Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 1116 - 1131, 2005

ANALYSIS OF MODE CHOICE BEHAVIOR OF STUDENTS IN EXCLUSIVE SCHOOLS IN METRO MANILA: THE CASE OF ATENEO DE MANILA UNIVERSITY & MIRIAM COLLEGE

Mark P. DE GUZMAN
Assistant Professor
Department of Civil Engineering
Saint Louis University
Baguio City, Philippines
E-mail: mark_deg73@excite.com

Crispin Emmanuel DIAZ
Assistant Professor
School of Urban & Regional Planning
University of the Philippines
Diliman, Quezon City, Philippines

Abstract: The advantages of mobility and access of the automobile has led to the growth of car usage in recent years which in turn has contributed greatly to the worsening of the traffic situation in Metro Manila. One solution revolves around getting people to use public transport and leave their cars at home. However, there are concerns, which have to be addressed in order to make this shift a reality. This study explored the relationships between travel patterns and their willingness to adopt an alternate mode. The study explored the economics of carpooling with respect to the nature of participation (whether they would participate as a donor-allow other people to share in the use of their vehicle, or as passengers-ride share with other car owners, for a fee.).The result is that a program of ride-sharing which addresses the costs of the vehicle operation for usage appears viable and worth further investigation.

Key Words: Mode Choice, Behavior Modeling

1. INTRODUCTION OF THE STUDY

1.1 The Problem and its Background

Metro Manila

Metro Manila being the National Capital Region (NCR) has a total land area of 636 km^2 which is 0.2% of the total land area of the Philippines. It has a rapid population increase wherein according to the 1995 census, about 13% of the total Philippine population, or about 9.45 million population is concentrated in the Metropolitan. These statistics have significantly triggered the rapid growth of the Metropolitan's urbanization beyond its formal boundary. Like the other big cities of developing countries, Metro Manila has its own share of urban problems caused by rapid urbanization. The enormous growth of its urban area resulting from an unprecedented scale of economic development and accelerated increase in population has created a big demand for mobility. This in effect imposed a heavy strain on the existing transportation system and consequently, increased the levels of motorization despite the persistence of government planners to manage its growth.

The increase in Metro Manila's population and its dominant commercial and industrial activities has enabled the provision of an efficient urban transportation for maximum mobility within and around the metropolis. Consequently, the ensuing urban transportation demand has put pressure on government to implement improvement and upgrading of transportation services and traffic facilities. Closely related in population is the increase in employment and school population in Metro Manila.

1.1.1 Passenger Movements

The 1996 total number of daily trips of residents in Metro Manila was 17.5 million according to the results of the person-trip surveys in MMUTIS (Metro Manila Urban Transport Integration Study). It showed 65% increase from 10.6 million trips in 1980. During the period of 1980-1995, the Metro Manila population increased at 9.5 million from 6 million.
In terms of trip direction, made by residents in the study area, the number of daily trips with both origin and destination located inside Metro Manila was calculated at 16.6 million. On the other hand, the number of daily trips between Metro Manila and its adjoining provinces, such as Bulacan, Rizal, Cavite and Laguna, which are experiencing rapid urbanization, was 2.1 million.
The trip rate per person in Metro Manila was calculated at 2.11 trips per day. This figure is similar with the one of Bangkok, the capital city of Thailand, at 2.22 trips per day.
The total shares of public transport modes were calculated 70.2% of the total. The urban transport depended highly on public transport modes. 38.7% or 6.7 million trips were made by jeepney, 16.6% or 2.9 million trips by bus and 12.7% or 2.2 million trips by tricycle. However, the shares of PNR and LRT were still low, and most of the passenger movements were served by road based modes such as buses and jeepneys.

Quezon City

Development in Quezon City is inevitable. Urban population increase and fast commercialization in EDSA adheres to major CBD's in Metro Manila. Fast commercialization in Quezon City also led to the development of Katipunan Road to be a major route; thus, traffic congestion will be a major problem in this City.
Quezon City is situated immediately northeast of Metro Manila, 11 kms. from the seaport and 20 kms. from the international airport. The traditional business districts of Binondo and Divisoria are about 10 kms. from the City center, Makati Commercial Center is 15 kms. south while the newly emerging Ortigas Center is just at the City's south border. Quezon City is the largest of the six cities and seventeen municipalities in Metro Manila. Sprawling over 15,106 hectares, it covers one-fourth of the National Capital Region's land area. With an estimated population of 1,854,943 as of 1993, the city represents 21.45% of Metro Manila and 2.85% of the Philippines. It has a growth rate of 3.6 percent per year compared to the National Capital Region of 2.69%. This led to an implication that Quezon City will need more commercial establishments to cater the needs of the growing urban population. There is also a need to improve transportation facilities for a more efficient system of living.
Transportation within Quezon City as in most parts of Metro Manila is purely land-based. It is linked to all urban and commercial activities in the region by three of the five major circumferential roads, and three of the ten big radial routes. The construction of the Light Rail Transport (LRT-3) along EDSA from West Avenue to Parañaque with central depot at North Triangle is expected to be completed by the year 2000. Improvement of access and mobility in Tandang Sora area is foreseeable with the completion of Mindanao Avenue extending to Visayas Avenue towards North Fairview. Moreover, continuation of Katipunan linking Luzon Avenue and Republic Avenue towards and beyond the North Diversion Road

is being pursued under the C-5 project. Development of Katipunan Avenue will be a main thoroughfare in terms of trip purpose .
The core of transportation are access to activity sites. This means that the population establishes proximity to places of work, recreation, socializing, shopping, and school.
In transportation planning, individual passenger trips are often classified by the purpose of the trip and the trip origin. Common home based trip types include:

a. ***Work Trips***. Trips made to a person's place of employment such as a factory, a store, or an office.
b. ***Shopping Trips***. Trips made to retail establishment regardless of the size or type of purchase. Trips made to a store "just to look" are shopping trips even though no purchase is made.
c. ***Social or recreational trips***. Cultural trips made to recreational or entertainment facilities (e.g., church, civic meetings, concerts, sporting events). Travel to social activities (parties, visiting friends) would be included.
d. ***Business Trips.*** Trips made in the course of performing a normal day's work. The origin of such trips is often the place of employment.
e. ***School Trips***. Trips made by the students to an institution of learning.

