The Impact of Rahayu Market Activity on the Performance of Imam Bonjol Street in Denpasar

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ABSTRACT

Jalan Imam Bonjol is a road section located in the West Denpasar sub-district, precisely in the Pemecutan Klod area there is Rahayu Market which has activities in the morning. Activities in this market will indirectly reduce the performance of the section because there are large roadside obstacles. This study was conducted to determine how the performance of the section that occurs on the Imam Bonjol section with and without market activity followed by the impacts that occur. This research includes primary data collection to obtain road geometric values, vehicle volumes, and roadside obstacles, as well as speed (spot speed). The data obtained were analysed using the MKJI 1997 method. The results of the analysis of the performance of road sections in the presence of market activities in two conditions where the traffic volume for hourly conditions at peak times has Q of 1857.35 smp / hour, C of 2946.806 smp / hour, DS 0.63, V 23.92 km / hour with level of service F. While for the peak hour the side obstacle has Q of 690.15 smp / hour, C of 2626.501 smp / hour, DS worth 0.26, V of 19.2 km / hour with level of service F. The performance of the road section without the market obtained Q of 1846.2 smp / hour, C of 3203.05 smp / hour, DS worth 0.58, V of 36.8 km / hour with level of service C. Comparison of road section performance for traffic volume increased 1% and decreased 63% than without market, capacity decreased 8% and 18% than without market, degree of saturation increased 9% and decreased 55% than without market, speed decreased 35% and 48% than without market.

Keywords: Road performance, Side barriers, Market activity

1. INTRODUCTION

Jalan Imam Bonjol is one of the roads located in West Denpasar District, precisely in the Pemecutan Klod area there is a Rahayu Market which is active around 05.00-10.00 WITA. This market activity often causes high side obstacles to traffic movements on the road. There are a number of factors that can cause obstacles on this section, including the presence of pedestrians who do not walk on the sidewalk, transportation that uses the road body to stop/park, and the activity of outgoing and incoming transportation from the surrounding neighbourhood roads. This condition causes the road geometric space to become narrow, so that the speed of vehicles on the road section decreases, travel time increases, capacity decreases and the level of road service decreases. Currently, it has not been found how the performance level of road sections with and without the presence of Rahayu Market. This study was conducted with the aim of finding out how the performance of the section with and without market activity and the impacts that occur due to the Rahayu Market activity.

2. THEORY AND METHODS

2.1 Road Section Performance

Section performance is a quantitative measure of the specific situation that occurs on the road. The performance of road sections can be seen from several factors, including the volume of vehicles, free flow speed, and speed, as well as the degree of saturation to the capacity value. While the qualitative measure will represent how the level of service in the road section which can be described by the operational state of travel and how the driver's perception of comfort when driving [1].

2.2 Traffic Volume

According to [2] Traffic volume can be defined as the total transport passing through a section in a given period of time.

$$Q = \frac{n}{T} \quad (1)$$

2.3 Road Capacity

Road Capacity is defined as the ability of a section to accommodate the amount of road transport that crosses the road section in the planned time space [2].

$$C = Co \times FCw \times FCsp \times FCsf \times FCcs \quad (2)$$

2.3 Speed and Travelling Time

Travel time (TT) is the average time taken by road transport to cover a road section with a certain distance. Travel speed is the average speed divided by the travel time [2]. In this study using the spot sopeed method, which is divided into two equations, namely :

1. Time-averaged speed

The average speed of road transport that crosses a point in a given period.

$$Vt = \frac{\sum Vi}{n} \quad (3)$$

2. Average velocity of space

The average speed of land transport travelling a certain distance on a road section within a certain period and calculated based on the average travel time of transport crossing an observation point [3].

$$Vs = \frac{n.d}{\sum ti} \quad (4)$$

2.4 Free Flow Speed

Free flow speed is the speed that a motorist chooses without being affected by other transport on the road [2].

$$FV = (Fvo+FVw) \times FFV_{SF} \times FFV_{CS} \quad (5)$$

2.5 Degree of Saturation

The degree of saturation is the ratio of traffic flow to capacity which is used as one of the determinants of the performance level of the traffic section [2].

$$DS=\frac{Q}{C} \quad (6)$$

2.6 Service Level

The level of service on a road section can be determined in several levels starting from level of service A which means that the section is stable and continues to decline to level of service F which has the worst section conditions [2].

