IMPACT ASSESSMENT OF TRAFFIC MANAGEMENT MEASURES IN THE VICINITY OF DE LA SALLE UNIVERSITY - MANILA

Danica C. CARPIO
Undergraduate Student
Civil Engineering Department
De La Salle University
2401 Taft Avenue, Manila
E-mail: danicaccarpio@gmail.com

Joshua Chris S. CHUA
Undergraduate Student
Civil Engineering Department
De La Salle University
2401 Taft Avenue, Manila
E-mail: jc.joshchua@yahoo.ca

Analyn A. DELA PENA
Undergraduate Student
Civil Engineering Department
De La Salle University
2401 Taft Avenue, Manila
E-mail: a_delapenaa@yahoo.com

Kervin Joshua C. LUCAS
Undergraduate Student
Civil Engineering Department
De La Salle University
2401 Taft Avenue, Manila
E-mail: lucaskervin@gmail.com

Alexis M. FILLONE
Associate Professor
Civil Engineering Department
De La Salle University
2401 Taft Avenue, Manila
E-mail: alexis.fillone@dlsu.edu.ph

Abstract: The streets in the vicinity of De La Salle University – Manila (DLSU-M) are always congested especially during peak hours. Despite the continuous effort of the local government of Manila to improve the traffic condition of the city, traffic congestion still becomes an everyday problem that commuters and private vehicle owners who pass through the vicinity of DLSU-M continue to face. Traffic congestion is primarily caused by the numerous trip generators and attractors like condominiums, institutions and commercial establishments which are found in the area. This study provides an assessment of the following traffic management measures through scenario modeling: converting a one way to two way street, and no on-street parking along certain streets. The four step model was utilized in this study and the traffic management measures were assessed using Emme for the purpose of scenario modeling. A calibrated network was used as basis for the current condition of the area of study where actual data were gotten from on board surveys, vehicle count among others. The scenarios modeled decreased the vehicle hour travelled (VHT) and vehicle distance travelled (VDT) by a large percentage where the basis of the study of having an effective traffic scheme is travel time. Based from the results generated by Emme, it can be concluded that traffic management schemes that would specifically clear the road of any obstruction such as on-street parking are the most effective schemes.

Keywords: Impact Assessment, Traffic Management Measures, DLSU, Traffic Congestion

1. INTRODUCTION

One of the busiest sections of Taft Avenue is from Quirino Avenue to Gil Puyat Avenue. The stretch houses major institutions like De La Salle University, De La Salle – College of Saint Benilde, St. Scholastica's College and Arellano University among others. These institutions attract people, commuters and car owners alike.

There are also trip generators and attractors located in the area of study. These include high-rise condominiums and hotels, commercial establishments and bus terminals. Additionally, Taft Avenue serves as a passageway to major cities surrounding Manila such as Makati, Pasay and Sta. Mesa, where airports, malls, socio-civic centers and other land use activities greatly attract people. Due to this and together with other factors, traffic congestion in the area of study, especially during peak hours, becomes inevitable.

Due to the numerous factors of traffic congestion that may be considered in the study area, and its direct effects on students, faculty, and staff of De La Salle University and the people in the vicinity as seen in Figure 1, the study will focus on the area between Quirino Avenue to Gil Puyat Avenue and from Adriatico Street to Bautista Street, also covering some area of Singalong Street.

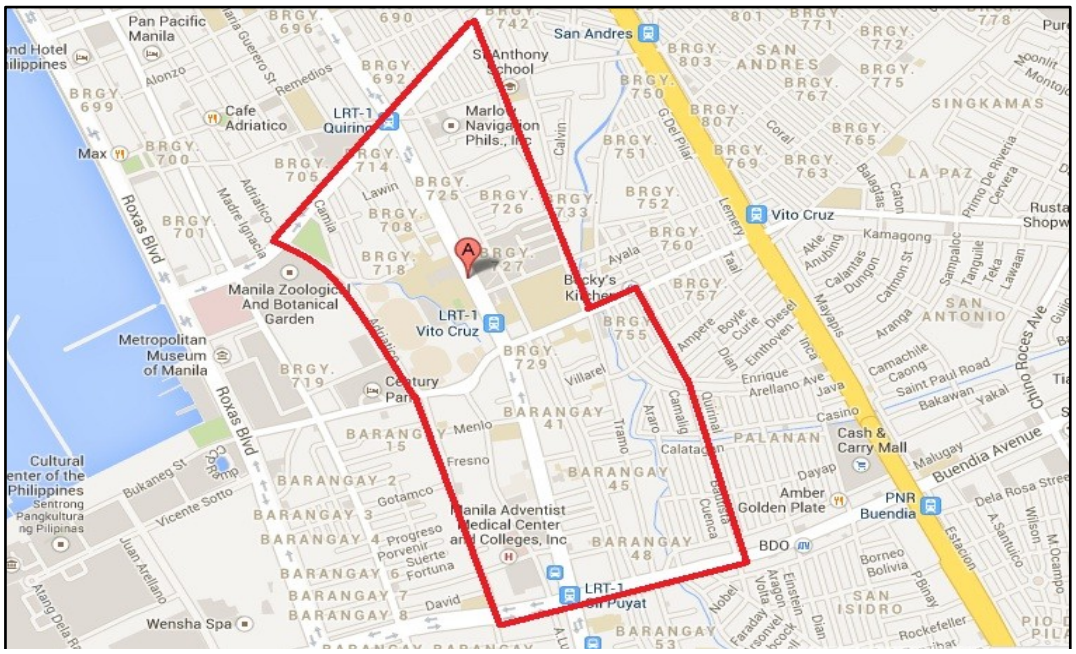


Figure 1 Vicinity Map of DLSU
(Source: Google Maps)

Traffic congestion causes students and workers to lose valuable time and money. It has been a continuous cycle that has yet to find its end. Traffic congestion has affected people passing along Taft Avenue and there is no immediate solution that could address the problem. Exploring the factors that contribute to the congestion in the vicinity of De La Salle University – Manila, the researchers will help assess the current traffic management measures implemented in the area. The process of assessment will eventually support proper recommendations to improve the movement of vehicles and lessen congestion.

The objective of this study is to model traffic management schemes in the vicinity of De La Salle University – Manila and estimate their impact. Specifically, it aims to identify the possible causes of traffic congestion in the vicinity of De La Salle University – Manila. It also aims to determine the travel characteristics of individuals travelling in the area given

their choice of transportation. It also aims to develop and assess the impact of traffic management scenarios on the traffic condition in the vicinity of De La Salle University – Manila. And lastly, it aims to recommend transport and traffic policies based from the results of the scenarios modeled.

The researchers wanted to address the continuous problem of clogged roadways during peak hours that caused delay not only to students of the university, but also to the motorists going to their destination. The purpose of this study was to recommend an effective policy that may help reduce the traffic congestion in the area. Regarding the existing traffic policies, the researchers would like to improve these since most of these policies are not being followed or observed. Aside from proposing a traffic management scheme to benefit the area, the group wanted to help students and drivers reach their destination with minimal delay by giving them the knowledge of how much time is wasted by traveling during peak hours around the area.

2. REVIEW OF RELATED LITERATURE

2.1 Traffic Congestion

A study done by Downs (2004) indicates that with traffic congestion, millions of dollars are lost due to the time wasted and additional gas expense. Peak-hour traffic congestion and its causes are discussed in the study together with strategies that can reduce traffic congestion, how to increase road-carrying capacity and creating additional transit systems. These elements are all important in this study because peak-hour traffic congestion is reflected by the condition of the roads around De La Salle University (DLSU). Investigating the causes of traffic congestion around the campus can help the researchers device a way to lessen it which may include increasing road-carrying capacities and adding or removing transit systems.