Dominant factors that may cause traffic congestion in the Metropolis citing the importance of trip purpose are work trips, shop trips during weekends, and school trips. The analysis of trip purpose will able to establish Travel Demand Measures in the reduction of traffic congestion since trip purpose will result to mode choice.
A distribution of these trip purpose (discounting walk trips and "to home" trips) reveal that work trips occupy 3,709,000 million or 31% of the total population in Metro Manila and followed by "to school trips" with 2,966,000 million or 25% of the total population as shown in figure 1.

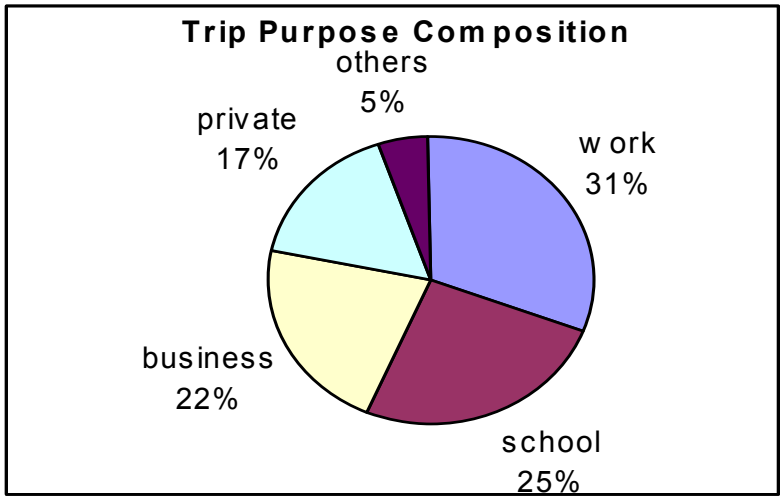


Figure 1 Trip Purpose Composition (Excluding "to home and walk trips

Table 1 shows modal share by trip purpose based from figure 1. This enables us to compare the modal split by this study wherein an analysis of car users against the public transport will be done. An interpretation of the table shows that majority of the people uses the public transport but private modes in the business trips is quite equal in terms of mode split where

43% composes it while 57% are for the public transport. For "to school trips", 20% uses the private mode while 80% uses the public transport mode. The study also determines the mode split between car usage and public transport for "to school" trips along Katipunan Road.

Table 1 Modal Share by Trip Purpose

Trip Purpose	Private		Public				
	Car	Others	LRT/PNR	Jeepney	Tricycle	Bus	Taxi
To Home	16	6	3	39	14	16	6
	22%		**78%**				
To Work	20	8	3	34	6	24	5
	28%		**72%**				
Business	25	18	1	24	13	5	14
	43%		**57%**				
To School	10	10	3	46	21	8	2
	20%		**80%**				
Private	21	3	2	42	12	13	7
	24%		**76%**				

School trip behavior is a key factor collecting trip generation as well as trip distribution taking into account that varying schedules of students specifically the tertiary level which tend to affect traffic flow any minute of the day. Travel demand is distributed unevenly throughout the day where trips are significant in the morning between 7 to 8 A.M. and in the afternoon between 4 P.M. to 6 P.M. Since this study deals with school trips, noon time between 11 A.M. to 1 P.M. is also take into account. Primary and secondary levels have a fixed schedule wherein these students comes to school at a fixed schedule in the morning , noon , and afternoon dismissal. Hence, a consideration of "peak hours" in relation to traffic flow along a road network is necessary.

Looking back at figure 1, work trips dominate the urban transport sector; thus, we can say that “to work” trips contributes much to traffic congestion in the metropolis. There were past studies regarding the analysis, solution, and recommendations for the problem such as: flexible work hours, staggered work hours, four-day (or compressed) work week, and job sharing/ part – time work, which were becoming common as a TDM measure in the United States as well as in West Germany. There were also studies linking “to shopping” trip behaviors which links commodity traits as an attribute to peoples needs in terms of daily living that enables them to have a variety of choice of shopping outlets. Thus, more urban travel leads to traffic congestion.

Katipunan Avenue will be a good study in terms of the analysis of travel patterns especially for school trips. Ateneo de Manila and Miriam College are located near the road network itself where it contributes much to the traffic problem in addition to car users leaving the campus; thus, delay in traffic flow in the main road
is too long.

In this study, the researcher will focus on the travel patterns and mode choice behavior of the students along Katipunan Road. Moreover, an analysis to its contributions to traffic congestion will also be studied.

1.2 Objectives of the Study

The analysis would focus on trip behavior of students by data acquisition.

Specifically, this paper aims to:

1.2.1 Analyze the trip patterns of students in the study area.

a. departure time from home to their first class.
b. lunch time location preferences that may contribute to peak hour congestion at noon time especially in the study area.
c. departure time from last class to their home or other trip purpose.
d. access roads they usually take leading to the study area.
e. parking preferences.
f. actual travel time, travel cost, and waiting time.
g. the number of mode combinations they use with regards to public transport use and the number of mode transfers.
h. the Origin Destination (O-D) trip for the purpose of comparing their actual travel time to the proximity of home to destination.

