Analysis of Activity-travel Patterns of Students at Mapua Institute of Technology

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Abstract: In today's fast-paced world, the need of practical activity-based travel demand models for special generators like universities need further development. Better understanding of how people organize and schedule their activities gives more solid basis for travel demand modelling which is being addressed in the activity-based approach to travel demand analysis. This study analyzed the activities of the students and their travel characteristics in terms of trip rates, travel modes and activity duration and allocation. Trip rates, that explicitly address student travel patterns was developed and a logit model was estimated. Result of the study indicate that the average trip rate of students at Mapua is around 5.0 trips/day. For the trip rate logit model, the gender and presence or not of driver's license are important predictors of students trip rates. Walking is the most dominant mode of transportation used by the students. Students prefer walking in short distances which is also related to the cost and time it takes compared to taking motorized mode of transport.

Keywords: Activity-based Travel Demand, Logit, Modelling, Trip rates, University Students

1. INTRODUCTION

Since the beginning of civilization, the viability and economic success of communities have been, to a major extent, determined by the efficiency of the transportation infrastructure. To make informed transportation infrastructure planning decisions, planners and engineers have to be able to forecast the response of transportation demand to changes in the attributes of the transportation system and changes in the attributes of the people using the transportation system. Travel demand models are used for this purpose; specifically, travel demand models are used to predict travel characteristics and usage of transport services under alternative socio-economic scenarios, and for alternative transport service and land-use configurations (Papacostas and Prevedourous, 2005).

The classic approach that is being used for modelling travel demand is called the 4-step travel demand model. This model consists of four sub-models which are trip generation, distribution, modal split, and traffic assignment. However, this model is entirely trip-based, which does not consider the activities that people pursue. It is academically recommended that a better understanding of how people organize and schedule their activities gives more solid basis for travel demand modelling which is being addressed in the activity-based approach to travel demand analysis (Ortuzar and Willumsen, 2011).

The need for realistic representation model of behavior in travel demand modeling is well-recognized in collected works (e.g. Ettema and Timmermans, 1997; Timmermans, 2005; Soltani and Zamiri, 2011). Improper management and planning of transportation facilities, affected by other external and environmental conditions could cause heavy traffic congestion, which will cause delay in the activities of people especially in an urban setting. In today's fast-paced world, the need of practical activity-based travel demand models for special generators like universities need further development. There is a need for universities to practice its commitment to the promotion of sustainable travel options aimed at encouraging and supporting travel choices amongst students, staff and visitors alike. Recent studies have been an increasing realization in the field that the traditional statistically-oriented trip-based modeling approach to travel demand analysis needs to be replaced by a more behaviorally-oriented activity-based modeling approach (Eom, et al. 2009; Irawan and Sumi, 2011).

With the main goal to promote sustainable travel options that will embolden and support travel choices that students, staff and faculty will make going to and from campus, this study was conducted to understand the current transportation demand and travel needs of students at Mapua Institute of Technology. In order to do so, activity-based analysis was employed. This study analyzed the daily activity-travel patterns of students in terms of generation of trip rates. Trip rates, that explicitly address student travel patterns was developed from their class schedules and other activities, rather than just adopting established trip-based ones. This analysis generates insight to university travel behavior as a first step towards the development of comprehensive models of activity-based travel behavior that will also enhance other universities in Manila, Philippines. Focused on activities of students enrolled at MIT at the time of data collection, Intramuros campus during schooldays. The researchers conducted a survey striving to distinguish student activity patterns through a travel diary, which includes socio-demographic and travel characteristics. The survey responses that were gathered from the participants only covered their one-day activity-travel diary to limit the tediousness of letting respondents accomplish the activity diary.

2. PREVIOUS STUDIES ON ACTIVITY-BASED TRAVEL DEMAND MODELING

Daily pattern of students are affecting their travel patterns which is one important aspect of transportation planning and travel demand forecasting. This aspect is normally analyzed through conventional 4-step travel demand model (see Figure 1 below). The model has four sub-models which are the trip generation, distribution, modal split, and traffic assignment. However, the models are entirely trip-based. This means that the models are based on the estimation of trip productions and attractions; then, simple tours are modelled until the trip assignment stage (Ortuzar and Willumsen, 2011).

