Structure Modelling of Traffic Movement at Housing Area in Makassar

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Abstract: ***Modelling of traffic movement at housing area represent the important model in transportation planning, because of housing area has potency as awaken of big traffic movement, so it is very encumbering of road that make congestion and traffic jam in road way. This research has aimed to determine factors that influence of traffic movement and set the structural model traffic movement at housing area. The area of this research is located in BumiTamalanreaPermai (BTP) Makassar. Variable that predict as the influenced at the movement such as accessibility, infrastructure and trip characteristic. Data are gotten by questionnaire and interview with respondent. Data is analyzed with Structural Equation Modelling (SEM). The result of the research is the factors that make traffic movement are amount of family (0.72), amount of working family member (0.50), and income (0.44). The structure modeling that set in this housing area is infrastructure that give directly influence but not significant with accessibility (0.03), trip characteristic don't have directly influence with accessibility, buth have directly influence and significant with movement (0.25), and accessibility have influence with movement (0.60).***

Keywords: Modelling SEM, Traffic movement, Transportation.

I. INTRODUCTION

Population is a major factor in the development of a city, which is accompanied by urban growth and the economy, especially in big cities and surrounding supporting cities and cities that have certain activity centers [1]. The growth of urban areas with the development of residential areas will increase mobility of passenger and goods transport to various regions. The transportation sector plays a very important role to facilitate the economy and serve the need for transportation services in the city and to all corners of the region [2].

Good planning of city facilities and infrastructure greatly influences the smoothness of every aspect of life in the city [3]. The road network is one type of infrastructure that is very important in its existence to realize a well-planned, orderly housing area, and can overcome traffic within the housing area itself and access to the city's road network [4].

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Determination of the network system and its characteristics is needed to fulfill its function in serving the needs of the housing area. Land use planning, especially the housing area, is expected to have good coordination between transportation planning and various related agencies, such as: city planning, land use, legal instruments, and other agencies to produce a good transportation policy [5].

The capital of South Sulawesi Province, Makassar City has developed into a center of various activities, especially service activities for the city population and the entire population of South Sulawesi Province [6]. This condition causes the city of Makassar to grow rapidly. One result of this high growth is the construction of new settlements built by housing developers. The development of these new settlement centers on the one hand is the success of the development of settlements and housing, but on the other hand this tends to impose new burdens on the field of urban transportation, for example congestion problems from residential areas to downtown or other areas that are potential destinations[7].

To support the smooth movement due to the activities mentioned above, transportation infrastructure is needed so that the movement or movement process can run well, namely fast travel time, no congestion, adequate service frequency, safe (free from possible accidents) and comfortable service conditions [8].

The rise of movement is generally analyzed using multiple regression models, where the movement generated by a family is a function of a number of socio-economic characteristics [9]. The variables are not free to relate to one or more independent variables. Socio-economic data contain a complicated relationship from what can be shown by an independent variable in a simple linear regression analysis model [10]. But to find out the movement patterns between zones is not only influenced by the generation of movements but is also influenced by the level of accessibility of the road network, the modes used, and the factors of the location / environment, security and comfort of the available infrastructure. So that the free variable is more than one and this relationship needs to be studied with multivariate techniques. [9,10]

BumiTamalanreaPermai Housing Area (BTP) included in Tamalanrea Village, Tamalanrea District, is one of the largest residential areas in Makassar City [11]. The main connecting road from the BTP Housing Area to the service centers is JalanPerintisKemerdekaan.

This road segment is a road with the status of a national road, which is passed by a vehicle with a high intensity of use. The result is the occurrence of transportation problems such as increasing time delay and traffic congestion, especially during peak hours. Therefore it is deemed necessary to know the characteristics that affect the generation of traffic movements and model the traffic movements that occur in residential areas.

Thus, in this work, the factors that influence the traffic movement in the BTP Makassar Housing Area is analyze. In addition, the analysis was done to determine the structural model of traffic movement formed in the BTP Makassar Housing Area.

II. METHODOLOGY

Research Location and Time

This research is a survey research, to produce explanatory research which is a research that intends to explain causal relationships between variables.This research was carried out in the BTP housing area (BumiTamalanreaPermai) which was located in TamalanreaSubdistrict, Tamalanrea District, Makassar City, South Sulawesi Province in June 2015.