According to Johnston (1995), it is certain that the major urban congestion will worsen. He started his research due to the increasing demand for highway use. In the past, having this kind of problem on road congestion would be addressed by widening the existing roadways to accommodate more volume of passing cars. In large metropolitan areas, congestions on urban freeways were considered to be the most serious problems according to Nam (1998). He also states that it is important to develop transportation plans or policies that can help and benefit the current transportation system.

2.2 Transportation Network

Creput (2007) states that organization is needed in order to supplement the existing networks without hampering the traffic. Since there are several public transportation units available, it is much needed for each of it to have a systematic network to avoid congestion.

2.3 Transit System

A study by Vuchic (2007) in Urban Transit Systems and Technology is significant for this study because it discusses about transit systems in detail. It presents efficient design in a transit mode for urban areas. The study can help the researchers understand the different aspects of transit systems, most especially of jeepneys, buses, taxis and light rail transit. All of which is presently used around DLSU.

2.4 Effects of Kuliglig/Pedicabs

In a study done by Jayme et al. (2007), "Effects of Pedicabs and Kuligligs to the Roadways around De La Salle University – Manila", the interaction of cars and pedicabs/kuligligs was analyzed as well as their speed relationships. Through the use of videos, survey questionnaires and road trap segment, the objective of the study was met. This particular study by Jayme et al. (2007) responds to the need of the researchers to obtain the effect of pedicabs/kuligligs to the traffic congestion around DLSU. It was concluded that this illegal mode of transportation only worsens the traffic condition because they tend to scatter around the area without following traffic rules.

3. METHODOLOGY

The four step transportation planning approach was utilized to carry out traffic demand forecast for this study even in a microscopic setting as the objective of this study was to model traffic management scheme which will be done in EMME. The four step are: Trip Generation, Trip Distribution, Modal Split, and Traffic Assignment. The modeling software, EMME, was used to model the transport network of the study area. Moreover, actual data was gotten like travel time and peak count among others for calibration purposes and supplying the variables in EMME. The data was continued thru Dynameq for a microscopic analysis.

The first part of the data gathering process and analysis of data was getting actual data of the present condition to identify possible causes of traffic congestion. On board travel was used to determine travel characteristics of motorists in the area such as delay and travel time. By car, the floating car technique was utilized where the researchers traversed the area of study at least 5 times per peak and off peak hour during weekends and weekdays. During these times, travel time and stopping time were measured and other obstacles that may affect traffic congestion were noted. These ranged from the number of on street parking present in a certain lane to the number of pedicabs among others. On board travel by jeepney and LRT was done where travel time was also measured as well as passenger count. The traffic flow/speed of private and public transportation was computed by using the formula of distance traveled over time. The average speed of the actual data was compared with the average speed produced by the software.

Volume counts for vehicles and people were also utilized. Volume counts for vehicles were done at four key locations during peak hours: Quirino Avenue, Gil Puyat Avenue, Estrada Street, and Pablo Ocampo Street. This was to determine the most used mode choice of the motorist in the area in addition to the getting the peak count of people riding the LRT. Peak count for the three major institutions in the area and seven key condominiums, seen in Figure X, was gotten for regression analysis. Many key aspects of a condominium for trip generation such as the number of establishments present, the number of parking slots, floor area among others were noted. For the major schools for trip attractions, the student and faculty population, floor area, number of floors among others were noted.

The study area was divided into 16 zones. All three major schools institute to one zone each where the other zone was divided by land use. Populations for the schools that attract trips and condominium that generate trips were included in determining the Origin Destination

Matrix. The matrix was developed by counting the number of houses in a zone and multiplying it by 4.3 which is the average number of households in Metro Manila from the National Statistics Office (NSO). This is for the purpose of predicting the trips generated per zone and distributing them.

The second part of the study is the network modeling. The network was made via EMME for the purpose of scenario modeling. The main objective of this study was to model traffic management schemes in which EMME was utilized. Link and nodes were created by scaling the Google Map of the area to the software. Average speed, frequency, and volume were determined already from the actual data presented at the start of chapter five. Calibration was also presented to compare the rough estimates for the outputs of the software.

4. DATA ANALYSIS

4.1 On Board Private Vehicle

The floating car method was used to determine the travel time and delay peak and off peaks hour for weekends and weekdays. The behavior in terms of travel time can also be seen. The vehicle travelled at random routes where parameters such as running time and stop time were recorded.

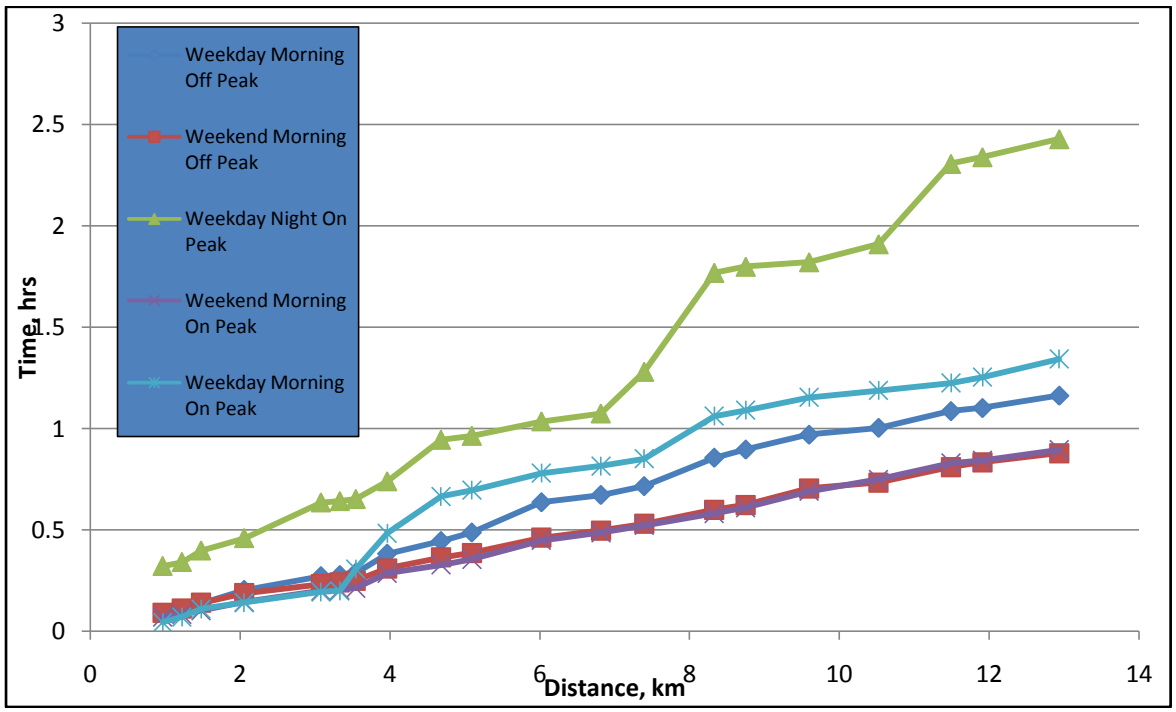


Figure 2 Graphs for Travel Time

Figure 2 above shows the behavior of the travel time for the five conditions. By observation, one can see that the travel time for the weekday night on peak is dramatically higher than the other conditions. As the researchers travelled on a weekday from 5:00pm – 7:00pm many areas were really congested thus taking a longer time to traverse road segments. This was possible because the majority of travelers were on their way home during this time. The most evident segment that was congested could be seen at segments 13 and 14. These streets were from Quirino Avenue to Vito Cruz Street and also after turning right from Adriatico Street to

Taft Avenue. One can see that those segments have a steeper line based from the graph as there was a higher travel time duration in the area. In other words, it took a longer time to pass those segments because of congestion occurred. Flat lines would show a generally faster travel time. It is also noted that during these times, the average speed was recorded to be the lowest of the five samples at 4.97 kph.

