

Renewing of Indonesia Highway Capacity Manual Urbanroad Segment with Traffic Microsimulation

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ABSTRACT

According to the fact that there is no renewing of Indonesia Highway Capacity Manual (IHCM) for over 17 years, while in the same way, traffic characteristics has significantly changed, leads the research to know the mismatch of the traffic performance prediction by IHCM. The research object is the traffic characteristics of WR. Supratman Street of Bandung and Affandi Street of Yogyakarta. Vissim software was used for the analysis purpose, then the result will be compared by KAJI software, which known as the product of IHCM. It shows that KAJI predicted the higher value of traffic speed and the lower value of road capacity than Vissim. Since Vissim's model is statistically valid, it can says that KAJI is no longer suitable to predict the traffic speed and road capacity of WR. Supratman Street of Bandung and Affandi Street of Yogyakarta.

Keywords: IHCM, KAJI Software, VissimSoftware, Road Capacity

I. GENERAL DESCRIPTION

According to the fact that there is no renewing of Indonesia Highway Capacity Manual (IHCM) for over 17 years, while in the same way, traffic characteristics has significantly changed, leads the research to know the mismatch of the traffic performance prediction by IHCM.

Below are the short review of IHCM:

The calculation procedures only apply for a level or near level vertical alignment, straight or near straight horizontal alignment. It shows that the calculation ignoring the factor of vertical and horizontal alignment, instead of a research by Chandra, (2004), it known if for each percent of gradient increasing will cause capacity decreased until 2,61% and in the decreasing of each percent of gradient there was capacity increased to 3,09%;

Traffic composition affects the speed-flow relationship and if capacity expressed by vehicles per hour, depends on the ratio of motorbike and heavy vehicle in the traffic flow, which has higher value now, certainly will change the speed-flow relationship pattern of IHCM;

A research by Malkhamah in 2005 about the impact of trip generation to traffic speed in commercial area of UripSumoharjostreet in Yogyakarta shows that:

Traffic speed affected by a free flow speed and the traffic flow,

The influenced of car parking flow to traffic speed is higher than motorbike parking flow did,

The impact of pedestrian crossing movement is higher than pedestrian moving along the sidewalk to traffic speed,

The decreasing of maximum traffic speed caused by pedestrian flow and parking flow have predicted by the authority of road of Indonesia only around 32%, the research instead got the value of 64,2%.

Road side activity which be a side friction affected road capacity and road performance, but it still needs an updating the new one and how it's influencing road.

There was a statement in IHCM, it says if "A small city contains of slowly driver behaviour and an old kind of vehicle" so it needs a research to the behavioral of driver, modeling it and also examined if the statement true or false.

Object of this research was traffic flow of two roads i.e WR. Supratman Street of Bandung and Affandi Street of Yogyakarta. The traffic flow data of WR. Supratman Street has taken from the video ofThe Indonesia Road Authority Agency, they make the video on 2011, December 29th and the traffic data of Affandi Street was from a field survey on 2014, November 3rd. The traffic performance analysis developed by using of Vissim software, then compared by the analysis result of KAJI software which known as a product of IHCM.

II. DATA AND ANALYSIS

Data

The snapshot of the streets shown below.



Image 1. WR. Supratman street of Bandung



Image 2. Affandi street of Yogyakarta Here in Table 1 below, is the data of Vissim modeling.

Table 1. Vissim Modeling Data

NO	STREET	CITY	DAY/DATE	TIME	VOLUME								
					Direction	Total	Composition					Bekak	
							Car	Truck	Bus	Bike	Motorbike		
1	Jl. WR. Supratman	Bandung	Thursday/29-12-2011	09.00-10.00	North	2511	1161	58	68	7	2215	3	
							bound	0,331	0,016	0,019	0,002	0,631	0,001
					South	2046	895	50	8	30	1862	2	
							bound	0,314	0,018	0,003	0,011	0,654	0,001
2	Jl. Afandi	Yogyakarta	Monday/3-11-2014	07.00-08.00	South	5507	770	5	32	33	4656	11	
							bound	0,140	0,001	0,006	0,006	0,845	0,002
					North	3499	472	5	33	40	2942	7	
							bound	0,135	0,001	0,009	0,011	0,841	0,002

The data for KAJI modeling as seen on Table 2.