Population and Samples

The population in this study is the people who live in the BumiTamalanreaPermai Housing (BTP) Makassar City (5,962 households).Based on the condition of the population, the withdrawal of the type and number of samples is based on the population of the number of households. Sugiyono (2001) states that the determination of the number of samples drawn based on the household population and refers to the level of error between 1% - 3%[12]. According to Bartholomew et al. (2008) that guidelines for sample size using the Maximum Likelihood Estimation (MLE) technique is used between 100 - 200 samples, so that the number of samples taken was 180 households in the study area [13].

Data Collection

The data needed to support this research consists of two groups, namely primary data and secondary data. Data collection in this study was carried out by preliminary surveys, questionnaires, and obtaining data from relevant agencies. The preliminary survey was carried out by distributing 50 (fifty) questionnaires, this was intended to find out whether the questions in the questionnaire could be understood by the respondent or something that needed to be changed, reduced and adjusted to local conditions. Based on the results of the preliminary survey, the authors assume that the questionnaire in the preliminary survey results can be continued. Question items submitted to the questionnaire are directed to several possible answers that are most suitable for the respondent. Questionnaire answers were arranged in the form of qualitative data using a Likert scale with five alternative answers. The use of a Likert scale with these five alternatives is more likely to spread the respondent's answer values

Data Analysis Method

The analysis technique in this study is a method of analysis of structural equation modeling (SEM). SEM analysis is an analysis model that can perform three activities simultaneously, namely an integrated model between factor analysis (Confirmatory Factor Analysis) which is useful to examine the validity and reliability of instruments, and the analysis used to test the model of the relationship between latent variables and to obtain a structural model according which is built on the hypothesis. Analysis of structural equation modeling (SEM) used for an approach that will reveal the causal relationship between one variable and another variable.

III. RESULT AND DISCUSSION

The test results are based on the constructed theoretical concept, that the accessibility variable ($\eta 1$) has three indicators, namely: cost (Y11), time (Y12), and distance (Y13), using the Confirmatory Factor Analysis, showing the factor load and t value significant, so that the three indicators can represent constructs. The order of each accessibility indicator is based on the order of the high and low charge factors and the t value is as follows: travel time ($\lambda = 0.82$, $t = 9.78$), travel distance ($\lambda = 0.71$, $t = 8.74$), and travel costs ($\lambda = 0.58$, $t = 7.28$), with degrees of freedom (0.00), chi square (0.00) / p (1.00), and RMSEA (0.00). Thus the load of accessibility factors analyzed by factor confirmation results in three sub-factors: travel costs, travel time and travel distance that can be used for further analysis.

The measurement model for movement variable ($\eta 2$) based on the theoretical framework .The sequence of each movement indicator based on the order of the low value of the factor load and are: the number of family members 0.72, $t = 5.39$. The value of the factor load explains that the number of households in the movement has a significant effect. The second indicator that also affects the movement is the number of family members who work with the load factor of factor 0.50, $t = 4.65$ and hereinafter is the revenue with factor charge of 0.44, $t = 4.37$.

The initial stage measurement model for infrastructure variables used as many as six indicators, namely: road conditions (X1), road width (X2), pavement type (X3), location / location of housing (X4), comfort level (X5), and security (X6) Factor load testing of the six indicators using Confirmatory Factor Analysis, yields the degree of freedom (9.00), chi square (5.85) / p (0.00), GFI (0.90) and RMSEA (0.17).

For this reason, modification is needed by issuing a number of indicators that do not meet because $t < 1$. is the condition of the road ($\lambda = 0.15$, $t = 1.67$), road width ($\lambda = 0.17$, 1.88), and pavement type ($\lambda = 0.17$, $t = 1.92$). The test results after the three indicators of type of pavement, location / location of housing, and level of comfort, were excluded from the model, other factor load indicators showed significant results, which resulted in the values of degree of freedom (0.00), chi square (0.00) / p (1.00), GFI (1.00) and RMSEA (0.00).