The behaviors of a peak and off peak of a weekday morning travel had an average speed of 11.05 kph and 10.93 kph, respectively. The average speed was between the weekday nights and weekend peak and off peak. On peak has a higher value of time as shown in the graph than off-peak. This is because there could be more people traveling to their desired destination at around 7 am – 9am than of the 9 am – 11 am period. At the off-peak period of a weekday, it is possible motorist are already at their destination during that time. Because of this, there would be less congestion in the streets.

Table 1. Average Speed of Segments

Segments		Actual Speed, kph
Taft Vito Cruz	Taft Buendia	22.36
Taft Buendia	Leveriza	9.49
Leveriza	Taft Buendia	14.75
Taft Buendia	Bautista	14.49
Bautista	Pablo Ocampo	16.48
Pablo Ocampo	Arellano	17.52
Arellano	Estrada	10.04
Estrada	Taft Estrada	6.31
Taft Estrada	Taft Quirino	7.45
Taft Quirino	Singalong	7.13
Singalong	Estrada	8.04
Adriatico	Quirino	8.93
Quirino	Taft Quirino	8.56
Taft Quirino	Taft Vito Cruz	7.11
Taft Vito Cruz	Leveriza	8.84
Leveriza	Gil Puyat	7.80
Taft Vito Cruz	Bautista	9.87
Taft Buendia	Taft Vito Cruz	8.89
Adriatico	Taft Vito Cruz	10.08
Bautista	Gil Puyat	9.23
Average		**10.67**

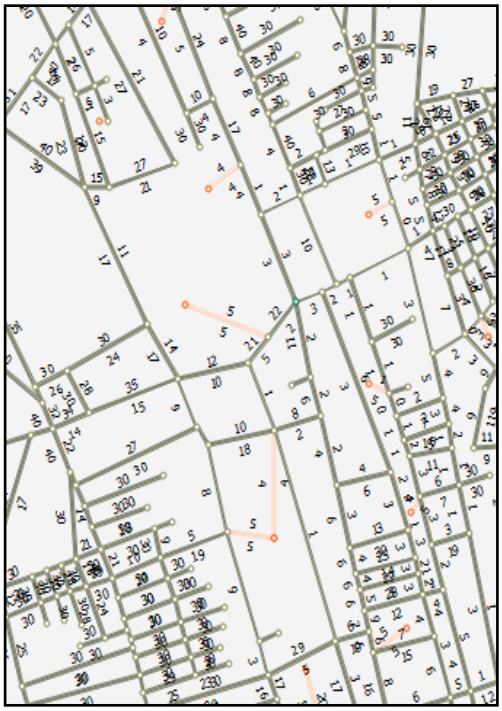


Figure 3. Average Speed in EMME

As seen from Table 1, the average speed for a fixed route was gotten to be 10.67 kph. From the software EMME in Figure 3, the average of the same route was determined to be 12.23 kph. This gives a percentage difference of 14.62% from the actual data to the modeled network.

4.2 Mode Choice Volume Count

The aim of volume count in this study was to identify the majority of the mode of transportation used. The data gathered helped the researchers determine which one should be

altered for the proposal of traffic management measures through the use of EMME. There were four point locations considered for the volume count of this study. These locations were near the intersections of Taft Avenue –Quirino Avenue, Taft Avenue -Vito Cruz Street, Taft Avenue – Estrada Street and Taft Avenue – Buendia Avenue. These were the chosen locations because of the observed worse traffic congestion on these streets during peak hours than the roads parallel to them. These intersections were also the crossroads of the major streets included in the study.

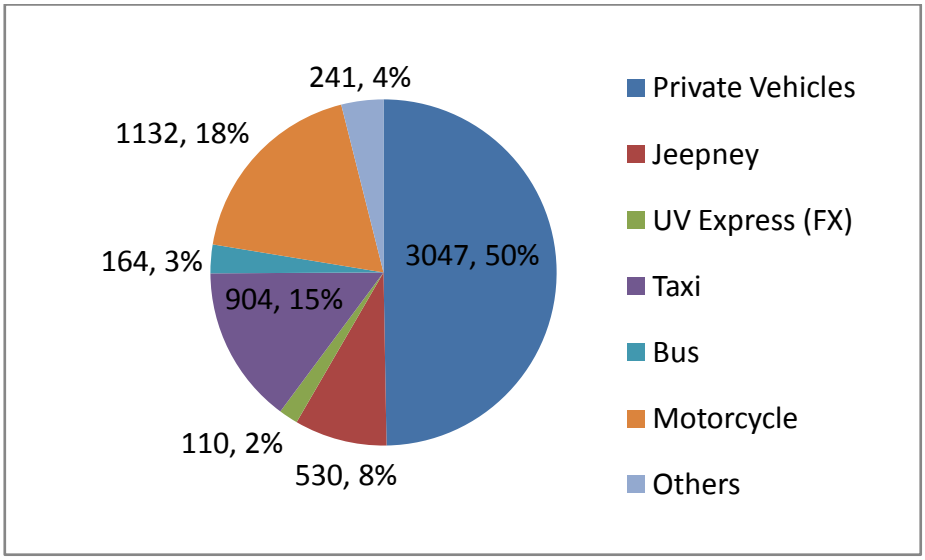


Figure 4 Total Peak-Hour Volume for the all Locations

The peak-hour was determined to be from 8:00am to 9:00am with Taft-Buendia Avenue having the largest volume with 2977 total vehicles while Taft-Quirino Avenue got the lowest volume count with 936 vehicles (Figure 4). The huge difference was accounted to the buses passing along Taft-Buendia Avenue. Buses were not present at the other three locations since they were banned by the municipality. In Figure 4, the distribution of the volume of vehicle per type is seen. It was clear that private vehicles constitute majority of the vehicles passing through the area of study during peak hour. 3047 private vehicles were present during the data gathering which is almost three times of that of the second highest count with 1392 vehicles.

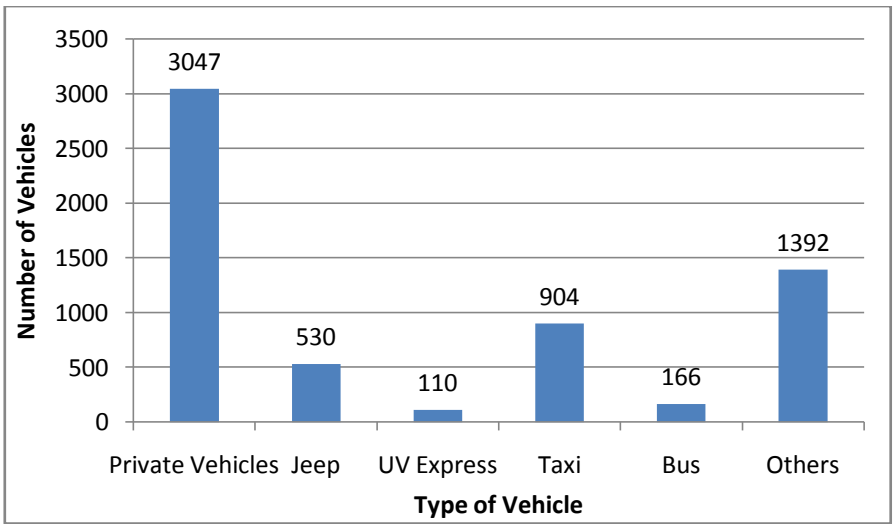


Figure 5 Volume Count According to the type of Vehicle

The term others was used as a name for motorcycles and pedicabs/kuligligs which may have passed along the area. Surprisingly, they made up 1392 of the volume count for peak-hour, followed by 904 taxis, 530 jeepneys, 166 buses and 110 UV Express. The small number of UV Express vehicles was caused by the limited route they traverse along Taft Avenue from Buendia Avenue to Quirino Avenue. Jeepneys that passed through the area of study reached until ten routes. Although private vehicles caused much of the traffic congestion in the area of study, the amount of motorcycles and pedicabs/kuligligs could be considered a threat if not properly organized.