Table 2. KAJI Modeling Data

DATA			WR. Supratman	Affandi
			Street	Street
Day/Date			Thursday/29-12-2011	Monday/3-11-2014
Time			09.00 - 10.00	07.00 - 08.00
Width of effective lane	NB		7 meters	6 meters
	SB		7 meters	6,4 meters
Width of bike lane	NB			1,1 meters
	SB			1,3 meters
Kerb-obstacle	NB		0,5 meters	2 meters

distance		SB	2 meters	2 meters
City size			Big	Small
Traffic volume	NB	LV	1161	475
		HV	126	39
		MC	2215	2958
		UM	10	47
	SB	LV	893	787
		HV	59	37
		MC	1862	4798
		UM	32	47

III. ANALYSIS

Development and calibration of Vissim model

The Vissim model development are below:

Draw link model which represented the research object;

Input traffic volume data and the vehicle composition refer to the vehicle type, equipped with the desired speed distribution; and

Driver behaviour parameter value i.e following, lane change and lateral are still in Vissim default, then running the simulation.

When using default value for modeling the two streets, found a warning from the software in the end of simulation, stated that some vehicle could not include in analysis because of the limit of simulation time, it shows that the existing Vissim model composition can not flowing all the traffic volume data, so it needs to be calibrated.

Table 3 below are the list of calibration factor.

Table 3. Vissim Model Calibration

NO	PARAMETER	DEFAULT	CALIBRATION	
1	Following:			
	Look ahead distance:	0 m	20 m	
	Minimal:	250 m	120 m	
	Maximal:	4	4	
	Observed vehicles:			
	Look back distance:	0 m	20 m	
	Minimal:	150 m	120 m	
	Maximal:			
	Model parameter (Wiedemann 74):	2	0.5	
	Average standstill distance:	2	0.5	
2	Lane change: Cooperative lane change:	No	Yes	
	3	Lateral: Overtake on same lane:	No	Yes

With those value, all inputting traffic volume data can be simulated.

Model validation

Validation required for all model which the object were time headway and speed distribution. The contingency table analysis shows if for the two streets the value of X^2 counting result

is higher than X^2 statistic stable (with level of significance of $(\alpha)=0.05$), so there is no relationship between time headway value of the survey result and the model result, or there was a significantly different between the two values, so the object of validation changed to the distribution of each 10 minutes traffic flow and the mean speed of each vehicle type. The analysis shows there was a little different between X^2 counting result and X^2 statistics table.

Due to the validation result above, another factor must be analyzed before using the model further, just to make sure of how valid the model is. In Vissim if we input a value of total traffic flow, there will be come out a different value in the simulation result, we checked the difference of the values, and the result shows there is no significantly difference between values. According to the result, we can say the Vissim models are valid. The summary of validation result shown by Table 4.

Table 4. The Summary of Validation Result

NO	VARIABLE	WR. Supratman Street		Affandi Street	
		X^2 counting result	X^2 table	X^2 counting result	X^2 table
1	Time headways distribution	North bound : 54.51	21.02	South bound: 95.95	12.59
2	Each 10 minutes traffic flow distribution	North bound : 12.25	11.07	South bound: 15.85	11.07
		South bound : 18.83	11.07	North bound: 18.64	11.07
3	Total of inputting traffic flow	Two ways: 0.0004	3.84	Two ways: 0.03	3.84
4	Speed distribution	North bound : 737.21	15.5	South bound: 2299.93	15.5
5	Mean speed of each vehicle type	North bound : 1.9	11.07	South bound: 0.96	11.07
		South bound : 0.21	9.48	North bound: 0.07	11.07

Road capacity analysis

The road capacity analysis by Vissim software are below:

Built Vissim model in various traffic volume input with different random seed value, and use same value of vehicle composition and desired speed distribution;

Traffic volume is in passenger car unit, refer to the latest research of the Indonesia Road

Authority; Record Vissim result for all condition; Analyzed the traffic density; and Built the relationship diagram of density and traffic speed then calculate the road capacity by using the formula of $(Dj \times Vf) / 4$.

The result shown by Table 5.

