

The Effect of Trip Attraction on The Road's Level of Service at Islamic Hospital

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ABSTRACT

This research aims to identify the characteristics of trip attraction at the Islamic hospital UNISMA land use and its influencing factors; 2) to formulate a model of trip attraction at the Islamic hospital INISMA area, and to analyze the influence of trip attraction of Islamic hospital UNISMA to the level of service of the road (Mayjen Haryono Street). We descriptively elaborate the characteristics of land use and quantitatively analyze, using Pearson Product Moment, the correlation of factors affecting trip attraction. Regression analysis (stepwise method) and other quantitative analysis were used to evaluate and formulate the model and the effects on the level of services of the road. The research found that the origins of the trip to the Islamic hospital UNISMA were mostly from residential areas (90%) mainly from Lowokwaru District (43, 41%). Characteristics of the patient's daily range of places to stay to the Islamic hospital UNISMA that is as the most numerous between 1 and 5 km (41. 47%). Characteristic travel time from places to stay to the hospital is the most for 11-15 minutes (39, 92%). The dominant mode of transport was motorcycle (45, 35%). The analysis formulated a model of trip attraction at the Islamic Hospital as an equation of $Y_{\text{Islamic Hospital}} = 24,258 + 0,288 (X_2) + 0,083 (X_3)$, where Y is trip attraction at the Islamic hospital and X_2 are the number of patient's daily, X_3 are the number of extents inpatient rooms. The Islamic Hospital contributed 0,85%, or 104 vehicles per day, of total trip that passed Mayjen Haryono Street. The influence to level of service (LOS) of the road decreased the volume per capacity of about 1.7 which means that there was direct interaction between trip generation / attraction and land use and this affected the LOS of road network system

KEYWORDS: trip attraction, Islamic Hospital, level of service

INTRODUCTION

Malang City is the biggest city in East Java with very dramatic economic growth. High urbanization flow is, therefore, witnessed in the city. Human movement is increased as the consequence. The movement from one zone to other may include the destination of more than one zone. The increased movement automatically increases the number of vehicles, and therefore, the congestion in main road internodes is a reasonable result [1].

One of main road internodes in Malang City is Mayjen Haryono Street. It is widely known that Mayjen Haryono Street refers to a road connecting the downtown of Malang City with Batu City, and it is the densest road in Malang City. Along Mayjen Haryono Street, many functions of land use have changed fast. There are various land uses found along Mayjen Haryono Street, including education, office, trade and service, as well as health. These land uses are often the result of conversion from the houses into the commerce building. Many storehouses are built very close with the road such that the borderline of road is reduced or even eliminated at all [2].

A solution for congestion problem at Mayjen Haryono Street is by understanding the influence of land use order along Mayjen Haryono Street on road performance. The generation and attraction model in Mayjen Haryono Street is needed to figure out the appropriate generation and attraction of the recent movement. This model is also useful to predict the future movement in Mayjen Haryono Street, and from this problem in Mayjen Haryono Street can be solved immediately and be redesigned in the future.

MATERIALS AND METHODS

This research was conducted in Malang city. Maps of Malang City was as in Figure 1, Lowokwaru District as in Figure 2, and location of study area was as in Figure 3 below.

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Figure 1 Malang City

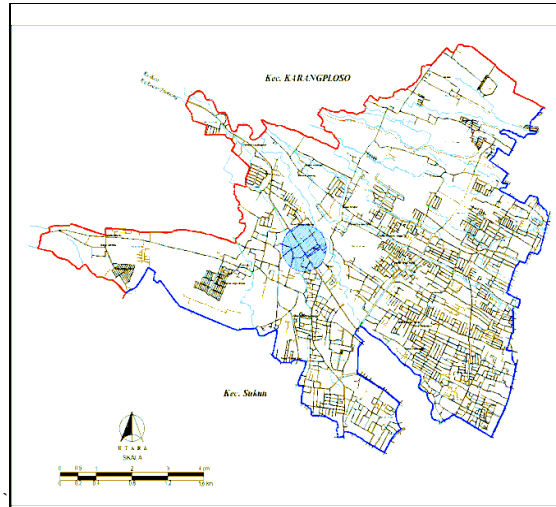


Figure 2: Lowokwaru District

One land use influencing of trip attraction in Mayjen Haryono Street is land use for health sector, including hospital and drugstore. A hospital located in Mayjen Haryono Street is Islamic Hospital. This hospital offers several kinds of in-service rooms, such as VIP Room, Class I Room, Class II Room, Class III Room, and Birthing Room.