The order of each infrastructure indicator based on the order of the high and low load factors and the t values are: security level 0.74, t = 8.25, convenience 0.67, t = 7.68, and then location / location of housing from the center of activity with a charge value of factor 0.56, t = 6.73.

The travel characteristics that consist of four indicators are: travel intent (X7), when traveling (X8), transportation mode (X9) used by residents in residential areas in the research area, and travel intensity (X10). Testing the goodness-of-fit model by using a Confirmatory Factor Analysis, shows that the degree of freedom (2.00), chi square (2.66) / p (0.26), GFI (0.99) and RMSEA (0.43) this meet the criteria of goodness of fit.

The test based on the factor load size and the t value, results in an insignificant indicator, namely the trip intensity with a factor load of 0.01 and t = 0.15.The test results after the travel intensity indicator is removed from the model, the other indicators indicate that the criteria for goodness of fit can be fulfilled which results in a degree of freedom (0.00), chi square (0.00) / p (1.00), GFI (1.00) and RMSEA (0.00).In table 1 shows that the factor load of the three indicators tested is significant.

Table. 1 Factor confirmation analysis (CFA) characteristic variables of the final stage of the trip

Latent variable	Manifest variable	*Load factor*	Value error	Value t> 1,96
Travel characteristics (ξ_2)	Travel Purpose (X_7)	0.58	0.66	5.38
	Travel Time (X_8)	0.39	0.85	4.29
	Modes of transportation (X_9)	0,79	0,38	6,06

The order of each travel characteristic indicator based on the order of the high and low charge factors and the t value as shown in table 2 are: transportation mode 0.79, t = 6.06, mean trip 0.58, t = 5.38, and then when traveling with value charge factor of 0.39, t = 4.29.

Table. 2 The test results of goodness of fit (GOF) for the measurement model of each variable with CFA.

GOF Criteria	Cut-off	Latent variable			
		(η1)	(η2)	(ξ1)	(ξ2)
Chi-square					
Significancy Probability	Small expected≥ 0,05	0.00	0.00	0.00	0.00
Degree of freedom (DF)	Small expected	1.00	1.00	1.00	1.00
RMSEA	≤ 0,08	0.00	0.00	0.00	0.00
GFI	≥ 0,90	0.00	0.00	0.00	0.00
AGFI	≥ 0,90	1.00	1.00	1.00	1.00
Relative chi square	≤ 2,00	1.00	1.00	1.00	1.00
CFI	≥ 0,90	0.00	0.00	0.00	0.00
		1.00	1.00	1.00	1.00

The reliability of a construct is said to be good if the construct reliability is greater or equal to 0.70 and the extracted variance value is greater or equal to 0.50. The calculation of construct reliability and variance extracted each construct using a mathematical formula that has been stated and in accordance with the results of calculations shown in table 3.

Latent variable	loading factor	*Measurem ent error*	*Reliability*		*Significance Probability ≥0.05*
			Construct reliability > 0.70	*Variance extracted >0.50*	
Accessibility	2.11	1.34	0.77	0.58	1.00
Movement	2.76	1.04	0.73	0.51	1.00
Infrastructure	3.88	1.03	0.79	0.62	1.00
Travel characteristics	3.13	1.23	0.72	0.51	1.00

This study aims to find a model of the relationship between various factors of movement in the BumiBumi Housing area of TamalanreaPermai Makassar which can explain the causal relationships that exist between research variables that refer to the results of structural equation modeling. The model was obtained from the results of the analysis carried out on the structure of the relationship between accessibility, infrastructure, and travel characteristics to the movements undertaken to achieve the goal by conducting a factor confirmation analysis (Confirmatory Factor Analysis). Referring to the results of testing the structural model that was previously presented, it can be evaluated based on the value of t> 1.96 is significant, while the value of t <1.96 is not significant.

Direct and indirect influences on the structural model of traffic movement in the Makassar City housing area (BumitamalanreaPermai) can also be known after seeing the significance of each variable.