Table 5. The Summary of Road Capacity Analysis

NO	STREET	VOLUME	SPEED	CAPACITY	V/C
1	WR. Supratman				
	a. North bound	2088	24.6	2776	0.75
	b. South bound	1555	38.2	4090	0.38
2	Affandi				
	a. South bound	2239	29.7	4477	0.50
	b. North bound	1400	38.0	4878	0.29

Trend analysis

Trend analysis describe more about the Vissim’s result. Shown by images below.

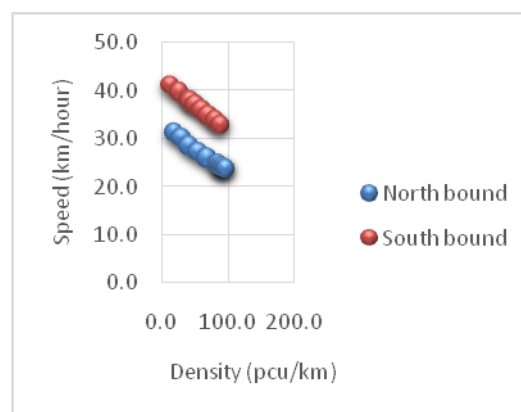


Image3. The scattered diagram of the relationship of density and speed of WR. Supratman Street

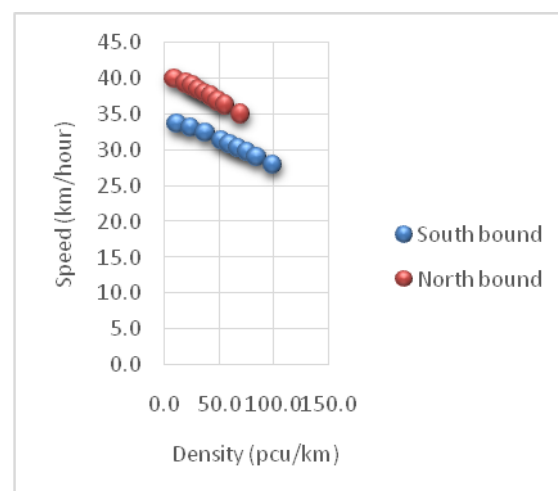


Image4. The scattered diagram of the relationship of density and speed of Affandi Street

In two images above found:

There was different capacity between two links in the same road, it happens because of the difference between the lower desired speed value as shown by Image 3 and 4.

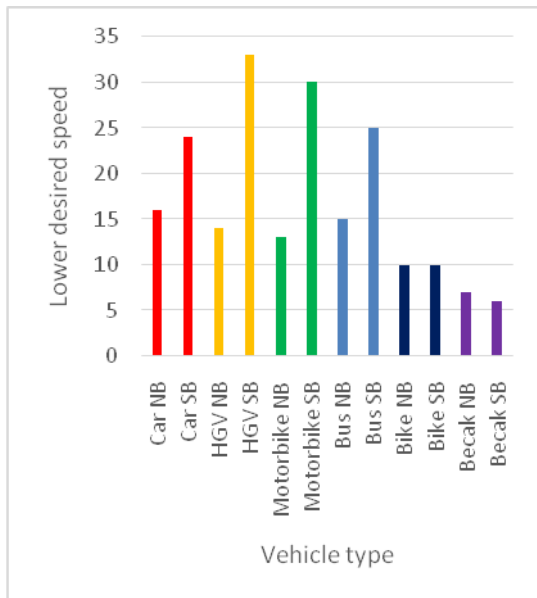


Image 3. The comparison diagram between lower desired speed on WR. Supratman street

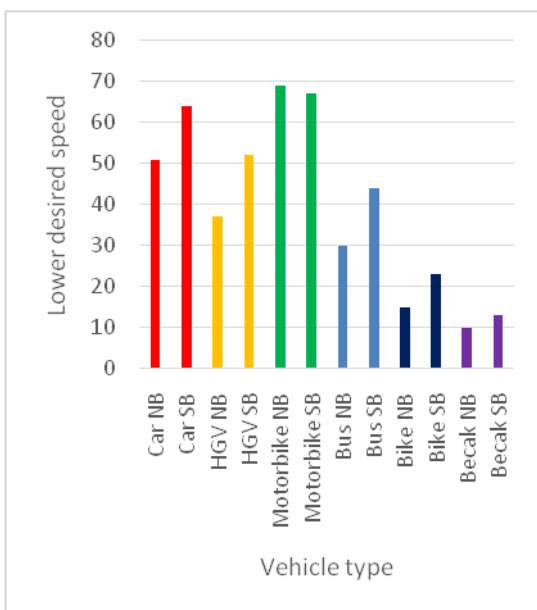


Image 3. The comparison diagram between lower desired speed on Affandi street

The differences above, have caused low determination coefficient (R^2) of the trend line, so the formula result (shown by Image 5 and Image 6) will not suitable for modelling road capacity calculation for both of WR. Supratman Street and Affandi Street.