Figure 3: Location of the Study Area

Data and research method

Research type is related to observation and identification, and therefore, it is called as descriptive research and evaluative research. Descriptive research is determining and reporting the existing condition, and then measuring this condition. Next step is assessment (evaluating the factual condition) to obtain new conclusion. The objective of research is to produce systematic, factual, and accurate sensing about facts and characters of certain population or region [3].

In addition, this research is also categorized into correlational research because this research detects how far is variations of the relation between one actor and other based on coefficient of correlation.

Research approaches are quantitative and qualitative approaches. Quantitative approach is used to construct the regression model to obtain direction and strategy of problem-solving at Islamic Hospital. Qualitative approach is used to identify the condition of study area and the characteristic of trip attraction from Islamic Hospital.

Data collection methods are primary survey and secondary survey. Primary survey techniques include field observation, interview and questionnaire. Secondary survey techniques involve survey on literature, survey on institution, and others. Analysis method is based on qualitative and quantitative approaches. Quantitative approach used in the research is correlation and regression analysis. Correlation research is used to detect the extent of variations on a variable associated with variations in one or more other variables based on the

correlation coefficient, while regression is used to propose guidance and strategies [4]. Other supporting analyses are ANOVA, road capacity and analysis of the level of services [5].

Variables

The type of generation and attraction models used is mathematic model. It takes a correlation form between the variable of land use order or location characteristic (as independent variable) and the variable of resurgence /attraction rate (as dependent variable). The equation type is regression equation because it has measurable reliability such that how far is the usability and the reliability of the model then can be understood [6].

Independent variable

The independent variable in this research is the degree of generation and attraction in certain interval. The interval is used because each location (with similar type of location) has the peak of generation / attraction (the biggest generation / attraction). It is clearly seen in Islamic Hospital. One attraction in health land use order (hospital and drugstore) is measured by the unit of vehicle / hour in the peak hour from 7 am to 9 am (morning), 11 am to 13 pm (noon), and 15 pm to 16 pm (afternoon). To facilitate the desegregation of vehicle type, the presentation of the type of in / out vehicle is revealed.

The candidate of dependent variable and correlation analysis

The variable candidates are X_1 = number of doctor/staff, X_2 = number of daily patient, X_3 = width of in-service room (m^2), X_4 = width of parking lot (m^2), and X_5 = width of building (m^2).

With the variable candidates then, correlational analysis is conducted to see the relation rate (statistically) between the variable of land use order characteristic and the variable of trip attraction. The coefficient rate of both variables is in the range of -1.0 and 1.0. The closer average was to 1.0 and -1.0, the higher correlation between both variables.

RESULTS AND DISCUSSION

Characteristic of land use at Islamic Hospital

This characteristic is identified based on the result of analysis over the daily patient Islamic Hospital. Two results are given, which are about the movement of daily patient and the movement of doctor/staff:

- The characteristic of the origin of the movement actors at Islamic Hospital is explained. The biggest percentage of the origin of the movement actors, either daily patient and doctor/staff, at Islamic Hospital is coming from Lowokwaru Sub district, with daily patient counted to 112 persons (43.41 %) and doctor/staff counted to 58 persons (37.91 %). The smallest percentage of daily patient movement is from Sukun Sub district with 13 persons (5.04 %), while that of doctor/staff is from Kedungkandang Sub district with 6 persons (3.92 %).
- The characteristic of the journey distance of the movement actors from their house to Islamic Hospital is considered. The biggest percentage of journey distance of daily patient to Islamic Hospital is 1-5 km and counted to 107 persons (41.47 %), while that of doctor/staff is 6-10 km and counted to 65 persons (42.48 %). The smallest percentage of journey distance from the house of daily patient and doctor/staff to Islamic Hospital is > 15 km, with 2 persons counted for daily patient (0.78 %) and 4 persons counted for doctor/staff (2.61 %).
- The characteristic of the journey length of the movement actors from their house to Islamic Hospital is also considered. The biggest percentage of journey length of daily patient and doctor/staff to Islamic Hospital is 11-15 minutes, and it is counted to 103 persons for daily patient (39.92 %) and 59 persons for doctor/staff (38.56 %). The smallest percentage of journey length of daily patient and doctor/staff is > 25 minutes, with 4 persons counted for daily patient (1.55 %) and 1 person counted for doctor/staff (0.65%).
- The characteristic of the journey mode used from house to Islamic Hospital is also explained. The biggest percentage of journey mode used by daily patient and doctor/staff to Islamic Hospital is motorcycle and it is counted to 117 persons for daily patient (43.35 %) and 134 persons for doctor/staff (87.58 %). The smallest percentage of the journey mode used by daily patient is walking with the count of 19 persons (7.36 %), while that of journey mode used by doctor/staff is car, with the count of 4 persons (2.61%).

Characteristic of trip attraction at Islamic Hospital

Islamic Hospital is addressed at Mayjen Haryono Street 139 and occupied on 20,800 m^2 land width with 9,857.25 m^2 building width. The number of in-served patient in the Islamic Hospital is 35 patients who are cared in VIP Room, Class I Room, Class II Room, Class III Room, and Birthing Room. The number of permanent

doctor who has practice in this hospital is 7 persons, while the staff total is 259 persons. The result of survey of the calculation of attraction (in) and generation (out) of vehicles in Islamic Hospital is shown in table 1:

Table 1. Result of The Calculation of Attraction (In) and Generation (Out) of Vehicles at Islamic Hospital

Hour	In - Vehicles			Out - Vehicles		
	Car	Motor Cycle	Total (vehicles/ hour)	Car	Motor Cycle	Total (vehicles/ hour)
07.00 – 08.00	15	89	37.25	10	34	18.50
08.00 – 09.00	8	36	17.00	7	24	13.00
09.00 – 10.00	4	32	12.00	5	22	10.50
10.00 – 11.00	2	23	7.75	1	14	4.50
11.00 – 12.00	3	16	7.00	2	4	3.00
12.00 – 13.00	4	17	8.25	2	7	3.75
13.00 – 14.00	13	29	20.25	10	22	15.50
14.00 – 15.00	8	19	12.75	15	26	21.50
15.00 – 16.00	11	14	14.50	5	19	9.75
16.00 – 17.00	6	20	11.00	7	15	10.75
17.00 – 18.00	30	70	47.50	20	90	42.50
18.00 – 19.00	10	34	18.50	8	22	13.50
19.00 – 20.00	5	22	10.50	4	14	7.50
20.00 – 21.00	1	8	3.00	1	15	4.75
Total	120	429	227.25	97	328	179

