Greenway model as a support of Makassar smart city

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Abstract. The problems that occur in Makassar City explain that the existing open green space does not meet the standards of the Ministry of Public Works PUPR, manipulated for urban scale, the proportion of green open space is 30% while Makassar City only has green open space of 13%. One of which is part of the green space is the greenway. The purpose of this study is to determine how the greenway model to support Makassar City as a Smart City. This research method uses quantitative methods proposed in the greenway model where data is collected by questionnaire and processed by statistical analysis techniques. The data is quoted using statistical analysis, namely Structural Equational Modeling or abbreviated SEM. The results of this study indicate that the Model Greenway as a support of Makassar Smart City has an elongated pattern to follow along the road, diverse vegetation, shady and neatly arranged, as well as land cover that is able to connect the air, maximize the aesthetics and constraints of roads and buildings, the availability of waiting places and bicycle paths and pedestrians, being a link to a larger, more comfortable and pleasant green space, the availability of street furniture and disability-friendly facilities, having good drainage channels and a well-organized electricity network, and providing road and pedestrian connections so as to provide security for pedestrians. This research can be made as a consideration in the planning and design of Makassar City to meet the needs of green space that can support Makassar City as a Smart City in terms of a Smart Environment.

1. Introduction
Makassar City as the capital of South Sulawesi Province has been categorized as a metropolitan city and is a city with all its activities which is quite busy, development in all directions causes the lack of urban green open space for oxygen space. Based on Minister of Public Works Regulation No. 05/PRT/M/2008 concerning Guidelines for Provision of Green Open Space in Urban Areas, the proportion of green open space in urban areas is at least 30%. Accordingly Makassar City still needs approximately 2,810 hectares of green space, to be able to achieve the targets set by the Ministry, which requires the application of green space 30% of the total area of about 5,232 hectares. Green open space consists of several types, one of which is the greenway [1].

According to Frischenbruder and Pellegrino, the greenway is an agreed concept of spatial use, has ecological, cultural, aesthetic and maintenance values, which has many suggestions; It has an elongated shape and provides recreational activities such as using pedestrians and making ecological contributions, is an integrated, functional system, to protect nature with the concept of sustainable development, and is a complement that supports physical planning. Based on these criteria, the greenway solution that synergizes with the approved land use concept comes as a solution to the
problem in Makassar City. In this way, the realization of Makassar as a Smart City is very possible [2].

According to IEEE Smart Cities.org, a smart city brings together technology, government and society to enable the following characteristics:

1.1. Smart economy
1.2. Smart mobility
1.3. Smart environment
1.4. Smart people
1.5. Smart life (smart living)
1.6. Smart governance [3].

Based on these problems, the researcher raised the topic "Greenway model as a support for Makassar Smart City". An important role in this research is the concept of data-based greenway in supporting the concept of Makassar City as a smart city that contains a sustainable environment. The purpose of this study is to determine the greenway model that is in line with the concept of Makassar City as a Smart City.

2. Methodology
South Sulawesi is one of the largest provinces on the island of Sulawesi, with a total of 22 regencies and one municipality, namely Makassar. Makassar City is bordered directly by Maros Regency, Gowa Regency and Takalar Regency.

Figure 1. (a) Map of south sulawesi province, (b) Makassar city map, (c) Location research objek map.

Makassar City is a fairly dense city that has protocol roads, some of which are the object of research in this study, namely Urip Sumoharjo street, Perintis Kemerdekaan, Sultan Alauddin, and Jenderal Sudirman street. When the research was conducted for 4 months, starting from the preparation of the proposal, from March to August 2019. The distribution of the research questionnaire was conducted at 11.00 - 16.00 West Indonesia Time. The timing of the study was based on the consideration that at these hours the air temperature reached its hottest point.