4.3 Present Condition

Figure 6 shows the land use map of the study area. Most of the land-uses in the area were for residential purposes but a concentration of institutional and commercial establishments in the area is shown near Taft Avenue and Pablo Ocampo Street. This is an indication that most of the trips were attracted in the said area.

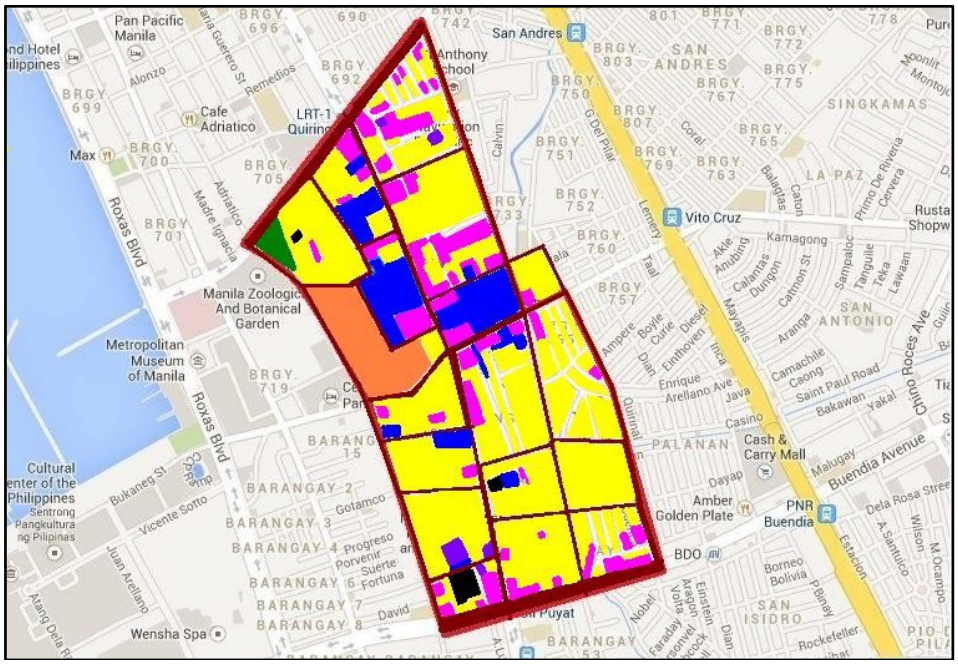


Figure 6 Land Use Map

LEGEND: Green – Recreational Park, Orange – Government Owned Sports Facility, Yellow – Residential, Pink – Commercial Establishment, Blue – Institutional, Violet – Medical Center/Clinic, Black - Church

As seen in figure 7, the area of study was divided into 16 zones. Major trip attractors like De La Salle University was given one zone (zone 14) with some establishments like EGI Taft Towers being a part of it. Zone 6, 7 and 8 consisted of primarily residential houses with local commercial establishments. Zone 5 houses schools like St. Scholastica College and the main building of College of Saint Benilde.

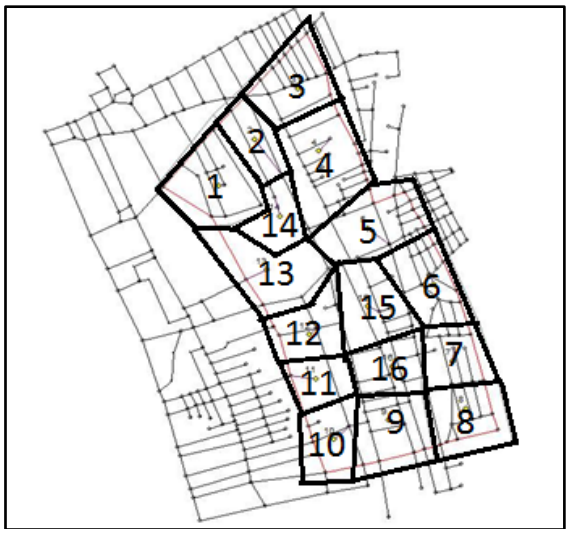


Figure 7 JICA-Strada Map with Zoning

It is to take note that node 363 (See Figure 8) has a dramatically high bar showing that this area attract trips the most. This is true as De La Salle University attracts students and workers alike where this zone also generate trips with residential establishments such EGI Taft Tower and other condominiums and dorms are located. Similar to node 363 is Node 367. Major institutional establishment could be located in this node being College of St. Benilde School of Design and Arts. As there are many students in the area, many commercial and residential establishments are found. The area around node 368, 372, and 373 are primarily residential with local commercial establishments to benefit the residence. As such, trip generation at that area would be greater than those that are attracted. This is also true for nodes 369, 370, 359 and 361 where 362 houses many condominiums and dormitories that produces trips naming Manila Dorm, Ivy Hill Residences and much more.

Node 371 is located at Buendia Avenue where there are many commuters changing modes to reach a desired destination from the LRT, Provincial Buses, Jeepneys, and much more attract more trips. For node 360, there are many recreational areas that would attract trips like the Paraiso ng Batang Maynila.

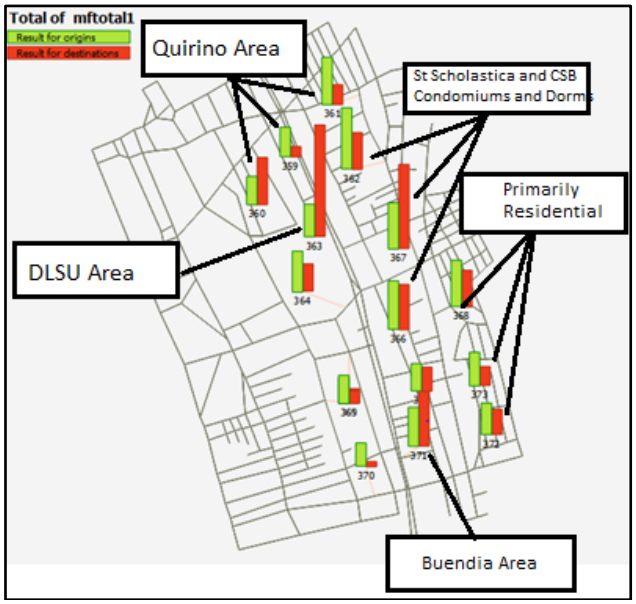


Figure 8 Results for Origin Destination

There are volumes that accumulate centrally at Vito Cruz Street - Taft Avenue Intersection. This is because the area houses many commercial establishments, major schools, many modes of travel to transfer, among others. Figure 8 shows how these volumes are divided. Majority could be found coming from the north (Quirino Avenue) splitting off partly to Roxas Boulevard. There are more that travel to Pablo Ocampo Street while others head straight going to Buendia Avenue. Majority from Buendia Avenue would head straight going to Quirino Avenue for numerous purposes.