1.2.2 Model the mode choice for such trips.

The mode choice behavior of the students will now be analyzed for "to school" trips only. The study will create a model that will determine the significant attributes of the trip maker that affects mode choice. The attributes are classified as the *socio - economic characteristics and trip characteristics*. The test model will be mode choice of car use against all public transport. This is now classified as the dependent variable while the attributes will be the independent variable. The model equation will be based from various non-linear regression models.

1.2.3 Assess the effectiveness of carpooling measures for school trips from their perceptions and the results of the model.

The effectiveness of carpooling is evaluated though the students perceptions. If the student are willing to participate without any privilege, they are given a choice as a donor or a passenger. If they act as donor, how much would they charge the passenger or vice-versa? They are also given an option to participate to carpooling when privileges are given such as free parking.

1.3 Significance of the Study

The study of school trips on their mode choice behavior and travel pattern will be of great importance in the implementation of Travel Demand Measures. The study will prompt the reader to be aware of the advantages and disadvantages of choosing a mode for travel as well as travel patterns based on his/her present trip behavior.
One important aspect of trip characteristic is "travel time." The actual travel time will be evaluated based on the total number of modes used. Travel time for each mode is summed up until destination is reached. If the individual is departing from home to first class, what made that individual depart 20 minutes before his/her first class? Is origin just approximate to the destination? Or Is the individual using a car that travel time is that fast while origin is a bit far from the destination? An Origin Destination (O-D) trip will be used to answer these questions and to know the group of respondents living near and far from the study area. If

the individual lives near the study area and travel time is long, it might be concluded that traffic congestion has got to do with that problem.
The study is also focused on the number of mode used especially for public transport. This may be classified as trip chaining wherein a maximum of 4 mode combinations are used to be able to reach the destination. This is not economical at all in terms of travel cost, travel time, and waiting time. Thus, a portion of this study will evaluate the level of service of public transport system.
Disaggregate travel is concerned with the movement of the individual. Individuals in a disaggregate data is particularly important for policy analyst who need to be able identify people whose only means of travel is the jeepney or the car. A disaggregate approach can be very useful in designing effective polices. This study will evaluate the present TDM measures particularly the Unified Vehicle Volume Reduction Program (UVVRP) on how it is effective in the study area. Assuming that majority are car users, an evaluation of carpooling perceptions is incorporated in the study to know it's impact if they are willing to participate on the said program.

1.4 Scope and Limitations

The scope of study is "to school trips" particularly for college levels. Metro Manila will be the study area and is restricted to focus on a specific corridor. The corridor will be Katipunan Road and the schools selected for sampling data where Ateneo de Manila University and Miriam College. These schools were selected because they are located adjacent to each other and it is a focal point in the traffic congestion problem along the study area. An ocular inspection along the study area was made and there were findings on heavy car usage being initiated especially by Ateneo de Manila. This is true especially on the exit point of gate 3 where delay in traffic takes about 3 minutes to a maximum of 5 minutes before traffic flow continues along the corridor.

The mode choice behavior will cover departure from origin to school, noon time activity along the study area, and departure from school to home. However, the study will give more focus going to school since morning trips particularly from 7 A.M. to 8 A.M. also includes work trips, business trips , and private trips. Moreover, the morning trip will be used as the mode choice model. For public transport users, the mode transfer is limited to 3 and 4 modes. A "walk" will be considered as mode if it obtains no transfer; otherwise, it will be considered as an access mode only. Mode choice behavior will now be incorporated to the socio-economic and trip characteristics of the individual. This is done by modeling mode choice behavior to the attributes that was previously mentioned using both linear and *non-linear regression*. It will now show the significant attributes that affects mode choice.

1.5 Conceptual Framework of the Study

The study of school trips along Katipunan Road is seen as a good subject in terms of mode choice behavior. Travel patterns of students is quite similar to employees to work trips since school trips obtains a general schedule. Ateneo de Manila University and Miriam College are seen as a good study area since majority of the students is car users. Car usage has always become a major contributor to traffic congestion especially along Katipunan Road. However, it is not yet empirically tested if school trips is really dominated by car usage; thus, the study aimed to consider the mode choice behavior of the students with their daily trip patterns. It is

also aimed to define their perceptions on the present Travel Demand Measures (TDM) with regards to mode choice.
The conceptual framework of the study perceives that the mode choice behavior of the students is highly related to their daily trip patterns, trip characteristics, socio-economic characteristics, and effectiveness of transport policies. The significant attributes especially from the socio - economic and trip characteristic data were determined to know which attributes greatly influence their mode choice behavior. The mode choice is generally between car and others (public transport) wherein, public transport includes jeepney, tricycle, bus, taxi, FX (HOV), LRT, and carpool. Walk is hereby considered as an access mode. Moreover, the produced conceptual framework has significantly help in the model formulation of the study. Through it, the proper choosing of the variables to be included in the modeling is being observed.

The use of public transport is not concentrated to a single mode only but a combination of several modes inducing mode transfers until a destination is reached. Socio-economic characteristics affects mode choice behavior in terms of monthly household income, vehicle ownership, age, sex, occupation, etc. The socio-economic profile is the first factor that affects mode choice then the trip patterns and trip characteristics follows. It is conceptualized that if the students' mode choice is car, what transport policies must be incorporated? Will they cooperate in carpooling to alleviate traffic congestion? Or stick to the present TDM measure instead, which is the UVVRP. If the choice is public transport, is the level of service satisfactory? If no, are they willing to cooperate also with carpooling? Figure 2 shows the conceptual framework of the study.