2.7 Side Barriers

The performance of the section has an impact on certain sections, which one of the impacts that occurs is due to activities on the side of the road, commonly referred to as side obstacles [2]. Some of the types of side obstacles that will have a major effect are:

1. People passing by the side of the road (PED),
2. Public transport (PSV),
3. Non-motorised vehicles (SMV),
4. Vehicles leaving and entering the neighbourhood (EEV).

Side barriers have several levels divided into five classes from lowest to highest. This level will play a role in the frequency of side barriers along the observation section. In its own determination, the side barriers are limited by the observation distance per 200 metres.

2.8 Market

According to [4] The market can be interpreted as a place of transaction activities that occur between transaction actors, both buyers and sellers, in which there are also prices that are formed based on demand and supply.

Based on [5] Traditional markets are formed and run by anyone from the government, private sector, cooperatives, or non-governmental organisations in the form of small-scale stalls or shops with negotiated business methods. Meanwhile, markets that have professional management with the aim of providing good service and quality can be defined as modern markets [6].

3. RESULTS AND DISCUSSION

This research was conducted in several stages where the first stage began with a preliminary study to find out information without a survey to clarify the problems to be studied by reading previous research as a reference to the issues raised. The object of this research study focuses on the activities that occur at the Rahayu Market located on the Imam Bonjol section which is precisely at point 2 + 400 m, Pemecutan Klod, West Denpasar District, Denpasar City, Bali. The problem that will be raised is side obstacles due to market activities such as people not walking where they should, and vehicles stopping/parking on the road. For more details can be seen in Figure 1.

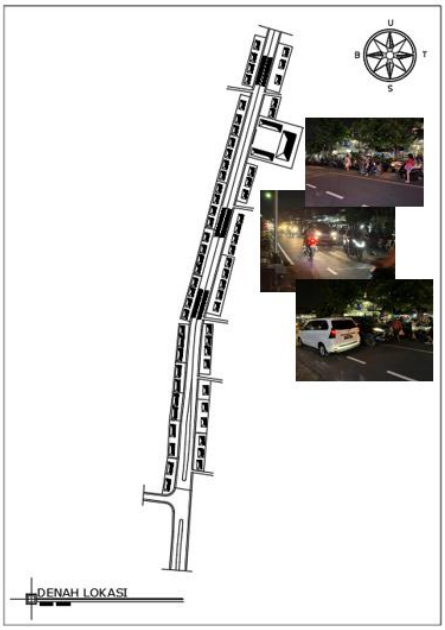

Figure 1. Research location

In the research, several data are used which are primary data and secondary data. Before the survey the research design was made first to find out how the method and what tools needed to be prepared to support this research.

Primary data collection methods are carried out directly, where there are road geometric surveys, traffic volumes (Figure 2.), travel time surveys (Figure 3.), and roadside obstacle surveys (Figure 4.) Secondary data is data used to complete survey results obtained from related agencies to determine the population and map of the research location.