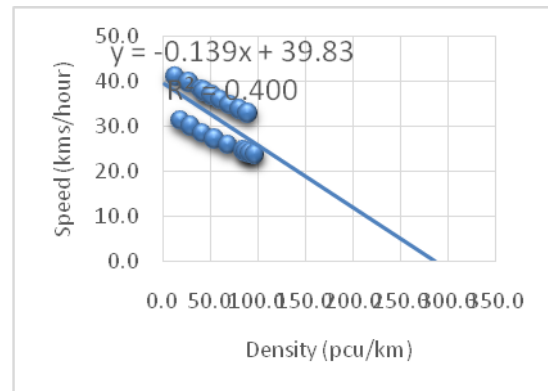


Image 5. The scattered data diagram and the trend line of the relationship of density and speed of WR. Supratman Street

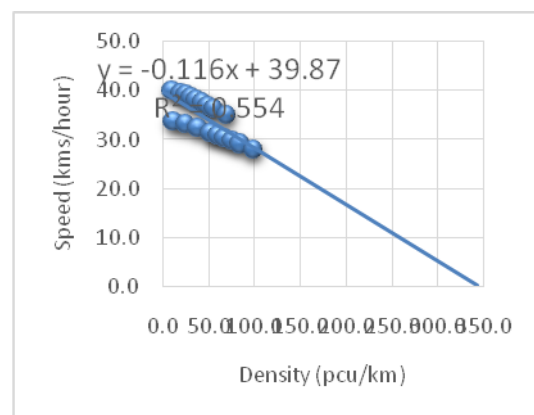


Image 6. The scattered data diagram and the trend line of the relationship of density and speed of Affandi Street

IHCM analysis

The relationship of density and speed as KAJI's result shown by Image 7 and Image 8.

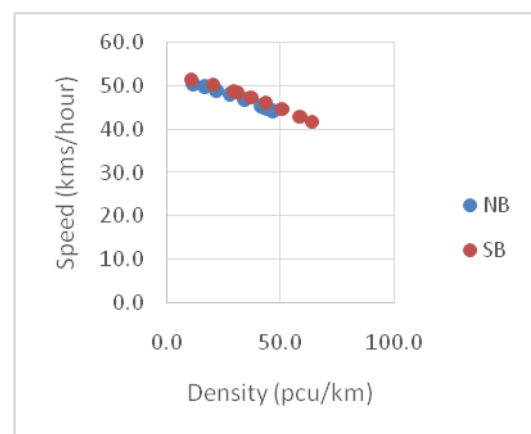


Image 7. The scattered data diagram of the relationship of density and speed of WR. Supratman Street as KAJI's result

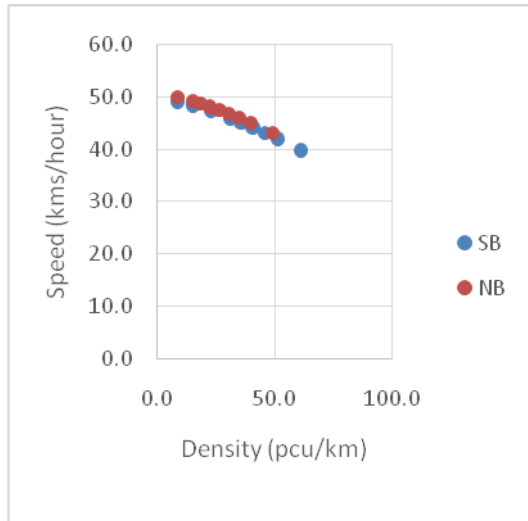


Image 8. The scattered data diagram of the relationship of density and speed of Affandi Street as KAJI's result

From the images above found:
Traffic speed prediction lies on 40 kms/hour to 55 kms/hour;

The relationship of density and speed have formed a linear scattered data, so it is suitable for a generalization of road capacity analysis.