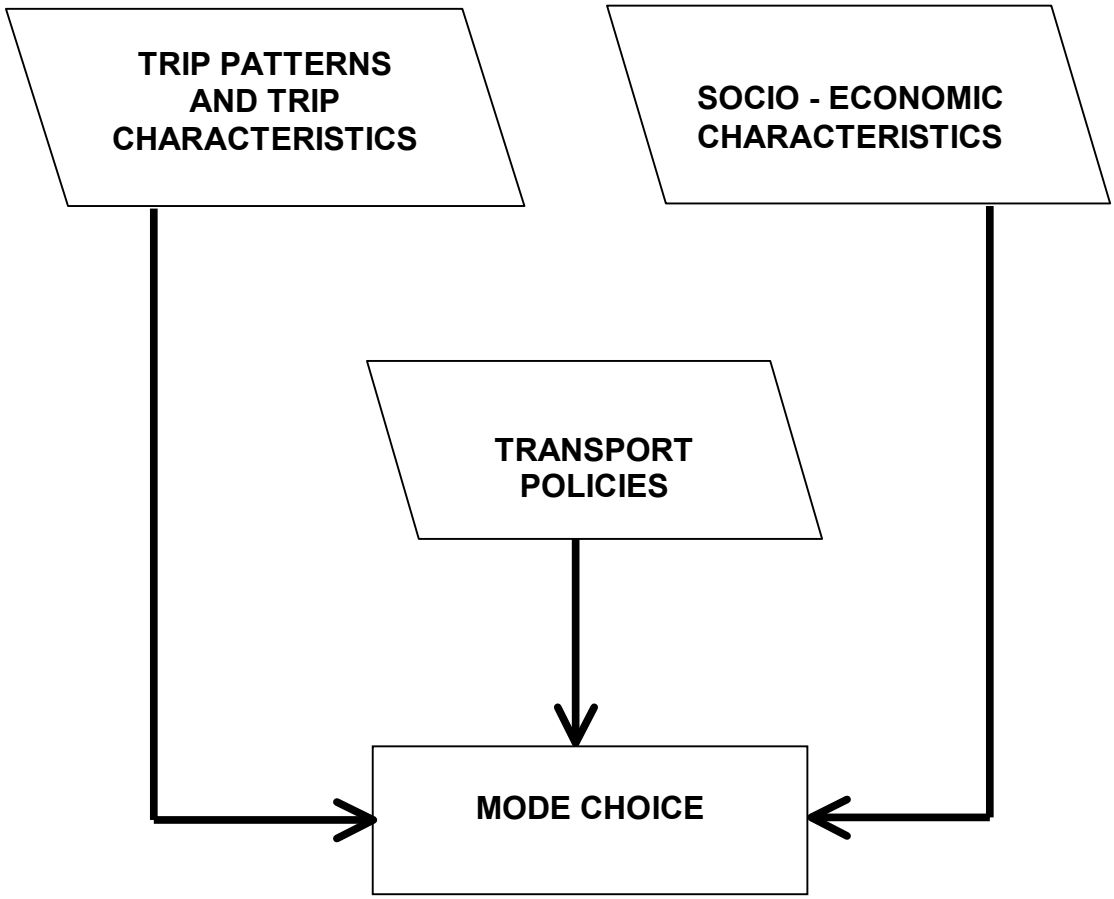


Fig. 2 Conceptual Framework

2. SURVEY RESULTS AND ANALYSIS

The specific objective is to know the mode choice behavior of the students and analyze their trip patterns. The incorporation of TDM measures to these objectives will also be evaluated. It dealt with important attributes and factors such as household information, personal information, and trip patterns. Household information is classified from the following attributes such as number of household members, number of students, number of households with driver's license, number of vehicles available for use, combined monthly household income, and the number of cars owned. Cross-classification is examined to some significant attributes. Attributes that are cross-classified were the number of students to the number of households, the number of vehicles owned to the number of license owned and the number of vehicles to household income.

Personal information is classified from the following attributes such as gender, civil status, age, occupation, personal monthly income, and type of driver's license. Civil status and occupation will not be a significant factor since all of the respondents are students and single in status. A classification is made between the number of male and female car users to school trip since majority of them are car users; thus, it may be one of the reasons that contribute to the traffic congestion along the study area.

For respondents using the public transport, their reaction to the existing service conditions is evaluated especially when they live far from the study area. A hypothesis can be made that they may incorporate the use of mode combinations to be able to reach their destination. This mode combination can be classified as "trip chaining" where a maximum of 4 modes can be used; hence it maybe uneconomical to the trip maker in terms of travel cost, travel time, waiting time, and comfort. From mode choice behavior, daily trip patterns will be analyzed especially for "to school" trips. The effect of "to school" trips will evidently affect peak hour congestion in the morning counting it together with work trips, business trips, and private trips. Trip behavior at noon will also be determined as well as afternoon trips departing from their last class. The preceding sections will show Origin - Destination (O-D) trips , total travel time, total travel cost, and total waiting time for "to school" trips only. Since these trips are based on a usual trip pattern, daily first class schedule was determined from each respondent and the time of departure from home to first class. This may determine the exact behavior of the students. Perceptions on various Travel Demand Measures is determined to know it's impact on their present travel behavior.