Figure 2. Sketch of traffic volume survey

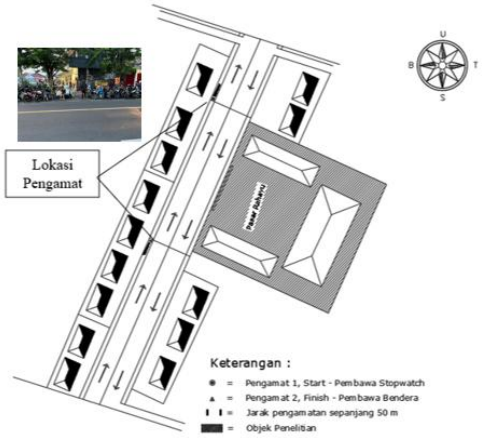

Figure 3: Travelling time survey

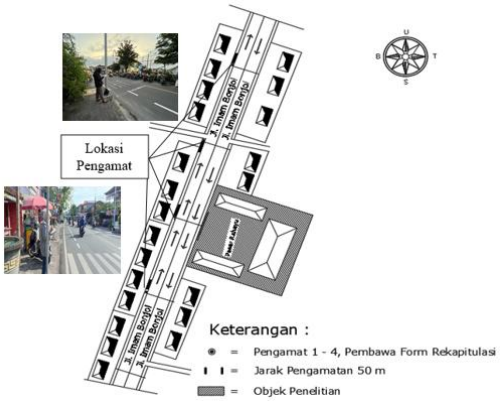

Figure 4. Side obstacle survey

After obtaining the necessary data, the next step is to analyse the data based on the study of [2], The data analysed are the performance of road sections with and without market activity, comparison of road section performance with and without market activity, and the impacts caused by market activity.

3.1 Road Geometrics

Imam Bonjol Street is a 2/2 UD road. In this study, the segment was determined to be 200 metres long.

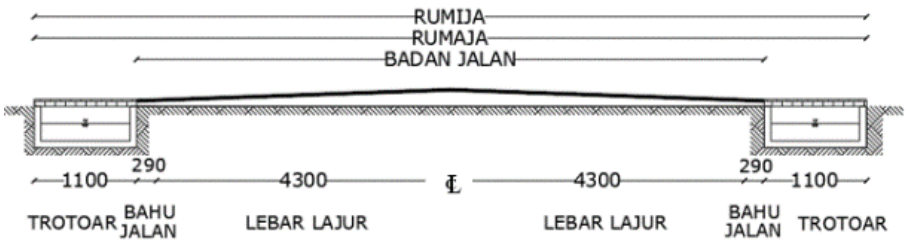

Figure 5. Road segment cross-section

Based on Figure 5, Jalan Imam Bonjol, West Denpasar has a lane width of 8.6 m with a width of 4.3 m each lane with a two-lane two-way type and has a shoulder width of 0.29 m with a sidewalk width of 1.1 m, then the width of the Imam Bonjol Road body is 9.18 m.. In [7], The classification of this road function is a primary collector road which is also in accordance with [8].

3.2 Traffic Volume

Volume surveys were conducted to obtain the highest peak volume times and total traffic volume results per direction. The survey was conducted during the market activities with a period of 5 hours.

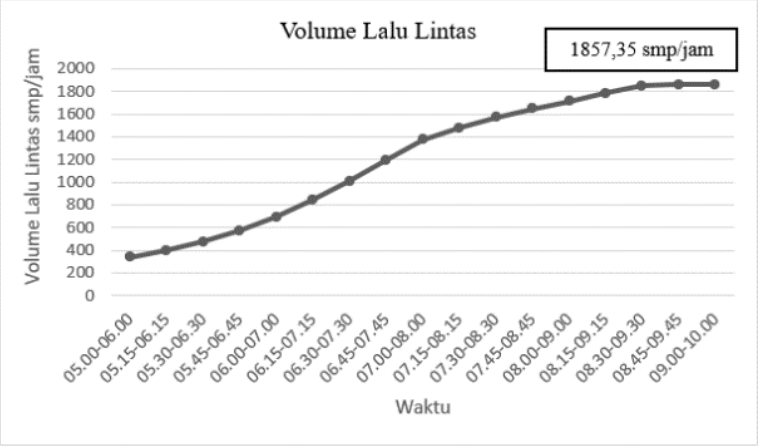

Figure 6. Traffic volume with market activities

It can be seen that the highest peak time on this section occurs at 08.45-09.45 with a total volume of 4,595 vehicles/hour or 1,857.35 smp/hour. While the lowest volume is at 05.00-06.00 with a total volume of 839 vehicles/hour or 339.5 smp/hour.