The steps taken to find a model that is appropriate and significant in approaching the reality of the field can be obtained through three hypotheses. The hypothesis is suspected that: a) infrastructure factors have an effect on accessibility, b) travel characteristics affect accessibility, and c) infrastructure factors, travel characteristics, and accessibility affect movement. The influence of available infrastructure factors on accessibility is 0.03 and t value can be observed as shown in table 30, indicating that t value is 0.33 <1.96. Thus the first hypothesis is that the infrastructure quality factor has a statistically insignificant effect on accessibility.

Analysis of the second hypothesis which states that the alleged travel characteristics affect accessibility, it was concluded that the travel characteristics factor had an effect on very small and insignificant accessibility factors.

The third hypothesis states that the alleged characteristics of travel, infrastructure, and accessibility affect movement. Structural test results show that the influence of travel characteristics on movement has a significant and positive direct effect on movement of 0.25 and t-value> 1.96 which is 2.45. Test results prove that the travel characteristics factor will have a significant effect on movement. However, the influence of infrastructure on movement is very small, as the results of structural testing show that the model does not achieve goodness of fit so that in modification of the model, changes are made to the pathway by eliminating the path of the relationship between infrastructure and movement to achieve goodness of fit. This does not mean that the relationship between infrastructure quality factors does not have a direct relationship to movement but is mediated by accessibility factors with a value of 0.60 and t-value> 1.96 which is 2.53 and also means that accessibility has a significant and positive influence on movement.

The test results on the three hypotheses prove that accessibility factors (cost, time, and distance of travel), and characteristics of travel (the purpose of the trip, the mode of transportation used, and when traveling) will have an effect on movement (number of family members, number of members working families, and income) and infrastructure quality factors (location / location of housing, comfort, and security live in residential areas) affect movement when mediated by accessibility.

IV. CONCLUSION

Referring to the results of the analysis and testing of hypotheses using structural equation tests as previously stated, the following conclusions can be drawn:

1. The factors that make up the movement of traffic in the residential area of BumitamalanreaPermai in the city of Makassar are the number of family members of 0.72, the number of family members working at 0.50, and the income of 0.44. 2. The results of the analysis of causal relationships between variables indicate that the structural model formed in the housing area in the study area is:

a. The available infrastructure gives a direct and insignificant influence on the accessibility factor of 0.03.
b. Travel characteristics have a direct and significant effect on movement of 0.25.
c. The available infrastructure has an influence on movement if it is mediated by an accessibility factor of 0.60.

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REFERENCES

1. Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in society*, *28*(1-2), 63-80.
2. Rodrigue, J. P., Comtois, C., & Slack, B. (2009). *The geography of transport systems*. Routledge.
3. Watson, V. (2009). Seeing from the South: Refocusing urban planning on the globe's central urban issues. *Urban Studies*, *46*(11), 2259-2275.
4. Falk, N. (2011). Masterplanning and infrastructure in new communities in Europe. *Urban Design in the Real Estate Development Process*, 34-53.
5. Balsas, C. J. (2003). Sustainable transportation planning on college campuses. *Transport Policy*, *10*(1), 35-49.
6. Turner, S. (2013). *Indonesia's small entrepreneurs: Trading on the margins*. Routledge.
7. Jensen, O. B. (2009). Flows of meaning, cultures of movements–urban mobility as meaningful everyday life practice. *Mobilities*, *4*(1), 139-158.
8. Amekudzi, A. A., Banerjee, T., Barringer, J., Cmapbell, S., Contant, C. K., Doyle, J. L. H., ...& Florida, R. (2012). *Megaregions: Planning for global competitiveness*. Island Press.
9. Washington, S. P., Karlaftis, M. G., & Mannering, F. (2010). *Statistical and econometric methods for transportation data analysis*. Chapman and Hall/CRC.
10. Urry, J. (2016). *Mobilities: new perspectives on transport and society*. Routledge.
11. Abdullah, S. (2016). Social Conflict Management through Multicultural Approach and Policy in Preventing and Overcoming the Social Disintegration. *TAWARIKH*, *5*(2).
12. Sugiyono, W. E. (2001). Statistikapenelitiandanaplikasinyadengan SPSS 10.0 for Windows. *Bandung: Alfabeta*.
13. Bartholomew, D. J., Steele, F., Galbraith, J., &Moustaki, I. (2008). *Analysis of multivariate social science data*. Chapman and Hall/CRC.