The study was able to clarify the important attributes that have a great impact on the daily trip patterns of the students and their mode choice behavior. The first part dealt with the socio-economic characteristics of the individual. The first attribute that was evaluated is the relationship between the number of students in a household member. The total respondents have a majority of 3 students in their household with 32%. The relationship is that as the number of household increases the number of students also increases that evidently implies that there is also an increase in “to school” trips. Vehicles owned and cars owned are evaluated as well. It was found out that they were almost equal; thus, all vehicles owned are car and approximately 80% of them have at least one car. This car ownership is also evidently shown in the combined household income where 20% of the total respondents has a monthly income of more P100, 000 pesos. The O-D (Origin- Destination) table was able to determine five zones were most of the respondents live. These zones arranged in an ascending order are Concepcion in Marikina, U.P. Diliman in Quezon City, Loyola Heights

in Quezon City, Fairview in Quezon City, Antipolo in Rizal, and Cainta in Rizal. Moreover, this is very evident in the O-D line in figure 3 below. The thick lines were represented by the 5 major zones aforementioned. This indicates that majority live near the study area; thus, evidently avails less travel time and less travel cost.

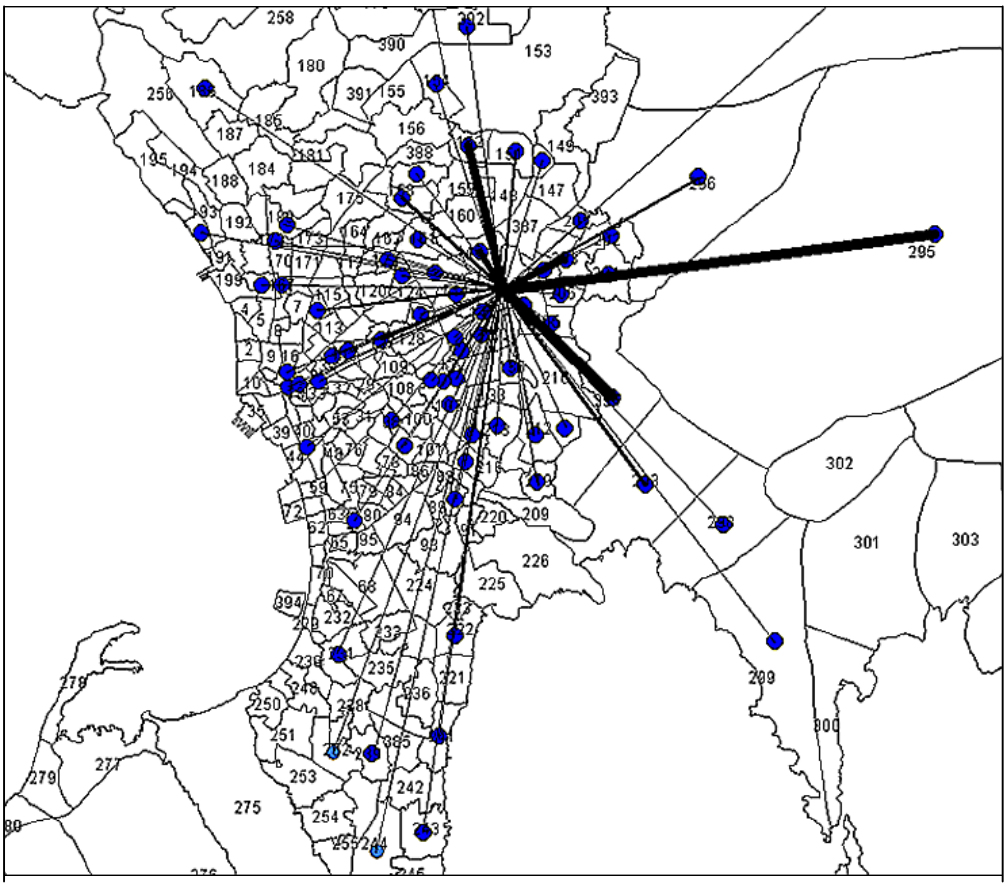


Fig. 3 O-D desire lines for each zone in Metro Manila

Noontime activity indicates that 51% of the total respondents take their lunch inside the school campus to take more time for school activities and also to avoid traffic congestion along Katipunan road. Trip purpose after departure from last class was evaluated and found out that 71% of them goes straight home. This indicates that trip distribution is not a factor in this study.

An investigation of the mode combinations was also taken into account for this purpose but the number of mode transfers was evaluated first. For "to school" trips, it was found out that 61% of the total respondents have no mode transfers where 40% of them are car users and remaining just live near study area. Aside from single mode use, the common mode combination used especially for those living far from the destination is the "jeepney - jeepney- walk" combination where 3.9% of the total respondents have access to it. Aside from the car itself, the number of times the respondent uses a type of mode at least once is evaluated as shown in table 2 below. The exact percentage of public transport users specifically the jeepney is now determined. Summing up car and carpool subtracted from the total respondents gives us a value of 228 respondents using the public transport or from actual count for car which is 195 and carpool which is 62; thus 485 – (195+62) = 228 respondents. From table 2, jeepney count is 139 out of 228 or 61% uses the jeepney at least once in the trip chain out of the total public transport users. For tricycle users, 104 out 228 or 46% uses the tricycle at least once in the trip chain out of the total public transport users.

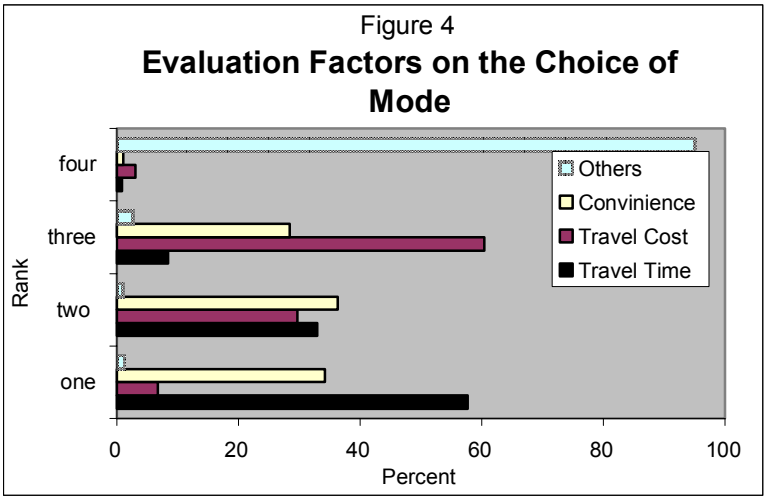
This only shows that there is evidently a poor level of service for public transport system. Speaking of level of service, the following single - trip characteristics were taken into account. Total travel cost of equal or more than 30 Pesos was 46% incurred by all modes. A further evaluation to determine the dominant mode on this 46% value showed that 86% car users has a total travel costs of equal or more than 30 pesos; thus, majority of these 46% are cars.