Traffic volume without market activity can be calculated based on the results of the vehicle volume survey minus the roadside obstacles in the form of vehicles stopping on the side of the road/parking.

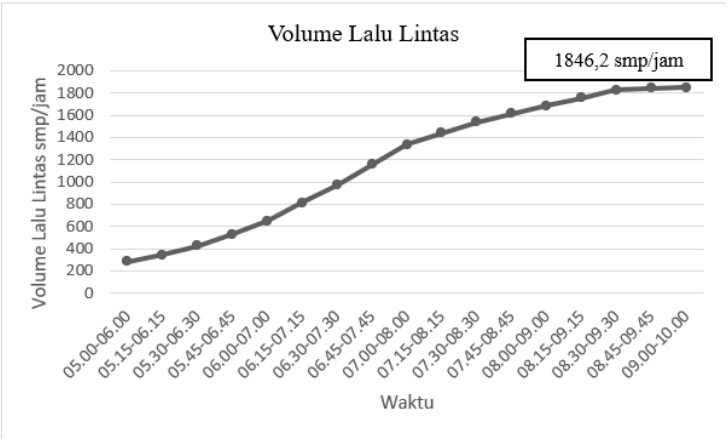

Figure 7. Traffic volume without market activity

Based on Figure 7, it is known that the highest peak hour on Jalan Imam Bonjol without market activity occurs at 09.00-10.00 WITA with a volume of 4,541 vehicles/hour or 1,846.2 smp/hour. While the lowest volume occurs at 05.00-06.00 with a volume of 612 vehicles/hour or 282.75 smp/hour.

3.3 Side Barriers

Data on side obstacles on Jalan Imam Bonjol Denpasar is used to determine the class of side obstacles that occur. In this analysis, it is found that the peak hour of side obstacles and the peak hour of vehicle volume are different. Therefore, the calculation of side obstacles is carried out during the peak time of vehicle volume, namely at 08.45-09.45 shown in Table 2. and the calculation of the peak hour of side obstacles at 06.00-07.00 shown in Table 3. The peak volume comparison can be seen in Figure 8.

Table 2. Analysis of side obstacles at 08.45-09.45 hours

Event Type Side Barriers	Symbol	Weight Factor	Frequency of Occurrence in Field (per hour/200 m)	Weighted Frequency (per hour/200 m)
Pedestrian	PED	0.5	33	16.5
Traffic. Parking & Stopping	PSV	1	58	58
Vehicle Exit & Entry	EEV	0.7	132	92.4
Slow vehicle	SMV	0.4	6	2.4
Total Occurrence (per hour/200 m)				169.3

Table 3. Analysis of side obstacles at 06.00-07.00 hours

Event Type Side Barriers	Symbol	Factor Weight	Frequency of Occurence in Field (per hour/200m)	Weighted Frequency (per hour/200 m)
Pedestarian	PED	0.5	325	162.5
Vehicles parking & Stopping	PSV	1	162	162
Vehicle Exit and Entry	EEV	0.7	510	357
Slow Vehicle	SMV	0.4	110	44
Total Occurence (per hour/200 m)				725.5