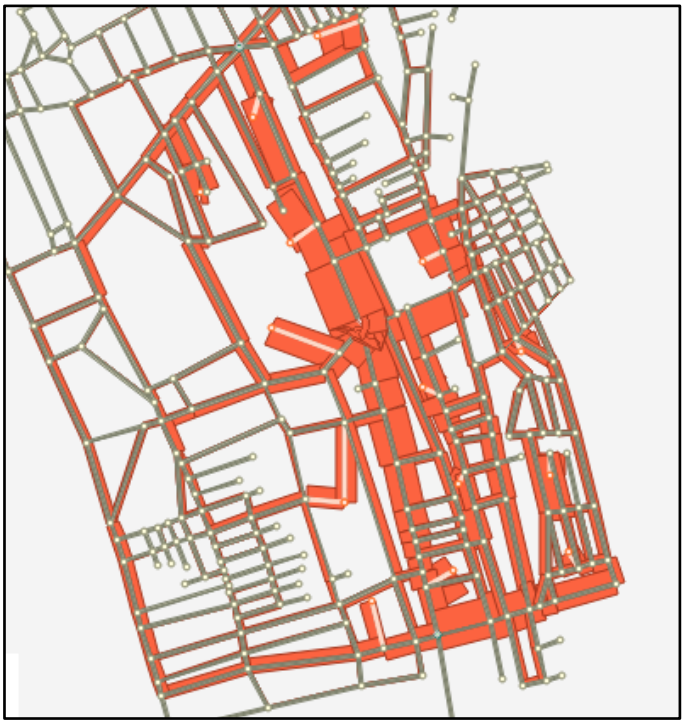


Figure 9 Volumes on links and turns

Figure 10 compares the actual count with the network calibrated with the speed (Figure 3) and volume count. The count is within a plus minus 20% difference with the model for each direction which shows good behavior in the network. The Vito Cruz intersection was used in calibration as it is the critical intersection in the study area.

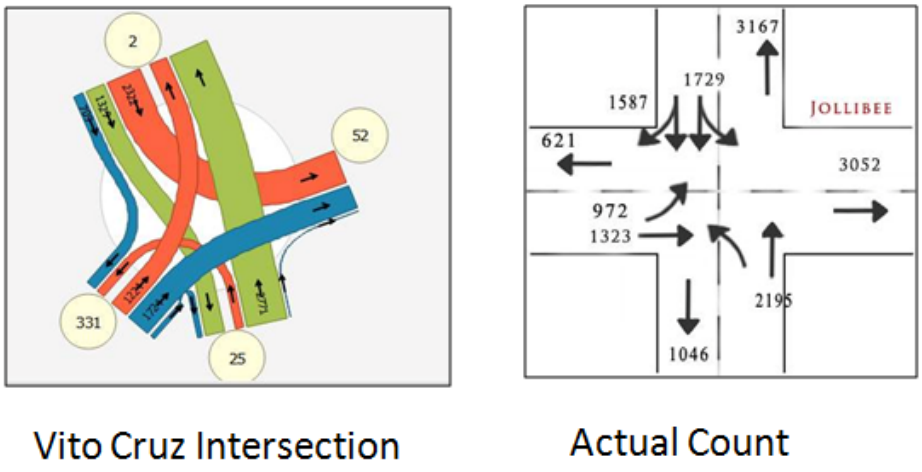


Figure 10 Calibration of Present Condition

4.4 Scenario Modeling

The scenarios to be modeled are presented below:
Scenario 1: Change Pablo Ocampo Street from one way to two way
Scenario 2: No On Street Parking Along Estrada Street and Singalong Street
Scenario 3: Change Estrada Street from one way to two way

4.5 Change Pablo Ocampo Street from one way to two way Street

As seen from Table 2, just by making Pablo Ocampo Street a two way lane, it showed positive effects to the Vehicle Distance Travel by decreasing it by 14%, the Vehicle Hour Travel by decreasing the value by 9% and the time it takes for a vehicle to pass around by 8%. Though average speed increased by 3%, it is to take into consideration the time a vehicle would travel. People would prefer to travel at a lesser time to reach their destination early and save consumption of fuel. Many may prefer using a shorter route by passing Pablo Ocampo Street from the School of Design and Arts side as it could be seen that volume increased, than traveling a bit more to Estrada Street to reach their destination. Or Estrada Street itself is too congested so motorist would turn to Pablo Ocampo Street. The Buendia Avenue area's volume decreased as motorist again changed routes with the lesser distance now being traveled. As seen from the present condition, the time it takes for a full travel in the area of study would take 42 mins. From the actual observation during the on board travel survey, it took an average of 45 mins to transverse the study area.

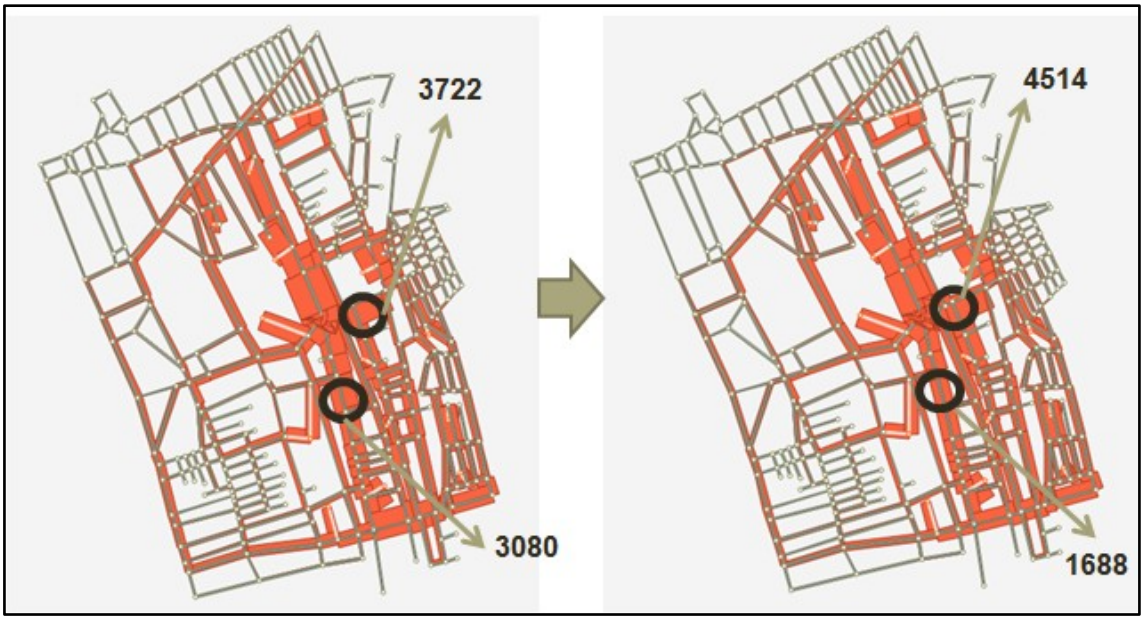


Figure 11 Pablo Ocampo St. to Two-way Volume Change

Table 2. Percentage Change from 1- Way Pablo Ocampo St. to 2 - Way

	Vehicle Distance Traveled (VDT)	Vehicle Hour Traveled (VHT)	Average Speed, kph	Time, min
Present Condition	2159778	835158	21.84	42.62

Scenario 1	1841806	↓14.71	764411	↓9.67	22.64	↑-3.66	39.06	↓8.35

4.6 No On Street Parking Along Estrada St. and Singalong St.

Though removing on street parking at Singalong Street and Estrada Street does not have an effect on the VDT, it does have a huge change in VHT by 17% and travel time by 10%. This was done by declaring the roads as one lane. Because of on street parking, lanes were originally declared as three lanes. With a much more space, vehicle would worry less of friction caused by on street parking. They would travel faster with more lanes to take space off. As stated, one should take into account time in traffic assessment.