Table 1. Research variable [4].

| Research Variable | Indicator |
|-------------------|-----------|
| 1. Elongated      | - Elongated following the pattern  |
|                   | - Along the way                       |
| 2. Ecological:    | - Types of ground cover             |
|                   | - Air refreshment                   |
|                   | - type of tree                      |
|                   | - Arrangement of trees and its distance |
| 3. Functional:    | - Road and building boundaries.     |
|                   | - Street and environmental aesthetics|
|                   | - Availability of a place to relax  |
|                   | - Link to other places              |
The data collection technique used is the collection of questionnaires which are guided by the theoretical criteria for the greenway that are outlined in the question items distributed to respondents at the study site. In addition to primary data, secondary data are also sourced from journals and books to support research data. The research sample was taken by means of non-probability sampling, because in selecting the research object based on the consideration of the existence of a greenway on the road that became the location of the study. While the selection of respondents was carried out randomly.

The data analysis technique used in this study is a quantitative technique that is focused on the role of the greenway as a support for Makassar Smart City. To get the greenway model to support Makassar Smart City, the theory obtained was tested using questionnaire data with statistical analysis, namely using Structural Equational Modeling or commonly called SEM [5].

SEM is not used to produce a model, but is used to confirm the theoretical model, through empirical data. Strong theoretical justification adds to the belief of researchers to propose a causality model by assuming a causal relationship between two or more variables, not based on the analytical [5].

### Table 2. Shape symbol in SEM [5].

| Symbol | Information |
|--------|-------------|
| ![Box symbol](image) | Box describe of manifest variables |
| ![Circle or oval symbol](image) | Circle or oval describe latent variables |
| ![Latent variables symbol](image) | Latent variables which is influenced by other latent variables with error values. |
| ![Relationship symbol](image) | Relationship between two manifest variables that are affected by the other manifest variable with the error value. |
| ![Latent variables affected by manifest variables symbol](image) | Latent variables are affected by manifest variables with independent error values. |

### 3. Results and Discussion

#### 3.1. Test Validity and Reliability of Questionnaire Items
Questionnaire data obtained from 110 respondents with 17 questions. Then the data is tested for validity and reliability using the SPSS application, from the data processing the following outputs are obtained:
Table 3. Output case processing summary.

| Cases               | N   | %     |
|---------------------|-----|-------|
| Valid               | 110 | 100.  |
| Exclude             | 0   | .0    |
| Total               | 110 | 100.  |

Table 4. Output reliability statistic.

| Cronbach’s Alpha | N of items |
|------------------|------------|
| .748             | 17         |

A measuring instrument can be declared reliable if the value of Cronbach’s Alpha > 0.6. While based on the Output Reliability table, the number of Cronbach’s Alpha is 0.748, so the data is declared reliable.

Table 5. Construct and research indicator.

| Construct     | Indicator                                           | Variable |
|---------------|-----------------------------------------------------|----------|
| Elongated     | Elongated following the pattern                     | X1       |
|               | Along the way                                       | X2       |
| Ecological    | Absorb Rain Water                                   | X3       |
|               | Air Refreshment                                     | X4       |
|               | Type of Tree                                        | X5       |
|               | Arrangement of trees and its distance               | X6       |
| Functional    | Road and Building Divider                          | X7       |
|               | As a Aesthetic road and environment                 | X8       |
|               | Availability of Relaxing Space                      | X9       |
|               | As a Connecting path to other place                 | X10      |
|               | Availability of Bycicle and Pedestrian way          | X11      |
| Recreative    | comfortable                                        | Y1       |
|               | There is a Movement of Visitors                     | Y2       |
|               | Difable Friendly Facility                           | Y3       |
|               | Availability of Street Furniture                    | Y4       |
|               | Good Drainage and Electricity Network               | Y5       |
|               | Safety for Pedestrian from vehicles                 | Y6       |

3.2. Development of Path Diagram

SEM path diagram consists of latent variables that are given oval shape symbols, manifest variables with square shapes, and error values are marked with a round shape. Latent and manifest variables are related using an arrow line to the manifest variable. While the error value is linked using the arrow to the manifest variable. The path diagram of this research can be seen as follows:
Figure 2. Path hybrid diagram model.