Table 2 Frequency of Mode Used

MODE	*No. of Respondents*
CAR	196
JEEPNEY	139
TRICYCLE	104
BUS	13
FX	80
TAXI	11
WALK	75
CARPOOL	65
TOTAL	**683**

At noontime, mode used is now evaluated for those taking lunch outside the school campus. Car use was minimized at this time where only 7% of the total respondents use it. Tricycle and jeepney use increased at 18% and 14% respectively since majority of them took lunch along the vicinity of Katipunan. This only implies that the respondents avoid traffic congestion at noontime and minimizes car use for this purpose. Increase in car usage is evident from 40% to 45% from home to first class and last class to home respectively. Factors affecting trip pattern such as travel time, travel cost, comfort / convenience , safety, and other considerations has a great influence in terms of travel behavior. In figure 4, respondents are asked to rank the importance of the factors on their choice of mode as previously mentioned. The factors are ranked according to their importance with 1(one) being the most important and 4 (four) as the least important.

Figure 4



The factors are shown in which the percentage are evaluated with the number of respondents. At first glance, it is seen that travel time ranks first with 58% but it's not yet proven in terms of scoring the respondents priority. The factors are again re-evaluated in table 3. This is done

by arranging the number of respondents beside the designated ranking designated as A and B respectively. A and B is multiplied to get the corresponding weight and summing up the total weight as well to get the final value of the factor to be evaluated.

Table .3 Ranking of Factors Considered in the Choice of Mode

Rank	Travel Time			Travel Cost			Convenience			Others		
	Score (A)	# (B)	AxB	Score (A)	# (B)	AxB	Score (A)	# (B)	AxB	Score (A)	# (B)	AxB
1	4	280	1120	4	33	132	4	166	664	4	6	24
2	3	160	480	3	144	432	3	176	528	3	5	15
3	2	41	82	2	293	586	2	138	276	2	13	26
4	1	4	4	1	15	15	1	5	5	1	461	461
∑		485	**1686**		485	**1165**		485	**1473**		485	**526**

With the final results, it is proven that "travel time" ranks first with a general weight of 1686 followed by "convenience" equal to a general weight 1473 and travel cost equal to a general weight of 1165. Travel time and convenience factors may imply that public transport service and maintenance is at poor since most of the respondents are car users.
In the evaluation of policies to avoid heavy car usage, the Unified Vehicle Volume Reduction Program (UVVRP) was evaluated by the students. A perception of this policy shows that 43% of them evaluates it's effectiveness as "fair" which indicates that this policy is effective. However, this is only applied on a certain day depending on the rules applied on odd-even ending of plate numbers. Thus, carpooling policy is being evaluated for it's possible implementation in the future. Carpooling perceptions shows that 60% of the total respondents are willing to act as donor while 76% of them are also willing to cooperate as a passenger even without any privilege. This is only shows a full cooperation of the respondents just to alleviate traffic congestion.

3. MODELING RESULTS

Travel behavior of students from home to school and other activity patterns from school contributes to the growing traffic congestion on a specific corridor. Travel patterns are related to mode choice behavior which affects the level of traffic congestion. Thus, transportation policies must take this into account. The importance of mode choice in transportation policy analysis and decision making has led to a variety of methods for predicting the effects of policy measures on student's mode choices.
In model 1,table 4, the choice of car was determined by using a non-linear method of estimation using binomial logit modeling. The following variables are found to be significant: parking access inside the school campus, effectiveness of the UVVRP, and the number of cars owned. Obviously, as the number of car ownership increased the more likely car is used; moreover, as availability of parking access increased the more likely car is also used. However, as the effectiveness of UVVRP increases the more likely public transport is used. The acceptability of model 1's significance level is that the value of P- level must be less than 0.05. The value nearer to zero the better is the fit. In addition, the higher the chi-square value the better is the fit. For this model, the value of p-level and chi-square was equal to zero and 251.6767 respectively; thus, the parameters are statistically significant.

Table 4 Model 1 Output

Variable	Estimate	Std. Error	t-value	p-level
Constant Bo	-1.74303	0.38024	-4.58409	0.00001
PARK	1.253404	0.162954	7.691278	0.000000
UVVRP-E	-0.55161	0.12609	-4.37479	0.00002
CARS-OWN	0.898348	.126299	7.112891	0.000000
Analysis of Model Fit				
df		3		
Final Value		166.0743394		
-2*log (Likelihood)		332.1487		
Intercept only		583.8254		
Chi - square		**251.6767**		
P - level		0.000000		

It is concluded that model 1 produced the best the model. The estimate parameters are now evaluated as an equation and the signs are interpreted in table 1.5.

$$\mathbf{p'} = -1.74303 + 1.253404\,\mathbf{PARK} - 0.55161\mathbf{UVVRP\_E} + 0.898348\mathbf{CARS\_OWN}$$

thus,

$$\mathbf{y} = \frac{\exp(p')}{1 + \exp(p')}$$

Variable	Sign	Interpretation
Const. Bo	-	Relativity of the null hypothesis is rejected.
PARK	+	Access parking inside the school campus enables them to use the car.
UVVRP_E	-	As the effectiveness increases, car use is at minimum.
CARS_OWN	+	As the no. of cars owned increases the more likely car is used.