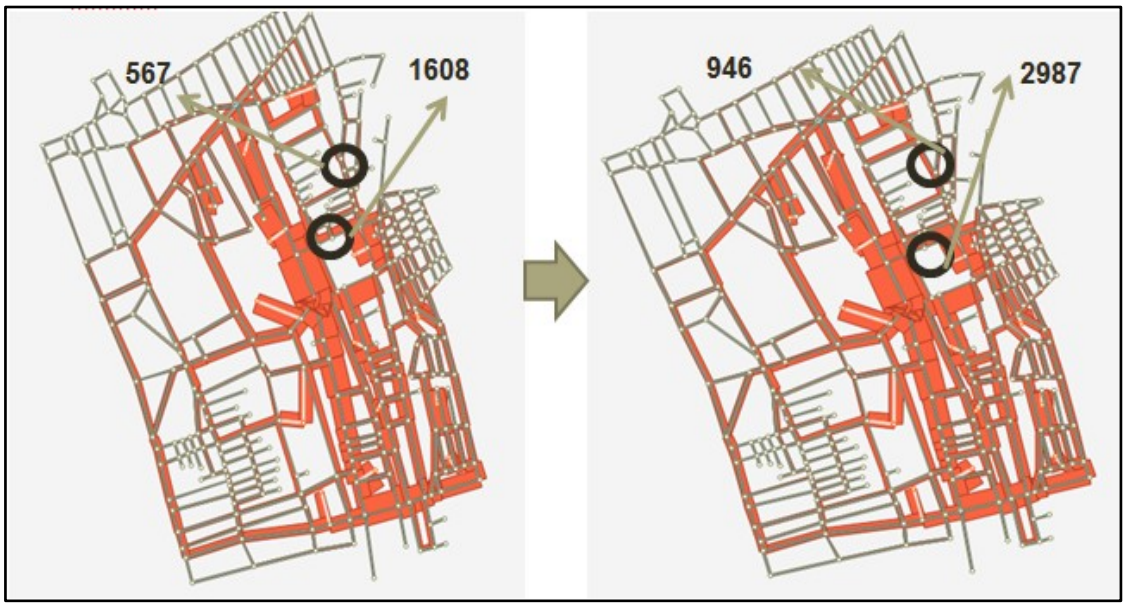


Figure 12 No Street Parking along Singalong Street and Estrada Street Volume Change

Table 3. Percentage Change of No Street Parking Along Singalong and Estrada Street

	Vehicle Distance Traveled (VDT)		Vehicle Hour Traveled (VHT)		Average Speed, kph		Time, min	
Present Condition	2159778		835158		21.84		42.62	
Scenario 2	2108366	↓2.38	680277	↓18.55	21.98	↑-0.64	38.08	↓10.6

4.7 Change Estrada Street from one way to two way

The three major institutions included in this study are all part of Estrada St., therefore many vehicles pass through this area making it one of the most busiest streets in the area of study. Due to the frequency of vehicles passing through, an alteration of Estrada Street from being a one way street into a two way street was made. By doing so, there was a change of volume in Estrada Street from 2374 vehicles to 3408 (Figure 13). This may have been caused by people trying to reroute their vehicles to Estrada because it was turned into two way. Since there was an increase in volume in Estrada Street, a decrease in volume along Taft Avenue was observed. From 3996 vehicles, it dropped to 3403 vehicles. This scenario was able to decrease Vehicle Distance Traveled (VDT) by 1.38% while Vehicle Hour Traveled by 0.36%

(Table 4). This only shows that changing Estrada Street from one way to two way did not make a huge impact to the traffic congestion in the vicinity of DLSU-M.

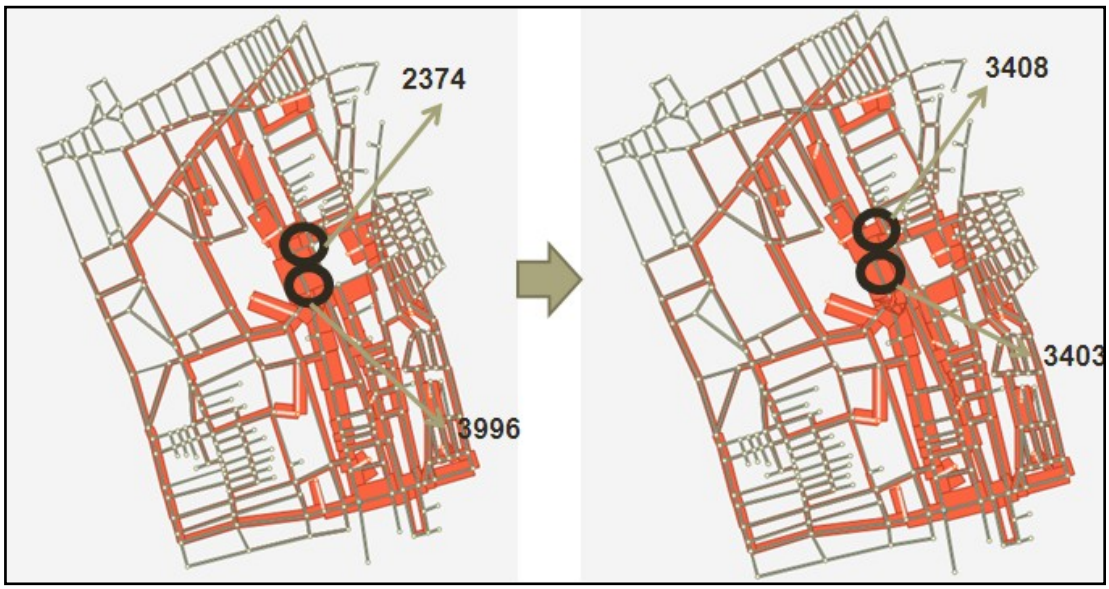


Figure 13 Estrada Street became Two Way Volume Change

Table 4 Percentage Changes when Estrada Street became Two Way

	Vehicle Distance Traveled (VDT)		Vehicle Hour Traveled (VHT)		Average Speed, kph		Time, min	
Present Condition	2159778		835158		21.84		42.62	
Scenario 3	2129944	↓1.38	832215	↓0.35	21.94	↑-0.46	42.37	↓0.59

4.8 Scenario Summary

As seen from Table 5, changing Estrada Street from a one way lane to a two way lane had little effect to the model. Instead of becoming beneficial to the network, it could have caused more traffic concluding that the scenario is ineffective. Prohibiting on street parking along Estrada Street and Singalong Street and turning Pablo Ocampo Street to two way lane would be the most beneficial to reduce congestion as it could be seen that travel did improve in VDT and VHT. It would also be easier to implement such actions and we recommend those who are affected by the no on street parking along the given area to simply find available parking space near the area or provide a parking lot on a nearby vacant lot. It is possible that this proposed traffic management measure would affect positively or negatively the surrounding areas not considered in the study but this effect would not be considered and could simply used for possible studies in the future.