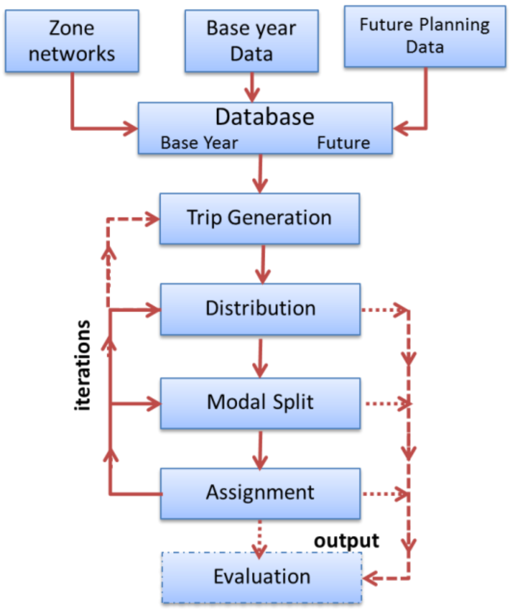

Figure 1. Conventional 4-Step Travel Demand Model

Activities happen in space and for people to reach their destination, they need to travel. Some activities are mandatory and must be performed within scheduled time, but some activities could be rescheduled. Considering trips in analyzing travel demands fail to integrate behavioral richness of connecting activities in various locations and time windows or constraints (Ortuzar and Willumsen, 2011). Literature indicates that in principle, a better understanding of how people organize and schedule their activities gives more solid basis for travel demand modelling. This has been the cause of fast growing interest from trip-based to activity-based approach to travel demand analysis (Ortuzar and Willumsen, 2011). Characteristics of activity-based approaches compared to the trip-based approach are summarized in Table 1 below.

Table 1. Summary of Characteristics of Trip-based and Activity-Based Approach

No.	Trip-based approach	Activity-based approach
1	Travel demand is trip-based	Travel demand is derived from activity participation
2	Non-linked daily household trip generation rates applied with zonal demographics to expand to zonal trip ends	Activity participation involves activity generation, spatial choice and scheduling
3	Distribution of non-linked trip ends accomplished via aggregate interaction models with generalized network impedances	Activity and travel behavior is delimited (or even defined) by constraints
4	Conventional 4 step process models network level traffic effects via static assignment	Linkages exist between activities, locations, times and individuals
5	All disaggregate spatial and temporal information is lost	Alternate decision paradigms are probable

Source: McNally, 1997

Activity-based approach to modelling travel demand still cover populations in the area of study under consideration, aggregated and zonal-based as well as traditional outputs needed for assessment of projects and policies. Nevertheless, the model address at least in principle a wider scope of policy instruments and behavioral responses due to a more detailed integration of activities, long-term and short-term decision-making, tours and mode choice. "Activity-based approaches to travel analysis and modelling describe which activities people pursue, at what locations, at what times and how these activities are scheduled, given the locations and attributes of potential destinations, state of transport network, aspects of the institutional context, and their personal and household characteristics" (Ettema and Timmermans, 1997).

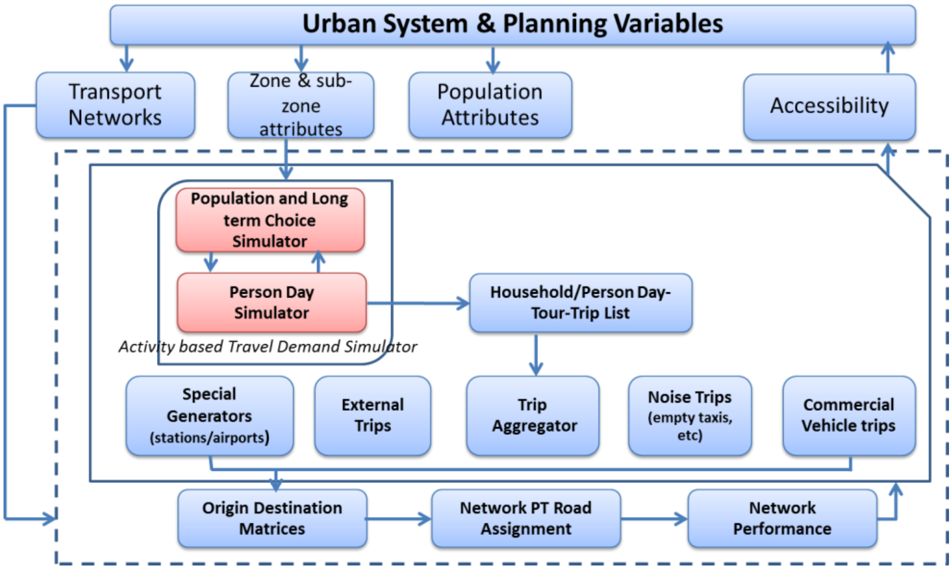

Figure 2. Transportation demand model with activity-based core analysis
Source: Ortuzar and Willumsen, 2011