Table 5 Model 1 Interpretation

4. SUMMARY AND CONCLUSION

A study on the trip patterns of the students was shown in the Origin - Destination (O-D) table. A total of five zones were determined where most of the respondents live. The zones are Concepcion in Marikina with 4.1%, U.P. Diliman in Quezon City with 4.3%, Loyola Heights in Quezon City with 5.2%, Fairview in Quezon City with 5.4%, Antipolo in Rizal with 6%, and Cainta in Rizal with 7%. Some of these zones are quite far from the destination but a selection of the school in the study area depends on the accessibility of roads leading to it. These access roads are free from traffic congestion; thus, less travel time and travel cost is achieved. An analysis of trip patterns is evident especially those using the public transport since mode combinations is taken into account. The mode combination used especially for those living far from the destination is the "jeepney - jeepney- walk" combination where 3.9% of the total respondents have access to it. Moreover, the number of mode transfers

found out that 61% of the total respondents have no mode transfers. This only shows that there is evidently a poor level of service for the public transport system.

In the mode choice behavior, the study shows that combined monthly household income of the students are not a factor in the mode choice behavior since 20% of them have a combined monthly household income of more than P100,000 pesos. This indicates that they can avail at least one or more car; thus, car ownership was a significant factor in the mode choice behavior. Car ownership was a significant factor where 25% of them owns at least one car while only 17% has no car. Moreover, it was also statistically significant where the p-level value is zero. As the car ownership increases the more likely they will use the car. Another factor in the choice of car is parking access. A total of 20% of the respondents park their car inside the university while 32% is kept by the family or the driver. The P-level of parking access is equal to zero which indicates that it is also statistically significant. Car use was minimized on certain days were the effectivity of the Unified Vehicle Volume Reduction Program (UVVRP) takes place. The effectiveness of the UVVRP was also significant in this study where 45% of car users ranks it 'fair'. Moreover, it was statistically significant with a p-level value equal to 0.00002. As the effectiveness of the UVVRP increases the likely they will use the public transport.

In the other model on linear regression estimate, the level of service variable total travel time was significant in the choice of car. As the total travel time increases the more likely they use car. This was also proven when the respondents were asked to rank travel time, travel cost, convenience, and other factors from first to the last in terms of priority. The results showed that a 'travel time' ranks first with a score of 1686 followed by 'convenience' with a score of 1473 and travel cost come in at last with 1165. It is observed that travel cost was not a factor in the mode choice as perceived by the respondents. Travel cost was not also significant as proven in model 1b.

It is evident that car ownership, parking access, and travel time affect the choice of car use. However, it is only minimized when UVVRP takes in effect on a designated day. It is now concluded that UVVRP cannot alleviate traffic congestion along the corridor. Since 58% of the total respondents owns more than two cars, It is inevitable that they can switch cars on that designated day with any member of the family depending on the last digit of the plate number. Take note that on that 58%, 34% owns 3 or more cars. Thus, the probability of switching cars in any day is high. An alternative policy which is the carpooling is now taken into account. It is evaluated on the respondents willingness to participate with or without any privileges. The results shows that an average of 68% of the total respondents are willing to cooperate to carpooling even without any privilege. Carpooling as donors has a total of 60% while passengers incur 76% of the total respondents.

5. RECOMMENDATIONS

Since car usage was found to be the mode choice of the students, it cannot be denied that heavy car usage was the focal point of traffic congestion in the study area. Alternative policies such as carpooling must be implemented to minimize car usage. There is also a need to improve public transport system to be able to motivate the student to switch to it. Car was the choice of mode since it is fast in terms of travel time and does not require any waiting time as well as mode transfers as proven in model 1b. The following recommendations were found to be significant in the alleviation of traffic congestion in the study area.

5.1 Improvement of Public Transportation

- Jeepney and bus drivers must be aware of the proper maintenance of their vehicles for convenience and better running conditions. From the respondent's perspective, convenience factor was ranked second next to travel time with an accumulated score of 1,473. The choice of car was evident with this factors.
- The government must also provide more traffic enforcers around the metropolis on public transport vehicles especially for jeepneys and buses so that security purposes for passengers will be maximized.

5.2 Implementation of Transport Policies

The effectiveness of UVVRP is good as stated by the respondents. This effectiveness may reduce car usage that may eventually reduce traffic congestion. At this point, respondents can not use their cars on a certain day and the mode choice is reduced. Thus, switching to public transport is more likely to happen. If the respondent is not accustomed to public transport, then they may participate to carpooling. To make carpooling more effective, the government should:

- assign traffic enforcers in front of the university premises and penalize students driving their car alone.
- advertise carpooling in mass media to inform the public of its advantages.

Carpooling policies should be implemented by the students themselves in both schools. This is especially true for group of students who drive their car alone living in the same area. These group of students should coordinate with each other by deciding a donor and at least 3 passengers to be more effective. The donor may charge the passengers for a cooperation fee for service, gasoline fare, and maintenance.
Carpooling should be implemented in the family also. They should arrange a schedule in such a way that at least 3 passengers are willing to go to their own trip purpose at the same time especially in the morning. A route schedule for drop-off points is necessary for each member before proceeding.

5.3 Land Transportation Office

The Land Transportation Office (LTO) should be strict in providing driver's license to students 18 years old and above. Figure 4.16 showed that 14% of the 17 year old respondents and 3% of the 16 year old respondents owns a driver's license which does not conform to the rule. Thus, more car is used that causes traffic congestion.