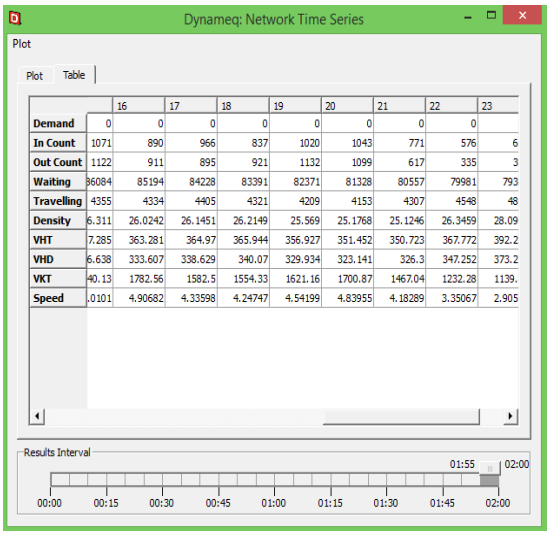
Table 5 Percentage Changes when Estrada Street became Two Way

Scenario	Vehicle Distance Traveled (VDT)	Vehicle Hour Traveled (VHT)	Average Speed, kph	Time, mins
Present Condition	2159778	835158	21.84	42.62

1	1841806	↓14.71	764411	↓9.67	22.64	↑-3.66	39.06	↓8.35
2	2129944	↓1.38	832215	↓0.35	21.94	↑-0.46	42.37	↓0.59
3	2108366	↓2.38	680277	↓18.5	21.98	↑-0.64	38.08	↓10.6

4.9 DYNAMEQ MODELING

Because the area is relatively small, the network was continued thru Dynameq. The modeling in EMME was for the purpose of scenario modeling. The Dynameq outputs were able to support the outputs from EMME as the behavior is similar. Instead of the four step approach, the user equilibrium was utilized in this approach.



	16	17	18	19	20	21	22	23
Demand	0	0	0	0	0	0	0	0
In Count	1071	890	966	837	1020	1043	771	576	6
Out Count	1122	911	895	921	1132	1099	617	335	3
Waiting	86084	85194	84228	83391	82371	81328	80557	79981	793
Travelling	4355	4334	4405	4321	4209	4153	4307	4548	48
Density	6.311	26.0242	26.1451	26.2149	25.569	25.1768	25.1246	26.3459	28.09
VHT	7.285	363.281	364.97	365.944	356.927	351.452	350.723	367.772	392.2
VHD	6.638	333.607	338.629	340.07	329.934	323.141	326.3	347.252	373.2
VKT	40.13	1782.56	1582.5	1554.33	1621.16	1700.87	1467.04	1232.28	1139.
Speed	.0101	4.90682	4.33598	4.24747	4.54199	4.83955	4.18289	3.35067	2.905

Figure 13 and 14 Dynameq Modeling

In Figure 15, it could be seen that implementing a no on street parking along Singalong and Estrada Streets would be beneficial in speed for a two hour interval as it shows a faster behavior in comparison to the present condition. Because removing obstructions in a lane would remove friction, speed improved. As for implementing a two way Estrada street, it did not benefit the network as speed decreased after an hour.

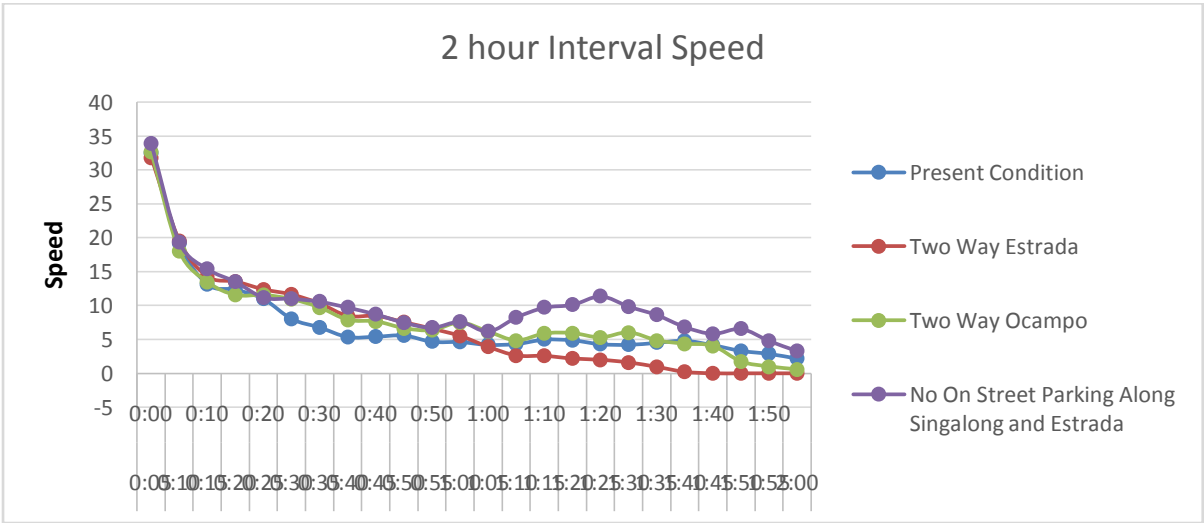


Figure 15 2 hour Interval Speed

Figure 16 and 17 shows the same behavior for both VHD and VDT 2 hour interval. Having smaller values in respect to the present condition shows positive effects in the network. In comparison to the output of EMME, they have similar outputs in rough estimation.