3. METHODOLOGY

This chapter presents the methodology that was employed in obtaining the objectives of the research. First, literature review was done to identify issues and research needs in the area of transportation planning, specifically travel demand modelling. Then, the activity-travel diary form which included the variables identified from literature review was prepared. Next, the actual survey was conducted targeted at students. Then completeness of the data was checked and verified. Then data analysis was done. The following sub sections describe more details on the study area, method used for analysis and interpretation of results.

3.1 Study Area and Collection of Data

The researchers selected MIT as the study area. MIT is located in Muralla Street, Intramuros Manila. It is known for being the biggest and number one engineering school in the country of having competitive-based learning in particular field of engineering. It has approximately 10,745 enrolled students, with 7382 male students and 3389 female students, and upholds to academic excellence and social responsibility as social core values. As in the field of transportation is concerned, the researchers work on how the students of the Institute carry out on their daily activities (Enrollment Statistics SY2013 Term 3). The main campus is located in Intramuros, Manila, which accommodates both academic and professional services, is well served by range of public transportation such as jeepneys, FX, city buses. It is walking distance to Central train station (LRT-1).

Figure 3. Vicinity Map of MIT, Intramuros Campus
Source: Google Maps (2013)

Data was gathered by the research team through face to face survey with the aid of questionnaires. Permission to conduct the survey in campus was obtained from the Office of the President. A set of survey questionnaire for respondents was developed. The researchers identified samples based on corresponding year levels and gender. To be precise, a random number of students representing the total population, was selected based on the criteria according to Ortuzar and Willumsen (2011).

The researchers approached the respondents and conducted face to face interview in order to ensure high quality of data and to meet the target number of samples needed. The respondents were asked to complete their travel diary for a day. The activity-travel diary form, contains socio-demographic and one day activity-travel data which could be accomplished by respondents within 10-15 minutes. The travel diary as a survey form is a tool to determine the one day travel activities of the students in the Institute. It is divided into two sections; the first part is to know their personal information that takes account of their stage of study and address of their accommodations (dorm-based or home-based) with this information the researchers could predict the type of transportation being used by respondents when going to and from the Institute. The second part is a one day activity-travel table to be answered specifically by the respondents for the researchers to trace their activities through the day.

The following describes the available modes of transportation to the population at MIT. Some students have their own private vehicles, some travel through available public modes (public utility vehicles, jeepneys, bus) and some live in dormitories around school, hence walk to school.

3.2 Method of Data Analysis

The discrete choice modeling framework according to Train (2009) is utilized for data analysis. Discrete choice models postulate that an outcome with the highest utility compared to other alternatives is selected by a decision maker. It is a closed form estimation method with the ability to capture behavioral context of the decision-making. The multinomial logit model type if employed for cases with more than 2 outcomes. It can be generated assuming that the random terms are distributed (IID) Gumbel. The multinomial logit used to model evacuation decision in this study specify that the utility function (U_{ih}), consists of a systematic term ($\beta' X_{ih}$) and a random term (ε_{ih}) as presented in Equation 1. Where β is a vector of parameters to be estimated; (X_{ih}) is a vector of corresponding independent variables that determine evacuation decision i of household h.

$$U_{ih} = \beta_{ih}^{'} X_{ih} + \varepsilon_{ih} \tag{1}$$

The probability of the outcome i of an activity for student h, is shown in Equation 2.The coefficients β in Equation 2 are estimated using the maximum likelihood estimation (MLE) where the log likelihood function.

$$P_{ih} = \frac{e^{\beta_{ih}^{'} X_{ih}}}{\sum_{i} e^{\beta_{ih}^{'} X_{ih}}} \tag{2}$$

The null hypothesis is that all coefficients in the utility function take the value of zero. This hypothesis can be statistically rejected if any relevant model parameter is different from zero at a 0.05 significance level. The significance of independent variables to evacuation activity outcome is assessed using p-values. Moreover, model fit is assessed using pseudo R^2.