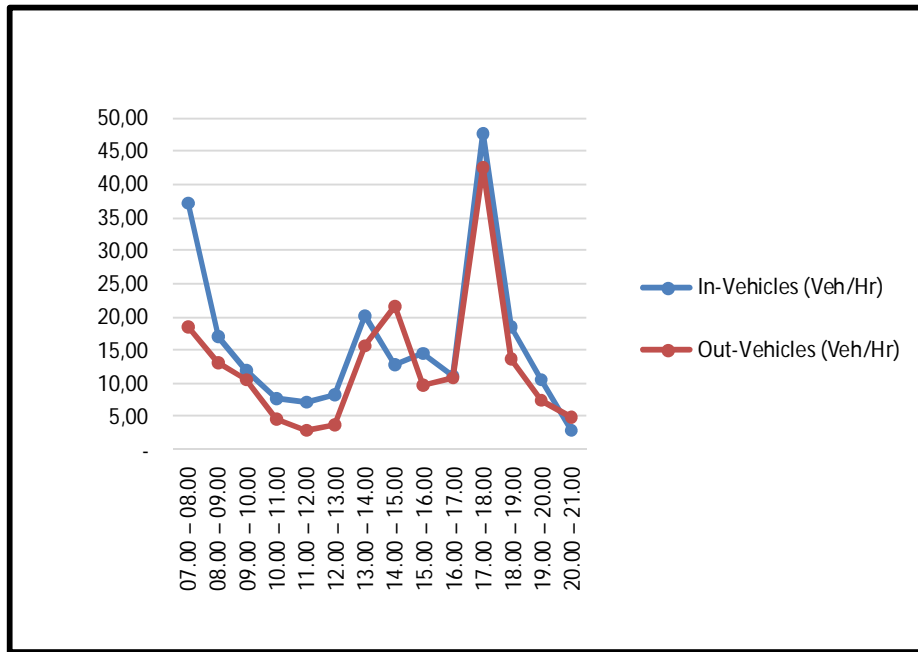


Figure-4 Attraction (In) and Generation (Out) Chart Vehicles at Islamic Hospital

Based on the survey upon visitors at Islamic Hospital shows, that the highest number of trip attraction (in vehicles) is occurred at 17 pm – 18 pm with 47.5 vehicles / hour. The highest number of trip generation (out vehicles) is also found at 17 pm – 18 pm with 42.5 vehicles / hour.

Analysis of trip attraction at Islamic Hospital

The relationship between the independent and the dependent variables can be described with the mathematic model by calibrating the model with data obtained from the field survey. Using the equation of linear regression analysis, the mathematic model is:

$$Y_{\text{Islamic Hospital}} = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5$$

where:

$Y_{\text{Islamic Hospital}}$ = number of trip attraction in Islamic Hospital

X_1 = number of doctor/staff

X_2 = number of daily patient

- X₃ = width of in-service room (m²)
- X₄ = width of parking lot (m²)
- X₅ = width of building (m²)

Primary data are collected from the result of survey, and it is tabulated as following:

Table 2 Characteristic of Islamic Hospital

Type of Room	Number of Doctor/Staff	Width of In service Room (m ²)	Width of Parking Lot (m ²)	Width of Building (m ²)
VIP	43	303.00	46	303.00
Class I	48	256.00	49.5	291.75
Class II	62	106.70	25	182.50
Class III	59	262.38	22.5	280.50
Birthing Room	54	368.73	36.75	459.90
Total	266	1,296.81	179.75	1,517.65

Correlation Analysis

Result of correlational analysis between variables using *software SPSS* is shown in table 3:

Table 3 Coefficient of Correlation Between Variables

Variables		Y	X ₁	X ₂	X ₃	X ₄	X ₅
Trip Attraction	Y	1					
Number of Doctor & Staff	X ₁	-0.101	1				
Number of Daily Patient	X ₂	0.923	-0.107	1			
Width of In-Service Room	X ₃	0.903	-0.043	0.672	1		
Width of Parking Lot	X ₄	0.668	-0.181	0.488	0.729	1	
Width of Building	X ₅	0.825	0.128	0.563	0.957	0.699	1

The result of correlational analysis indicates that the variable of the width of in-service room is the variable with the strongest correlation to the movement attraction, and can be used as the control variable through partial correlation.

Combination of regression models

The summary of the result of regression analysis is shown in table 4:

Table 4. Result of The Calculation of Partial Correlation

Control Variable	Variables	Y	X ₁	X ₃	X ₄	X ₅
Number of Daily Patient	Trip Attraction	Y	1			
	Number of Doctor/Staff	X ₁	-0.006	1		
	Width of In-Service Room	X ₃	0.993	0.040	1	
	Width of Parking Lot	X ₄	0.647	-0.149	0.620	1
	Width of Building	X ₅	0.959	0.228	0.945	0.589
Number of Daily Patient & Width of In-Service Room	Trip Attraction	Y	1			
	Number of Doctor/Staff	X ₁	-0.383	1		
	Width of Parking Lot	X ₄	0.337	-0.221	1	
	Width of Bulding	X ₅	0.520	0.586	0.011	1

From the result of analysis in table 4, the influential independent variables are acknowledged, and the regression equation model is as following:

Table 5. The Regression Analysis over Trip Attraction in Islamic Hospital

No.	Model	R ²	F-Stat	Coefficient of Regression	T	Significance	Note
1.	(Constant)	0.851	22.858	12.268	0.727	0.507	Signbificant
	Number of Daily Patient (X ₂)			0.462	4.781	0.009	
2.	(Constant)	0.998	717.545	24.258	9.904	0.002	Significant
	Number of Daily Patient (X ₂)			0.288	16.164	0.001	
	Width of In-Service Room (X ₃)			0.083	14.532	0.001	
3.	(Constant)	0.998	437.513	23.220	8.201	0.015	Not Significant
	Number of Daily Patient(X ₂)			0.295	14.667	0.005	
	Width of In-Service Room (X ₃)			0.068	3.716	0.065	
	Width of Building (X ₅)			0.012	0.862	0.480	

$$Y_{\text{Islamic Hospital}} = 24.258 + 0.288 (X_2) + 0.083 (X_3)$$

where:

X_2 = number of daily patient

X_3 = width of in-service room (m^2)

Based on this equation, it is shown that:

- Every additional 1 person to the number of daily patient will cause additional total of trip of 0.288.
- Every additional 1 m^2 to the width of in-service room will cause additional total of tript of 0.083.

The coefficient of determination or R-square is 1.00 or 100 %, meaning that movement is explained by variables of the number of daily patient and the width of in-service room.

Validation of trip attraction at Islamic Hospital

After the model is produced by linear regression analysis with *Stepwise* method, the next step is the validation of this model through F-test, t-test, and significance test. This statistic testing is explained as following:

1. F-test

Result of analysis indicates that F_{count} is 717.545, while F_{table} is 224.58. $F_{\text{count}} > F_{\text{table}}$ such that is concluded that the variables of the number of daily patient (X_2) and the width of in-service room (X_3) are simultaneously influencing the number of trip attraction in Islamic Hospital.

2. t-test

Table 6 t-test for Independent Variables at Islamic Hospital

Independent Variables	t-count	t-table	Note
The Number of Daily Patient (X_2)	16.164	12.71	t calculated > t table
The Width of In-Service Room (X_3)	14.532		t calculated > t table

Based on the result of t-test, it is asserted that the variables of the number of daily patient (X_2) and the width of in-service room (X_3) are partially influencing the number of trip attraction at Islamic Hospital.

3. Significance Test

Table 7 Signification-test for Independent Variables in Islamic Hospital

Independent Variables	sig-count	sig-table	Note
The Number of Daily Patient (X_2)	0.001	0.05	$Sig_{\text{calculated}} < sig_{\text{table}}$
The Width of In-Service Room (X_3)	0.001		$Sig_{\text{calculated}} < sig_{\text{table}}$

Related to the result of significance test, it is indicated that the variables of the number of daily patient (X_2) and the width of in-service room (X_3) are significantly influencing the number of trip attraction at Islamic Hospital.

Final results of regression model

Considering the result of various tests over the independent variables, the best regression model is then proposed:

$$Y_{\text{Islamic Hospital}} = 24.258 + 0.288 (X_2) + 0.083 (X_3)$$

where:

X_2 = the number of daily patient

X_3 = the width of in-service room (m^2)

The occurred trip attraction

Taking account the result of analysis of correlation test between variables and of the analysis of combined regression, it is obtained that the equation which is suitable to calculate the trip attraction in Islamic Hospital is:

$$Y_{\text{Islamic Hospital}} = 24.258 + 0.288 (X_2) + 0.083 (X_3)$$

where:

$$X_2 = 1,029 \text{ persons}, \quad X_3 = 1,296.81 \text{ m}^2$$

$$Y_{\text{Islamic Hospital}} = 24.258 + 0.288 (1.029) + 0.083 (1,296.81) \\ = 428.24523 \approx 428 \text{ vehicles / days}$$

The analysis level of service (LOS) at Mayjen Haryono Street

The base capacity of Mayjen Haryono Street in the peak hour in the morning, noon and afternoon is shown in table 8.

Table 8 the Road Capacity of Mayjen Haryono Street

C ₀	FC _w	FC _{SP}	FC _{SF}	FC _{CS}	C
2900	1.00	0.97	0.85	0.94	2,267.587

Regarding to the result of analysis above, the base capacity of Mayjen Haryono Street Corridor is 2,267.587 vehicles / hour. The calculation level of service of Mayjen Haryono Street is indicated in table 9.