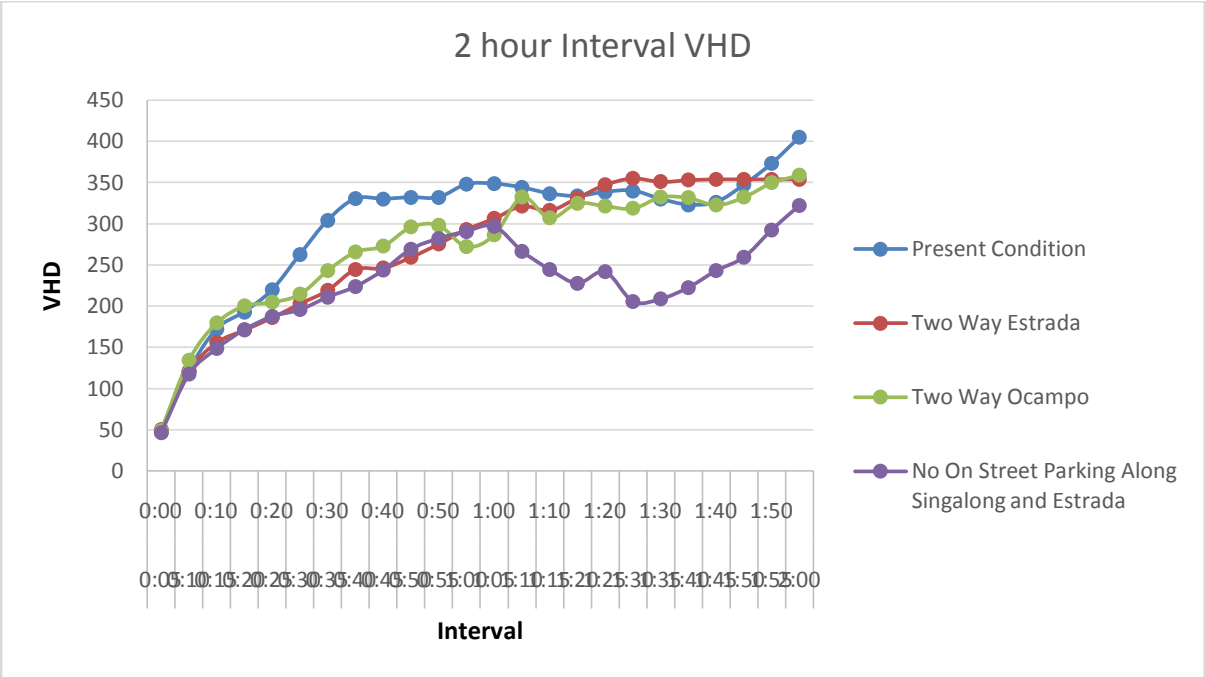


Figure 16 2 hour Interval VHD

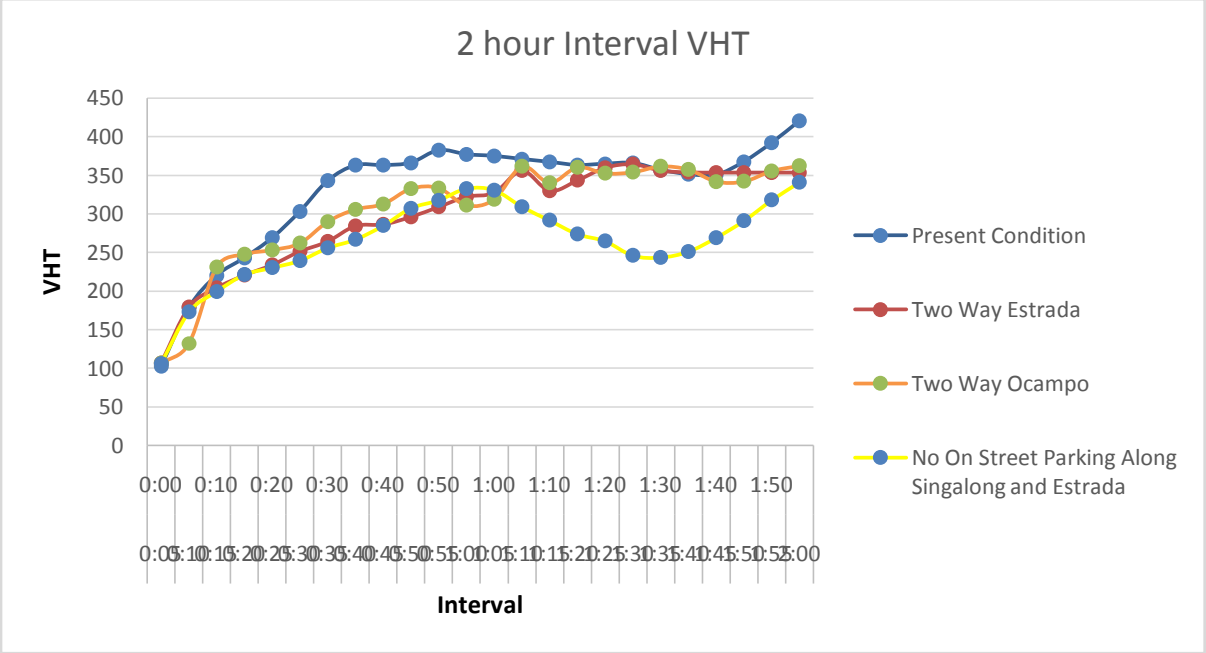


Figure 17 2 hour Interval VHT

5 CONCLUSION AND RECOMMENDATION

Three scenarios were developed for the purpose of this study based from the observations the group had seen in the present condition. It was observed through volume counts and on board travel surveys that one way areas like Pablo Ocampo St. and Estrada St. were too congested so the researchers decided to change its conditions by turning them into two way roads. It

was also seen that along Estrada St. and Singalong St., roadside friction are heavy due to the on-street parking so the group also decided to do a scenario, modeling no on-street parking allowed along the area. It can be concluded that Traffic management schemes that would specifically clear the road of any obstruction such as on-street parking are the most effective schemes.

Scenarios were modeled using EMME. VDT and VHT were used in the assessment process. It was seen that a two way Pablo Ocampo St. and no on street parking along the given area are beneficial as it decreased the parameters like VDH, VHT and travel time. Turning Estrada St. to two way street had little effect on the model and might cause problems in the network when implemented.

The group recommends implementing a no on-street parking along Singalong St. and Estrada St. and turning Pablo Ocampo St. to a two way road as seen from the positive effects presented in the area. Effects from outside the study area were not considered when modeling the scenarios. The estimated impacts are only effective within the study area. The local government could be responsible in implementing this. As such, the Manila City Hall in cooperation with the MMDA could improve this study to benefit the area.

It was concluded that implementing a no on street parking along Singalong St. and Estrada St. and turning Pablo Ocampo St. to a two way road are most beneficial. In doing so, it may affect traffic flow and the behavior of motorists within the study area. Those motorists that park along Singalong St. and Estrada St. would have to relocate. The researchers recommend finding a possible empty lot near the area for parking.

The researchers did not consider the effects outside the study area. This could be included in future studies. The researchers recommend continuing this study by adding external factors that could affect the area of study. This could be done by widening the area of study to include adjacent zones because the total population in the study area during peak hour constitutes both people that lives within and outside the zone.

ACKNOWLEDGEMENT

We would like to take this opportunity to express our gratitude to everyone who helped us in making this research meaningful. Thank You to our Abba Father for bringing us this far in our study. We would like to thank our thesis adviser, Dr. Alexis M. Fillone, for his guidance and never ending patience for our group

REFERENCES

Bonneson, James A. (1992). Change Intervals and Lost Time at Single Point Urban Interchanges. Journal of Transportation Engineering, 118, 631-651.

Bullok.Darcy and Quiroga, Cesar A. (1999).Measuring Control Delay at Signalized Intersections,125, 271-281.

Creput, Jean-Charles and KoukamAbderrafiaa (2007).Interactive Meshing for the Design and Optimization of Bus Transportation Networks.Journal of Transportation Engineering, 133,529-539.

De La Salle University - Manila. (2012). Quick facts and figures. Retrieved from http://www.dlsu.edu.ph/inside/default.asp

Downs, Anthony (2004). Still stuck in traffic: Coping with peak-hour traffic congestion. Virginia: R. R. Donnelley.

Jayme, Jamiel L. & Sia, Paul Angelo C. (2011). Effects of pedicabs and kuligligs on the capacity of the roads in the vicinity of de la salle university. Manila: De La Salle Uniersity.

Johnston, Robert A., et al (1995). Capacity-Allocation Methods For Reducing Urban Traffic Congestion. Journal of Transportation Engineering, 121, 27-37

Lee, Young-Jae and Vuchic, Vukan R. (2005).Transit network design with variable demand.Journal of Transportation Engineering, 131, 1-4.

Levinson, David M. (1998). Speed and Delay on Signalized Arterials. Journal of Transportation Engineering, 124, 259-271.

Lo, H. K., Chow, A., (2003). Control strategies for oversaturated traffic. Journal of Tranportation Engineering, 128, 4-6.

Nam, Do H. and Drew, Donald R. (1998). Analyzing Freeway Traffic Under Congestion: Traffic Dynamic Approach. Journal of Transportation Engineering, 124, 209-213

National Statistical Coordination Board. (2011). [Table of registered vehicles from year 2003 to 2011]. Rail, Water, Land and Air Transportation Statistics. Retrieved from http://www.nscb.gov.ph/secstat/d_trans.asp

Rakha, H., Ding, Y. (2003). Impact of stops on vehicle fuel consumption and emissions.Journal of Tranportation Engineering, 129, 1-3.

Sia, Ronald, et al. (2002). Trip attraction of condominiums in metro manila. Manila: De La Salle Uniersity.

Traffic Volume Counts. Manual Count Method. Retrieved from http://www.ctre.iastate.edu/pubs/traffichandbook/3trafficcounts.pdf.

Travel time data collection Handbook. Chapter 3-Test Vehicle Technique. Retrieved from http://www.fhwa.dot.gov/ohim/handbook/chap3.pdf

Travel time data collection Handbook. Chapter 4-Tlicense plate matching technique. Retrieved from http://www.fhwa.dot.gov/ohim/handbook/chap4.pdf

Vuchic, Vukan R. (2007). Urban Transit Systems and Technology. New Jersey: Wiley & Sons, Inc.