In the diagram, it can be seen that there are 4 constructs, each of which has indicators. Where the number of manifest variables is 17 items that are part of a latent variable which amounts to 4 with 3 exogenous variables and 1 endogenous variable. Exogenous variables are given x notation and endogenous variables are given Y notation which has many arrows in their direction.

3.3. Conversion path diagram to the equational

The model that has been made in the path diagram is then converted into two equations namely structural equations and measurement equations. Structural equations are formulated to obtain causal relationships that occur between each construct and research variables, while the measurement model equation is carried out to find out which indicators or variables are used to measure the construct.

3.3.1. Structural equation. Structural equations are used to construct causality relationships. The thing that needs to be done is to construct a structural model by connecting between latent constructs both endogenous and exogenous and determining the model that is connecting endogenous or exogenous constructs with indicator or manifest variables.

Figure 3. Greenway path diagram model.

The structural equation formula for this greenway research is as follows:

\[
\text{Recreative (Re)} = \text{Elongated (El)} + \text{Ecological (Ec)} + \text{Functional (Fu)} + \text{Error (e)}
\]

Because there is only one endogenous latent variable, only exogenous variables are formulated.
3.3.2. Measurement model. Measurement model can be seen in the description of the following:

| Indicator | Measurement Model |
|-----------|-------------------|
| Me1       | $\lambda_1 Me + e_1$ | $Re_1 = \lambda_{12} Recreative + e_{12}$ |
| Me2       | $\lambda_2 Me + e_2$ | $Re_2 = \lambda_{13} Recreative + e_{13}$ |
| Ec1       | $\lambda_3 Ec + e_3$ | $Re_3 = \lambda_{14} Recreative + e_{14}$ |
| Ec2       | $\lambda_4 Ec + e_4$ | $Re_4 = \lambda_{15} Recreative + e_{15}$ |
| Ec3       | $\lambda_5 Ec + e_5$ | $Re_5 = \lambda_{16} Recreative + e_{16}$ |
| Ec4       | $\lambda_6 Ec + e_6$ | $Re_6 = \lambda_{17} Recreative + e_{17}$ |
| Fu1       | $\lambda_7 Fu + e_7$ |
| Fu2       | $\lambda_8 Fu + e_8$ |
| Fu3       | $\lambda_9 Fu + e_9$ |
| Fu4       | $\lambda_{10} Fu + e_{10}$ |
| Fu5       | $\lambda_{11} Fu + e_{11}$ |

3.2. An Input Estimation Matrix
SEM analysis uses variance / covariance matrix as input data for the estimation it does. Covariance matrices are generally more widely used in research on relationships, because when using a correlation matrix as an input, the standard errors presented generally show inaccurate numbers. The matrix used in the AMOS program in this study is attached.

3.2.1. Structural Equational Model (SEM). Tests using SEM statistics are performed to test the hypotheses developed in this study, SEM tests are carried out with two kinds of tests namely the model suitability test (Goodness of Fit Test) and the causality test (Regression weight).

3.2.2. Goodness Of Fit Test. Tests using SEM statistics are performed to test the hypotheses developed in this study, SEM tests are carried out with two kinds of tests namely the model suitability test (Goodness of Fit Test) and the causality test (Regression weight).

![Figure 4. Result of SEM Test.](image)
Table 7. Value $CMIN$, $DF$, $P$, $CMIN/DF$.

| Model               | NPAR | $CMIN$  | $DF$ | $P$  | $CMIN/DF$ |
|---------------------|------|---------|------|------|-----------|
| Default Model       | 40   | 147,141 | 113  | .017 | 1,302     |
| Saturated Model     | 153  | .000    | 0    |      | 2,976     |
| Independence Model  | 17   | 404,792 | 136  | .000 |           |

$CMIN / DF$ is one indicator to measure the fit level of a model, generated from the Chi-Square ($CMIN$) statistics divided by Degree of Freedom ($DF$). Expected $CMIN / DF$ is $\leq 2.0$, which indicates acceptance of the model. While the results of the study indicate the value of $CMIN / DF$ is 1.302, so that the existing models can be accepted.

