* (Sarstedt et al., 2017) in *(*Ghozali & Latent 2015, 2018).

***Values of R 2, Q* 2 *and F$^2$***

An indicator of how much the external structure can explain endogenous construction is by the coefficient of determination (R2). The coefficient of determination (R2) is estimated to have a value between 0 and 1. Strong, medium and weak models, which are indicated by R2 values of 0.75, 0.50,

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and 0.25. (Sarstedt et al., 2017). Chin classifies the R2 criteria as strong, medium, and weak with values of 0.67, 0.33, and 0.19. (Ghozali & Latent 2015, 2018) **.**

**Table 6.** *R* Square and *Q Square* values

| Variable | R Square | Q Square |
|---|---|---|
| LCC ANALYSIS | 0,836 | 0,991 |
| BPDS | 0,900 | 0,995 |
| CBS | 0,810 | 0,990 |
| TENDER DOCUMENTS | 0,740 | 0,986 |
| DTPK | 0,450 | 0,971 |
| EVALUATION | 0,790 | 0,989 |
| FPPS | 0,870 | 0,993 |
| FUNCTION | 0,550 | 0,976 |
| IMPE | 0,840 | 0,992 |
| IMPLEMENTATION | 0,290 | 0,962 |
| INFORMATION | 0,750 | 0,987 |
| PPP | 0,430 | 0,970 |
| CREATIVE | 0,680 | 0,983 |
| New HIjau Area | 0,730 | 0,986 |
| LCC MODELING | 0,680 | 0,983 |
| LCCA | 0,700 | 0,984 |
| PROJECT MANAGEMENT | 0,940 | 0,997 |
| MRL | 0,810 | 0,990 |
| DEVELOPMENT | 0,810 | 0,990 |
| PRESENTATION | 0,740 | 0,986 |
| Value Engineering | 0,780 | 0,988 |

The r-square value is a value that expresses how much a free variable is able to explain the variance of a non-free variable. Known R-square result against Y = cost of 0. 947 are all latent variables and the median is able to explain from non-free variables or affect costs by 94.7%.

The value of Q Square is obtained > 0 for all *latent variables* predicting the relevant value, and the result of F square f Square On the variable construct of the new green area to the cost and VE to the cost with a result below 0.002 for the *latent variable* and the other median is obtained > 0.35.

***Path Coefficient* and Interpretation**

Measurement of *path coefficients* to determine signifiers and strength relationships between constructs and to test hypotheses. The value of the measured path coefficient ranges from -1 to +1, the relationship between the two constructs gets stronger when it approaches the value of +1, and weak approaches -1 (Sarstedt et al., 2017) in (Ghozali & Latent 2015, 2018).

**Table 7.** Path Coefficient Value

| Variable | Original Sample (O) | Standard Deviation (STDEV) | P Values |
|---|---|---|---|
| New Green Area -> COST | 0,31 | 0,20 | 0,12 |

| Variable | Original Sample (O) | Standard Deviation (STDEV) | P Values |
|---|---|---|---|
| New Green Area -> BPDS | 0,95 | 0,01 | 0,00 |
| New Green Area -> DTPK | 0,67 | 0,07 | 0,00 |
| New Green Area -> FPPS | 0,89 | 0,03 | 0,00 |
| New Green Area -> IMPE | 0,89 | 0,02 | 0,00 |
| New Green Area -> PPP | 0,66 | 0,07 | 0,00 |
| New Green Area -> MRL | 0,86 | 0,03 | 0,00 |
| New Green Area -> Value Engineering | 0,88 | 0,03 | 0,00 |
| Residential Area -> COST | 0,71 | 0,22 | 0,00 |
| Residential Area -> TENDER DOCUMENTS | 0,90 | 0,02 | 0,00 |
| Residential Area -> New Green Area | 0,86 | 0,03 | 0,00 |
| Residential Area -> PROJECT MANAGEMENT | 0,97 | 0,01 | 0,00 |
| LCCA -> LCC ANALYSIS | 0,91 | 0,02 | 0,00 |
| LCCA -> FEES | 0,44 | 0,22 | 0,04 |
| LCCA -> CBS | 0,86 | 0,03 | 0,00 |
| LCCA -> LCC MODELING | 0,82 | 0,05 | 0,00 |
| Value Engineering -> COST | -0,72 | 0,20 | 0,00 |
| Value Engineering -> EVALUATION | 0,93 | 0,01 | 0,00 |
| Value Engineering -> FUNCTIONS | 0,90 | 0,03 | 0,00 |
| Value Engineering -> IMPLEMENTATION | 0,53 | 0,11 | 0,00 |
| Value Engineering -> INFORMATION | 0,86 | 0,03 | 0,00 |
| Value Engineering -> CREATIVE | 0,83 | 0,06 | 0,00 |
| Value Engineering -LCCA > | 0,84 | 0,03 | 0,00 |
| Value Engineering -> DEVELOPMENT | 0,74 | 0,05 | 0,00 |
| Value Engineering -> PRESENTASI | 0,90 | 0,03 | 0,00 |