6. FURTHER STUDIES

The mode choice behavior model showed parking access, car ownership, and travel time as significant variables in the choice of car. However, the UVVRP is satisfactory as a policy to minimize car usage when it takes into effect. An inclusion of the distance traveled from the origin to destination will be a great factor in the mode choice model for future studies. Distance will be a vital factor in the actual speed of the student and will clearly explain how location of residence really affects car use.
The study did not include detailed questions about carpooling factors especially on the willingness to pay attitude in the analysis of the model proper. Thus, the effect of carpooling

variables was not significant in the models. The questions asked on the perceptions on carpooling were not fully described in detail due to time constraints. It was also observed that the passengers could not specify the role that they will choose since they can act both as a donor or a passenger.

Carpooling studies must be continued beyond the scope of the study and this policy possibly be implemented. A scenario may be given in detail especially on the willingness to pay attitude by the passenger and the cooperation fee charged by the donor. Moreover, actual travel cost for both private or public mode might be compared in detail with that of the cooperation fee which could be a factor for the respondents to participate in this policy. Alternative privileges must also be given to carpooling participants aside from free access to parking. The summary of the study is shown in the appendices.

REFERENCES

Ben -Akiva, B. and Lerman,S. (1985). **Discrete Choice Analysis:** ***Theory and Application to Travel demand.*** The MIT Press Cambridge, Massachusetts London England.

Bruton, M.J. (1975). **Introduction to Transport Planning**. Hutchinson Of London

Ettema, D.F. and Timmermans, H.J.P. (1997**). Activity – Based Approaches to Travel Analysis**. Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K. Elsevier Science Inc., 660 White Plains Road, Tarrytown, New York 10591 – 5153, U.S.A. Elsevier Science Japan, Higashi Azabu 1 –chrome Building 4F, 1-9-15, Higashi Azabu, Minato-ku, Tokyo 106, Japan.

Garling Tommy, Laitila Thomas, Westin Kerstin .(1998). **Theoretical Foundations of Travel Choice Modeling**. ELSEVIER SCIENCE Ltd. The Boulevard, Langford Lane Kidlington, Oxford OX5 1GB, U

Hanson, Susan (1986). **The Geography of Urban Transportation** . A Division of Guilford Publications, Inc. 200 Park Avenue South, New York, N.Y. 10003.

Horowitz, Joel., et al (1986**). A Self Instructing Course in Disaggregate Mode Choice Modeling. Final Report**. US Department of Transportation, Urban Mass Transporation Administration, Washington, D.C.

JICA (1997). **Filipino Way: Transportation in the Philippines** . Version 2

Ortuzar, J.D. and Willumsen, Luis G. (1990**). Modeling Transport**. 2nd Edition. John Wiley and Sons, New York, NY.

Stopher Peter, Meyburg Arnim, Brog Werner (1981). **New Horizons in Travel – BehaviorResearch** . LexingtonBooks D.C. Health and Company Lexington, Massachusetts Toronto.

Walpole, Ronald E. (1982). **Introduction to Statistics**, 3rd edition. Macmillan Publishing Co. Inc. New York. Collier Macmillan Publishers. London

APPENDICES

Objectives	Analysis	Findings	Conclusions & Recommendations	Further Studies
Analyze Trip Patterns of the students	Departure from home to first class	5.2%of the respondents comes from Loyola Hts. in Quezon City, 4.3% from U.P. Diliman in Quezon City,5.4% from Fairview in Quezon City, 4.1% from Concepcion in Marikina , 6% from Antipolo in Rizal, and 7% from Cainta in Rizal.	The respondents tend to choose a school near their origin.	Consider the representative route of each zone to be able to determine 'actual distance'
		40% of the respondents uses car	Improve public transport system like re-routing public transport vehicles to avoid mode transfers.	To specify and define access routes of public transport system.
		67% car users have no mode transfers		
	Noontime Activity	51% takes their lunch inside the campus	To probably avoid traffic congestion at noon.	
	Departure from last class	71% goes straight home	Other trip purpose is not as an important factor in the afternoon.	To consider travel behavior from school to other purpose
		45% of the respondents uses car	Probable increase in car usage in the afternoon	
Model the mode choice	**Model 1:** Car & Other public transport Probable variables: 1. PARK 2. UVVRP_E 3. CARS_OWN 4. TRANSFER 5. HH_INCOME	**p'** = -1.74303 + 1.253404**PARK** – 0.55161**UVVRP_E** + 0.898348**CARS_OWN** $y = \frac{\exp(p')}{1 + \exp(p')}$ P – level : 0.000000 Chi – Square : 251.6767	1. As parking access increases the more likely car is used. 2. As car ownership increases the more likely that car is used. 3. As the effectiveness of UUVRP increases the more likely that public transport is used. • Household income variable was not significant since majority of them belongs to the high income class. • TRANSFER variable was not also significant since majority of them is car users.	
	Model 2: *Cart & Other public transport* Probable variables: 1. TOTIME 2. TOTCOST	**y** = 0.113319 + 0.293385 **TOTTIME** R^2: 0.474327	As the travel time increases the more likely that car is used. Possibly indicating that people who live far tend to use cars.	• To include travel distance in the model. • To include middle and low income classes for further studies.
Assess effectiveness of carpooling	To cooperate to carpooling as donor	60% of the total respondents are willing to cooperate	Carpooling will probably succeed to minimize car usage	To give a more detailed question on their willingness to pay and specify clearly their role in carpooling.
	To cooperate to carpooling as passenger	76% of the total respondents are willing to cooperate		

Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 1116 - 1131, 2005