Table 8. Value of $GFI$, $AGFI$.

| Model               | RMR | $GFI$  | $AGFI$ | $PGFI$ |
|---------------------|-----|--------|--------|--------|
| Default Model       | .02 | .966   | .919   | .740   |
| Saturated Model     | .000| 1,000  |        |        |
| Independence Model  | .136| .602   | .552   | .535   |

The recommended level of acceptance if $AGFI$ has a value equal to or greater than 0.90. A value of 0.95 can be interpreted as a good level (good overall model fit) while a value between 0.90 - 0.95 indicates a sufficient level (adequate model fit).

Table 9. Value of $TLI$, $CFI$.

| Model               | $NFI$ | $Delta1$ | $RFI$ | $Rho1$ | $IFI$ | $Delta2$ | $TLI$ | $Rho2$ | $CFI$ |
|---------------------|-------|----------|-------|--------|-------|----------|-------|--------|-------|
| Default Model       | .637  | .563     | .983  |        | .947  | .973     |       |        |       |
| Saturated Model     | 1,000 | .000     | 1,000 |        | 1,000 |          |       |        |       |
| Independence Model  | .000  | .000     | .000  | .000   | .000  | .000     |       |        |       |

The expected TLI value as a reference for accepting a model is $\geq 0.95$ and a value close to 1.0 indicates a very good fit.

Table 10. Value of $RMSEA$.

| Model               | $RMSEA$ | LO 90 | HI 90 | PCLOSE |
|---------------------|---------|-------|-------|--------|
| Default Model       | .053    | .024  | .075  | .413   |
| Independence Model  | .135    | .120  | .150  | .000   |

$RMSEA$ value which is smaller or equal to 0.08 is an index for model acceptance. The $RMSEA$ index can be used to compensate for chi-square statistics in large samples. While in table 9 it can be seen that the $RMSEA$ value is 0.053.

Table 11. Recapitulation goodness of fit test.

| Goodness Of Fit Indices | Result Model Test | Cut Of Value | Information |
|-------------------------|-------------------|--------------|-------------|
| $Chi Square$            | 147,141           | $\geq 0.05$  | Good        |
| $Probabilitas$          | 0.17              | $\leq 2.00$  | Good        |
| $CMIN/df$               | 1,302             | $\geq 0.90$  | Good        |
| $GFI$                   | 0.966             | $\geq 0.90$  | Good        |
| $AGFI$                  | 0.919             | $\geq 0.95$  | Good        |
| $CFI$                   | 0.973             | $\geq 0.95$  | Marginal    |
| $TLI$                   | 0.947             | $\leq 0.08$  | Good        |
| $RMSEA$                 | 0.053             |              |             |
From the data in table 10, it can be said that the criteria for forming a greenway are stated in accordance with the estimated model.

Table 12. Test result standardized regression weight.

|                | Estimate | S.E  | C.R  | P    | S.R.W |
|----------------|----------|------|------|------|-------|
| Re             | Fu       | .748 | .479 | 1.561| .119  |
| Re             | Me       | .199 | .211 | .944 | .345  |
| Re             | Ek       | .142 | .257 | .554 | .579  |
| Y.3            | Re       | .265 | .205 | 1.290| .197  |
| Y.2            | Re       | -.082| .379 | -.216| .829  |
| Y.4            | Re       | 1.504| .411 | 3.657| ***   |
| Y.5            | Re       | 2.298| .593 | 3.873| ***   |
| X2.1           | Ek       | 1.000|      |      | .591  |
| X2.2           | Ek       | .950 | .209 | 4.535| ***   |
| X2.4           | Ek       | 1.136| .268 | 4.238| ***   |
| X2.2           | Ek       | .962 | .217 | 4.433| ***   |
| X3.5           | Fu       | 1.012| .402 | 2.519| .012  |
| X3.4           | Fu       | .238 | .353 | .675 | .500  |
| X3.3           | Fu       | .495 | .266 | 1.863| .062  |
| X1.1           | Me       | 1.000|      |      | .471  |
| X1.2           | Me       | 1.808| .669 | 2.702| .007  |
| X3.2           | Fu       | 1.000|      |      | .370  |
| Y.1            | Re       | 1.569| .488 | 3.214| .001  |
| X3.1           | Fu       | 1.121| .426 | 2.630| .009  |
| Y.6            | re       | 1.000|      |      | .415  |

The value of the relationship between variables can be seen in the standardized regression weight column. If there is no negative sign, the relationship between these variables is positive. Whereas the significance value between variables can be seen in column C.R., a significant requirement is to compare the C.R value against the Ttable value. While it is known that the value of T - table is 1.98 (with df = 106 and α = 0.05).