Vissim and KAJI Comparison

After all the analysis process above, the next step is to identify the comparison between Vissim's result and KAJI's result, to know the differences of both. The result as shown on Image 9 and Image 10.

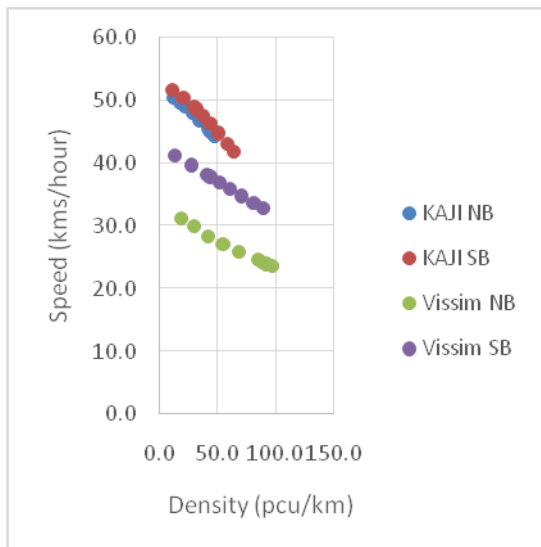


Image 9. The scattered data diagram of the relationship of density and speed of WR. Supratman Street according to Vissim and Kaji's model

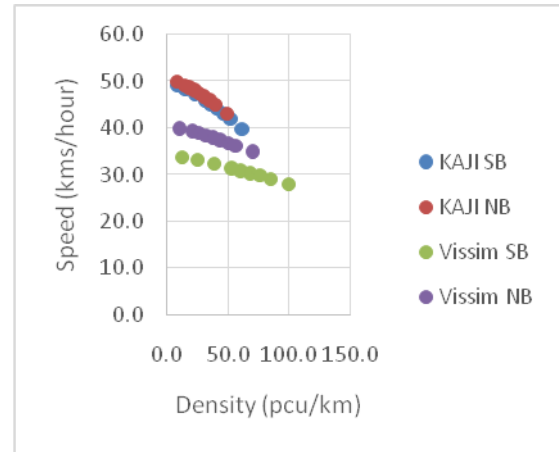


Image 10. The scattered data diagram of the relationship of density and speed of Affandi Street according to Vissim and Kaji's model

It shows that KAJI have predicted higher traffic speed than Vissim, and according to the validation result which Vissim model have known valid for the mean speed of all vehicle type, so it says that KAJI has no longer suitable for predict traffic speed on WR. Supratman Street and Affandi Street.

The next comparison is prediction value of road capacity as shown on Image 11.

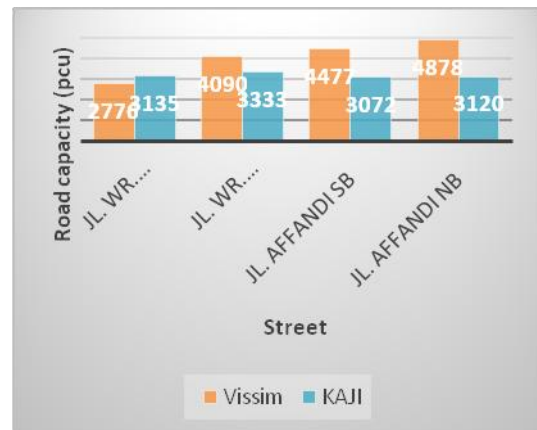


Image 11. The comparison diagram of road capacity value

IV. SUMMARY

The summary of this research are:

The default value of Vissim software for driver behaviour need to be calibrate for simulation process of WR. Supratman Street of Bandung and Affandi Street of Yogyakarta. For the changing of the value, found that the driver behaviour parameter is more aggressive than the default value.

Vissim model is valid for the variable of total volume assigned and the mean speed of each vehicle type. The Vissim result is so influenced by the desired speed distribution, the different trend

line of the scattered data of the relationship of density and speed for the same road but different direction can occurred.

Since Vissim's model is statistically valid, it can says that KAJI is no longer suitable to predict the traffic speed and road capacity of WR. Supratman Street of Bandung and Affandi Street of Yogyakarta..

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