Source: Self-Processed Products

The result of the interpretation of the *coefiicient* path according to the *table path coefficient* is the result taken from the *bootstrapping* process, the results of path analysis or structural models have a significant effect if the *statistical T* value > 1.96 and *the p value* < 0.05.( Ghozali & Latent 2015, 2018). The intepretation results from the significance test of the direct line analysis that the *residential* area to the project management *variable* was 150. 13(0.000) had a significant positive effect, then the path from the new green area to the infrastructure and facilities load of 86. 59(0.000) has a significant positive effect, for the third path it is an *engineering value* to an evaluation of 66.5 9(0.000) a significant effect is positive and can be sorted onwards. Direct line analysis that has no significant effect is the new green area to cost 1. 56 (0. 12) with O = 0. 31 is value positive and *Value engineering* to cost 3. 64 (0. 00) with O = -0. 72, this means that stand-alone methods of the relationship to green area costs have no significant effect and are of negative value because there is a cost impact that arises. As for the hypothesis test, it is said that the hypothesis is accepted if the sig (P.Values) < 0.05 and the T-statistics > 1.96 and the results provide significant information (Harahap, 2018).

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In proving the hypothesis test using the relationship method to the cost of the New Green Area, it can be seen in the analysis of indirect pathways or using a specific median (Specific indirect effect). The results of the relationship between the application of the new green area concept using the VE and LCCA methods have a significant effect on cost performance in residential areas, this can be seen in figure 4. **New** Green Area ***Residential*→ Area→ VE LCCA Cost→→** is 2. 17 (0.000) with a positive O value of 0. 28 this suggests that the hypothesis is proven.

Mean, STDEV, T-Values, P-Values | Confidence Intervals | Confidence Intervals Bias Corrected | Samples | Copy to Clipboard: | Excel Format | R F

| | Original Sampl... | Sample Mean... | Standard Deviation... | T Statistics ... | P Values |
|---|---|---|---|---|---|
| Value Engineering -> LCCA -> ANALISA LCC | 0.77 | 0.77 | 0.04 | 19.32 | 0.00 |
| Kawasan HIjau Baru -> Value Engineering -> LCCA -> ANALISA LCC | 0.67 | 0.68 | 0.05 | 13.21 | 0.00 |
| Kawasan Residential -> Kawasan HIjau Baru -> Value Engineering -> LCCA -> ANALISA L... | 0.58 | 0.58 | 0.06 | 10.07 | 0.00 |
| Kawasan Residential -> Kawasan HIjau Baru -> BIAYA | 0.26 | 0.27 | 0.16 | 1.63 | 0.10 |
| Value Engineering -> LCCA -> BIAYA | 0.37 | 0.37 | 0.17 | 2.22 | 0.03 |
| Kawasan HIjau Baru -> Value Engineering -> LCCA -> BIAYA | 0.33 | 0.33 | 0.15 | 2.19 | 0.03 |
| Kawasan Residential -> Kawasan HIjau Baru -> Value Engineering -> LCCA -> BIAYA | 0.28 | 0.28 | 0.13 | 2.17 | 0.03 |
| Kawasan HIjau Baru -> Value Engineering -> BIAYA | -0.63 | -0.64 | 0.18 | 3.61 | 0.00 |
| Kawasan Residential -> Kawasan HIjau Baru -> Value Engineering -> BIAYA | -0.54 | -0.55 | 0.16 | 3.48 | 0.00 |
| Kawasan Residential -> Kawasan HIjau Baru -> BPDS | 0.81 | 0.81 | 0.03 | 29.03 | 0.00 |
| Value Engineering -> LCCA -> CBS | 0.72 | 0.72 | 0.05 | 15.24 | 0.00 |
| Kawasan HIjau Baru -> Value Engineering -> LCCA -> CBS | 0.64 | 0.64 | 0.06 | 11.15 | 0.00 |

**Figure 4.** Specific Indirect Effect Source: Processed SEM-PLS

From the results of the discussion and analysis, it was obtained that the factors taken by the top 10 influenced the improvement of the cost performance of the new green area based on Value Engineering and Life Cycle Cost Analysis applied to residential areas are as follows:

**Table 8.** Results of Influential Factors

| No. | Factor | Original Sample | Mean | Against R Square |
|---|---|---|---|---|
| 1 | Top Management Support | 0,90 | 0,90 | 0,94 |
| 2 | Sources of Electrical Energy | 0,95 | 0,95 | 0,90 |
| 3 | Alternative Water Sources | 0,95 | 0,95 | 0,90 |
| 4 | Waste Manager | 0,95 | 0,95 | 0,90 |
| 5 | Transit facilities (bus stops) or bicycle parking lots | 0,89 | 0,88 | 0.87 |
| 6 | Provision of Green Open Space (RTH) | 0,89 | 0,89 | 0,84 |
| 7 | Materials affect health | 0,86 | 0,86 | 0,81 |
| 8 | Cost Reduction | 0,74 | 0,74 | 0,81 |
| 9 | Selection of material alternatives | 0,74 | 0,74 | 0,81 |
| 10 | Initial Cost | 0,86 | 0,86 | 0,81 |

## CONCLUSION

The results of the research are in the application of the concept of green areas in *residential* areas based on *value engineering* and *lifecycle cost analysis* has a significant effect on improving the cost performance of new green areas and obtaining the most influential factors, namely: Project Management, Infrastructure and Facilities Burden, Infrastructure and Facilities Service Functions, Microclimate and Ecosystem Preservation , Environmentally Friendly Materials, Development, *Cost Breakdown Structure*, LCC Analysis, Evaluation, *Value Engineering*. By using SEM-PLS analysis, it is more effective in obtaining correlation of theoretical relationships in research.

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