4. RESULTS AND DISCUSSION

This section presents the results of the study including the descriptive results of the data, correlation results, model estimation and validation results.

4.1 Data

The data collected from the survey was evaluated through statistical analysis. First, a descriptive analysis of the sample population is presented. Then average daily student trip rates by status (undergraduate, graduate, staff); travel modes (for instance personal vehicle, walk, tribike, campus vehicle, jeepney, fx) and trip types were developed. Daily trips have been modeled using regression analysis. This is due to its power and simplicity. If the travel survey provides enough samples of trips to cover most of the geographic area surveyed, the regression model is useful to predict the trips (Eom, et al., 2009). In modern science, regression analysis is a necessary part of virtually almost any data reduction process. Popular spreadsheet programs, such as Quattro Pro, Microsoft Excel, and Lotus 1-2-3 provide comprehensive statistical program packages, which include a regression tool among many others.

A total of 445 samples were collected. After cleaning the data and removing those with incomplete information, 441 samples was used for analysis. Table 2 shows the characteristics of the students interviewed whose information was used for analysis. The information collected from each student includes their age, gender, year level, income or allowance, the type of accommodation they have, whether they have the license to drive or not and whether they have their own personal vehicle or not. The students in Mapua are aged 16-26 years old. This was grouped into 3 which include 16-18 years old, 19-21 years old and greater than 21 years old. Students are identified whether they are male or female. 149 (33.8%) of the interviewed students are male, while 292 (66.2%) are female. 14.7% are first year students, 43.1% are second year students, 24.9% are third year students and 17.2% are fourth year students. Students were also inquired about their monthly allowance or income. 155 (35.1%) of the interviewed students had an allowance or income of P1000 – P5000 per month, 266 (60.3%) had an monthly allowance of P5001 - P10,000, and 20 (4.5.%) of the students had an monthly allowance or income of more than P10,000 per month. 304 (68.9%) of the students lived at their own homes while 137 (31.1%) rented a dormitory or condominium for their accommodation. 278 (63%) of students haven't acquired a license and 163 (37%) of them are able to drive and have acquired a non-professional license. 280 (63.5%) of the students are commuting and does not have a personal car while 161 (36.5%) are using their own personal vehicle on their way to school.

Table 2. Descriptive Statistics of Interviewed Students' Characteristics

Variable	Description	Coding	Number in Data	Percentage in data
Age	Age of the student	1:16-18	244	55.3
		2:19-21	179	40.6
		3: >21	18	4.1
Gen	Gender of the student	0: Female	149	33.8
		1: Male	292	66.2
Ylevel	The year level of the student	1: 1st year	65	14.7
		2: 2nd year	190	43.1
		3: 3rd year	110	24.9
		4: 4th year	76	17.2
Income	Monthly allowance/income of the student	1:1000-5000	155	35.1
		2:5001-10000	266	60.3
		3:>10000	20	4.5
Accommodation type	Type of accommodation of the student	0: Rented dormitory	137	31.1
		1: Own house		
			304	68.9
License	Indicates if student have the license to drive or not	0: no license	278	63.0
		1: with license	163	37.0
Car Ownership	Indicates if student have the personal vehicle or not	0: no car	280	63.5
		1: with car	161	36.5

Table 3. Number of Trips and Corresponding Number of Students in Data

Number of trips per day	Number of Students	Percent
2	9	2.0
3	95	21.5
4	68	15.4
5	131	29.7
6	68	15.4
7	45	10.2
8	17	3.9
9	7	1.6
10	1	.2
	441	100.0

From the total of 441 samples used for analysis in this research, recorded number of daily trips range from 2-10 trips/day. Table 3 shows the number of students with corresponding number of trips. 9 (2%) of the students averaged 2 trips/day, 95 (21.5%) averaged 3 trips/day, 68 (15.4%) averaged 4 trips/day, 131 (29.7%) averaged with 5 trips/day, 68 (15.4%) averaged with 6 trips/day, 45 (10.2%) averaged with 6 trips/day, 17 (3.9%) averaged with 8 trips/day, 7 (1.6%) averaged 9 trips/day and only 1 (.2%) averaged 10 trips/day.