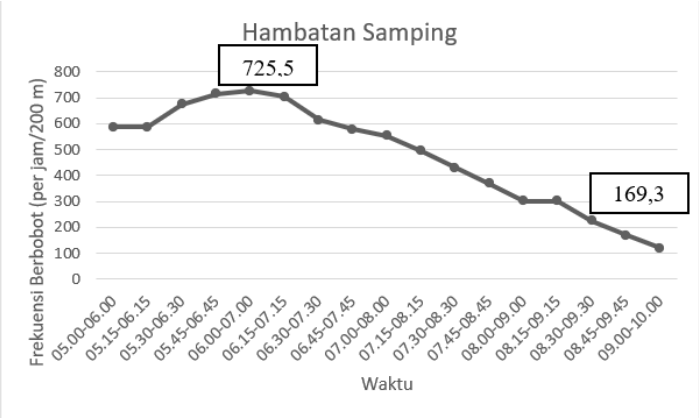

Figure 8. Side barriers

Based on Figure 8. it can be seen that the peak hour of the highest total weight of side obstacles is 725.5 per hour / observation distance of 200 m. based on the peak value of side obstacles obtained in this section in the presence of market activity, the value of the obstacle class is in class H. On the other hand, the weight of the roadside obstacles obtained during the peak time of vehicle volume is 169.3 per hour / 200 m. Therefore, the value of side obstacles is included in the low class (L).

3.4 Total Population

Based on data obtained from [9] the number of people living in the last 5 years is shown in Table 4.

Table 4. Total population

Population Projection of Denpasar City (People)	
Years	Total
2015	880.600
2016	897.300
2017	914.300
2018	930.600
2019	947.100
2020	962.900
Percentage Growth	1,803%

3.5 Performance Analysis of Road Sections with Market Activities

The data analysis required is all primary and secondary data. This analysis is carried out in 2 conditions, namely during the peak time of traffic volume and the peak time of side obstacles.

1. Capacity
   After getting some predetermined values, the calculation looks like this:

   - Peak time traffic volume condition

   C = Co x FCw x FCsp x FCsf x FCcs

   C = 2900 x 1,25 x 0,94 x 0,92 x 0,94

   C = 2946,806 smp/hour

   - Peak time condition of side obstacles

   C = Co x FCw x FCsp x FCsf x FCcs

   C = 2900 x 1,25 x 0,94 x 0,82 x 0,94

   C = 2626,501 smp/hour

2. Degree of Saturation
   The calculation is done as follows:

   - Peak hour traffic volume conditions
     DS = Q/C

     DS = 1857,35/2946,806

     DS = 0,63

   - Peak hour conditions side barriers
     DS = Q/C

     DS = 690,15/2626,501

     DS = 0,26

3. Free Flow Speed
   After getting some predetermined values, the calculation looks like this :

   - Peak hour traffic volume condition

FV = (Fvo+FVw) x FFV_{SF} x FFV_{CS}

FV = (44+4) x 0,96 x 0,95

FV = 43,776 km/hour

- Peak hour condition side obstacles
  FV = (Fvo+FVw) x FFV_{SF} x FFV_{CS}

  FV = (44+4) x 0,82 x 0,95

  FV = 37,392 km/hour

4. Speed
   The calculation of average speed is calculated as follows :

   - Peak hour traffic volume conditions time range 08.30-10.00
     Vs = (n.d)/(∑ti)

     Vs = (36 x (50/1000))/(270,85 dt/3600)

     Vs = 23,92 km/hour

   - Peak hour condition of side obstacles time range 05.30-07.30
     Vs = (n.d)/(∑ti)

     Vs = (48 x (50/1000))/(449,86 dt/3600)

     Vs = 19,2 km/hour

3.6 Road Section Performance Analysis without Market Acitivity

The value of side obstacles in analysing the performance of sections without market activity is not taken into account so that it is worth 1.