3.3. Assess the possibility of identification problems
Problems in identification are problems regarding the inability of the model developed to produce good estimates. Problems that occur in identification usually consist of several things which are described as follows:

3.3.1. The standard error is too large for some coefficients.

3.3.2. The program is not able to display the required matrix.

3.3.3. There are unnecessary numbers such as negative variance.

3.3.4. There is a very high correlation between the estimated coefficients obtained from the results of the analysis (For example > 0.9). Analysis of the model testing conducted in this study did not find any identification problems as described previously.

3.4. Model evaluation
Evaluation of the model is carried out to determine the accuracy of the model used by studying various Goodness of Fit Test criteria. This evaluation is carried out when estimating the model of the program
used in SEM analysis, the AMOS program. Evaluation of the model can be done in several ways namely as follows:

3.4.1. Sample size evaluate. According to Hair et al, that a suitable sample size is between 100-200 samples. This is based on 5xn and 10xn the amount of observation data. While in this study 110 samples were used, fulfilling the required sample size for SEM usage.

3.4.2. Evaluation of normality assumptions. Assumption of univariate or multivariate data normality can be done by observing the critical value of the assessment of normality test results from the AMOS program. If there are values outside of -2.58 ≤ C.R ≤ 2.58 it can be said that the distribution of existing data is not normal. Data deemed abnormal is removed in the next analysis. The assumption of normality in the last row of assessment of normality is seen in column C.R obtained from the analysis.

3.4.3. Outlier evaluation. Evaluation of Outliers is done by comparing mahalanobis distance or commonly called mahalanobis distance. The results of SEM analysis in this study indicate that the greatest mahalanobis distance is 57,004. So it can be concluded that there is no multivariate outlier, because the model is said to be multivariate outlier if the mahalanobis value is \( d - \text{square} > \) of the chi square value.

3.4.4. Assumptions of multicollinearity and singularity. The AMOS program has provided a "warning" facility if there is a possibility of multicollinearity and singularity, while in the analysis results there is no warning "warning" which means that there is no assumption of multicollinearity and singularity.

3.4.5. Model interpretation and modification. The estimated model does not need to be further modified because the results of the standardized residual covariances matrix have no value outside of -2.58 ≤ residual ≤ 2.58.

Figure 5. Greenway model as a support of makassar smart city.

The results of this study indicate that the Model Greenway as a support of Makassar Smart City has an elongated pattern to follow along the road, diverse vegetation, shady and neatly arranged, as well as land cover that is able to connect the air, maximize the aesthetics and constraints of roads and
buildings, the availability of waiting places and bicycle paths and pedestrians, being a link to a larger, more comfortable and pleasant green space, the availability of street furniture and disability-friendly facilities, having good drainage channels and a well-organized electricity network, and providing road and pedestrian connections so as to provide security for pedestrians. This research can be made as a consideration in the planning and design of Makassar City to meet the needs of green space that can support Makassar City as a Smart City in terms of a Smart Environment.

4. Conclusion
The results of the Model of the Greenway as a Support for Makassar Smart City, are known based on Goodnes of Fit is an appropriate model, which meets the criteria set according to the standard, so the hypothesis that the indicators are the building blocks for the greenway construct can be said to be appropriate. The model of the Greenway can be used as a reference to meet the greenway data in digital form, it can support the concept of Makassar City as a smart city which includes a process of sustainability and better management of resources, especially in terms of the environment which is part of forming the smart city namely smart environment or smart environment that prioritizes the management of IT-based or digital environment.

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