Table 9 the Level of Service of Mayjen Haryono Street

Time	Peak Hour		Volume (vehicle/hour)	Street Capacity (vehicle/ hour)	LOS (V/C)	LOS Category
Week end	Morning	07.00-08.00	2,293.35	2,267.587	1.02	F
		08.00-09.00	2,885.10	2,267.587	1.28	F
	Noon	12.00-13.00	2,453.95	2,267.587	1.09	F
		13.00-14.00	2,381.00	2,267.587	1.06	F
		16.00-17.00	2,643.55	2,267.587	1.18	F
Week days	Morning	07.00-08.00	2,617.00	2,267.587	1.16	F
		08.00-09.00	2,443.55	2,267.587	1.09	F
	Noon	12.00-13.00	2,424.70	2,267.587	1.08	F
		13.00-14.00	2,338.80	2,267.587	1.04	F
		16.00-17.00	2,545.80	2,267.587	1.13	F
	17.00-18.00	2,493.55	2,267.587	1.11	F	

The influence of trip attraction to the level of service of the street

The analysis of road loading is aimed to understand the rate of trip attraction in the land use along Mayjen Haryono Street because this land use charges certain load into the corridor. In this study, road loading is caused by the existing land use order along the road on road service rate of Mayjen Haryono Street Corridor, and the emphasis is land use order for health, which is Islamic Hospital. The calculation the attraction volume of vehicle in the land use order along Mayjen Haryono Street can help the understanding the contribution of vehicle volume in the land use order to the total volume of Mayjen Haryono Street.

Table 10 the Analysis of Plate Matching

	Before Mayjen Haryono Street		After Mayjen Haryono Street		Deviation		Total Deviation
	1	2	1	2	1	2	
Total Counted Vehicle	3,588	2,440	2,492	3,204	1,096	764	1,860
1 = destination Malang-Batu 2 = destination Batu-Malang							

Table 10 shows that 1,860 vehicles become the attraction of the visitor of land use order along Mayjen Haryono Street. For clear description about the attraction of vehicle flow, the following table can be useful:

Table 11 the Load Accepted by Mayjen Haryono Street

Location of Loading	The Number of Vehicle	The Percentage of Vehicle Total (%)
Storehouse Complex	286	12.95
Education	120	5.53
Office	5	0.23
Health	127	5.75
Trade & Service	647	29.30
Mayjen Haryono Street, Lane VIII	224	10.14
Mayjen Haryono Street, Lane X	87	3.94
Mayjen Haryono Street, Lane XII	275	12
Tlogo Indah Street	169	45
Perum Batu Pertama Street	268	7.65
Total	2,208	100.00

Table 11 shows that the storehouse complex contributes 12.95 % of total attraction/generation of vehicle in the land use order in Mayjen Haryono Street. Islamic University

of Malang contributes 5.07 %, while Islamic Hospital has contribution of 5.39 %. The contributions from other land uses are detailed as following: 5.75 % from total health sector, 29.30 % from trade and service, 10.14 % from Mayjen Haryono Street of Lane VIII, 3.94 % from Mayjen Haryono Street of Lane X, 12.45 % from Mayjen Haryono Street of Lane XII, 7.65 % from Tlogo Indah Street, and 12.14 % from Perum Batu Permata Street.

CONCLUSION

Trip attraction is occurred due to certain activity in one of various land uses in Dinoyo Region, which is Islamic Hospital. The hospital contributes 428 vehicle's trip per day, or 5.39 % of total vehicles pasang through Mayjen Haryono Street. The analysis of regression generated an equation model $Y_{\text{Islamic Hospital}} = 24.258 + 0.288 (X_2) + 0.083 (X_3)$. The influence of trip attraction produced by model may be explained as follows. The additional 100 % to every variable in this model influences (increase) the movement volume to 5.91 %. However, the influence on road service reduces the volume per capacity to 11.82. It means that there is a direct interaction between generation / attraction of influence from land use order activity, with the level of service road network system.

Hospital Development plan UNMUH (with 6 floors) in the similar corridor may in the future influence the increase of generation/attraction of movement from health land use, and possibly influence the decrease level of service at road network system in Mayjen Haryono Street.

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