1. Capacity
   Capacity calculation is as follows :

   C = Co x FCw x FCsp x FCsf x FCcs

   C = 2900 x 1,25 x 0,94 x 1 x 0,94

   C = 3203,05 smp/hour

2. Degree of Saturation
   The calculation is done as follows :

   DS = Q/C

   DS = 1846,2/3203,05

   DS = 0,58

3. Free Flow Speed
   FV = (Fvo+FVw) x FFV_{SF} x FFV_{CS}

   FV = (44+4) x 1 x 0,95

   FV = 45,6 km/hour

4. Speed
   The speed without the market can be obtained through the graph shown in Figure 9.

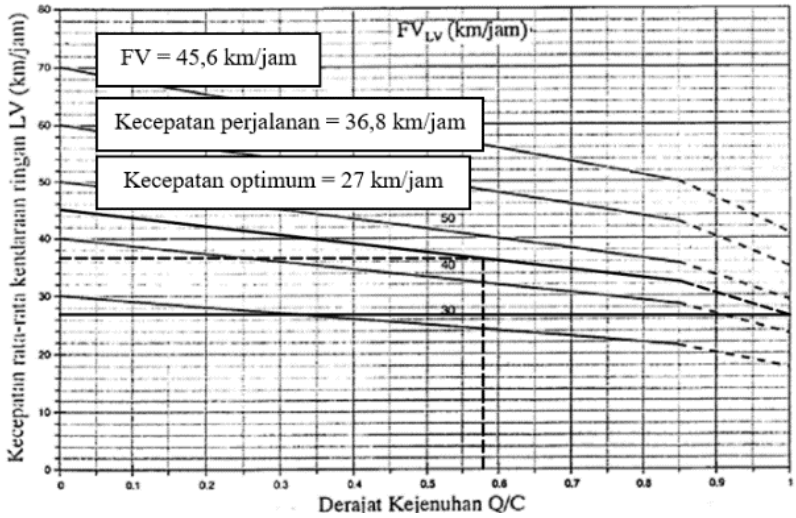

Figure 9. Optimum speed and travelling speed without markets

3.7 Comparison of Road Section Performance With and Without Market Activity

In the presence of market activity in the peak hour, traffic volumes have increased 1% more than without the market, while traffic volumes in the presence of market activity in the peak hour of side barriers have decreased 63% compared to without the market. Capacity in the presence of market activity in the peak hour traffic volume is 8% less than without the market, while capacity in the presence of market activity in the peak hour side obstacles is 18% less than without market activity. The degree of saturation in the presence of market activity in the peak hour traffic volume is 9% greater than without market activity, while the degree of saturation in the presence of market activity in the peak hour side obstacles is 55% less than without market activity. Speeds with market activity decreased by 36% and 48% compared to without market activity. This results in the presence of market activity making the speed decrease, the capacity becomes smaller, so that the level obtained at the level of service decreases, where the level of service with market activity is at level F and for the level of service without market activity is at level C.

4. CONCLUSIONS

Based on the results of the analysis and calculation of MKJI 1997 at Pasar Rahayu, the following conclusions can be drawn:

1. The performance of the section with the Rahayu Market activity, which was reviewed with 2 conditions, namely peak time Q of 1,857.35 smp / hour, C of 2,946.806 smp / hour, DS of 0.63, and V of 23.92 km / hour with level of service F. While for V at the peak time the side obstacle was 690.15 smp / hour, C of 2,626.501 smp / hour, DS of 0.26, and V of 19.2 km / hour with level of service F.
2. Performance of Jalan Imam Bonjol without Rahayu Market activities, obtained Q at peak time of 1,846.2 smp/hour, C of 3,203.05 smp/hour, DS of 0.58, and V of 36.8 km/hour with service level C.
3. The impact of the Rahayu Market activity on the performance of the road section is that the performance of the road section without market activity is better than the presence of market activity. Comparison of the performance of Jalan Imam Bonjol with and without Rahayu Market activity, where the traffic volume at peak hours with market activity has increased by 1% and decreased by 63% at the peak time of side obstacles. Capacity with market activity at peak hour traffic volume is 8% smaller and 18% at peak hour side obstacles. Degree of saturation with market activity at peak hour traffic volumes is 9%

greater and 55% less at peak hour side barriers. Speed with market activity is smaller by 35% and 48%, with the level of service obtained at levels C and F. This results in the presence of market activity making the speed decrease, the capacity becomes smaller so that the level obtained at the level of service decreases.

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