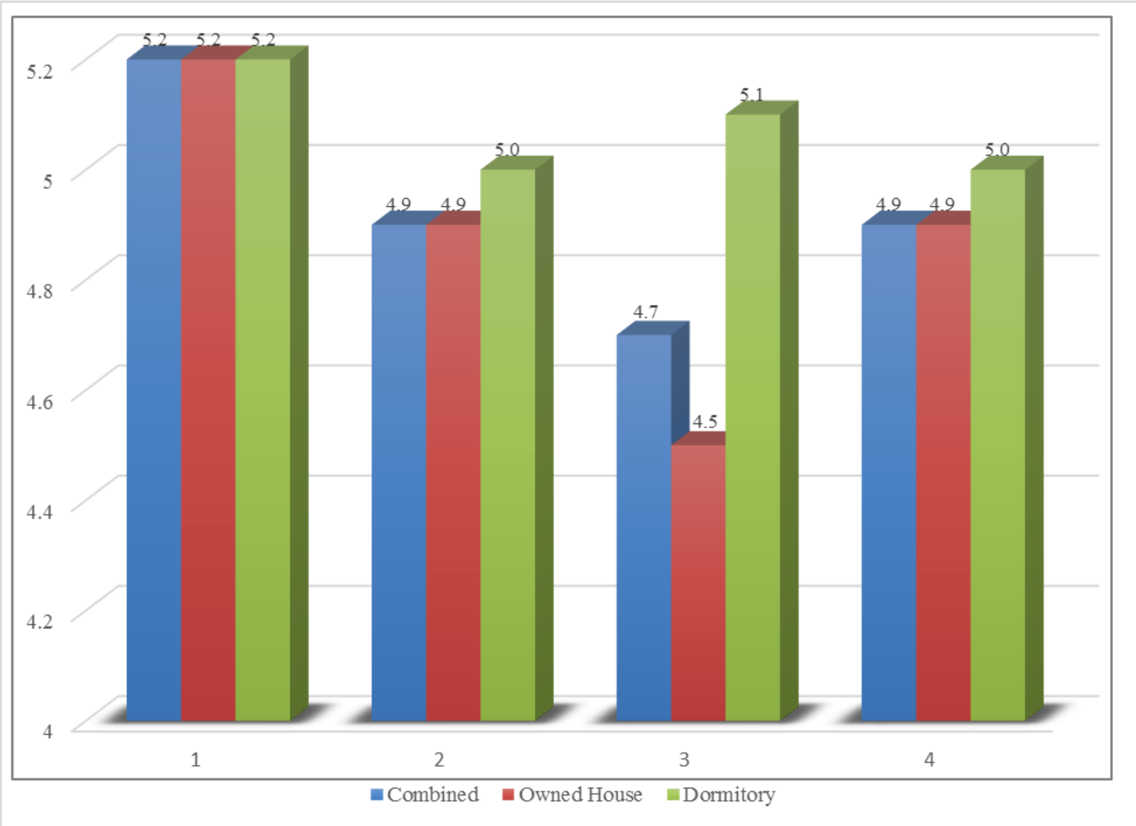

Figure 4. Average Daily Trip Rates of Students by year level and Type of Accommodation

Figure 4 shows the daily average trip rate (trips/day indicated in the y axis) of students for first year, second year, third year and fourth year level respectively (labeled as 1,2,3,4 at the x-axis). The figure also shows the trip rates of these students according to the type of their accommodation. It is evident that students who are going home to their own house in Metro Manila area have almost the same average trip rate with those who are living in dormitories. Specifically, first year students' average trip rates, disaggregated into the combined trip rate as well as according to the accommodation type are similar which is 5.2 trips/day. This indicates that since students in this year are having regular course schedules and are usually fully loaded with certain number of units to take, they usually have similar itineraries/activities, most of it which including going to school/attending classes and doing some school work then going back to their accommodations. For the second year students, the average trip rate combined is the same with the average trip rate of those who are living in their own house, while those who are living in dormitories have slightly higher average trip rate due to the curfew or some restrictions for those who are living in dormitories than those who are living in their own house. For the third year students, the average trip rates for the three categories vary. This might be due to the fact that higher level students have more complex and different schedules compared to those who are in the lower levels, which have similar activities. For the fourth year students, the average trip rate combined is the same with the average trip rate of those who are living in their own house, which is similar to the results of second year students. The increase in trip rates may be due to the fact that graduating students have busier schedule because of the numerous requirement needed for completing major subjects. Frequent trips may also be due to increased school/organizational activities.

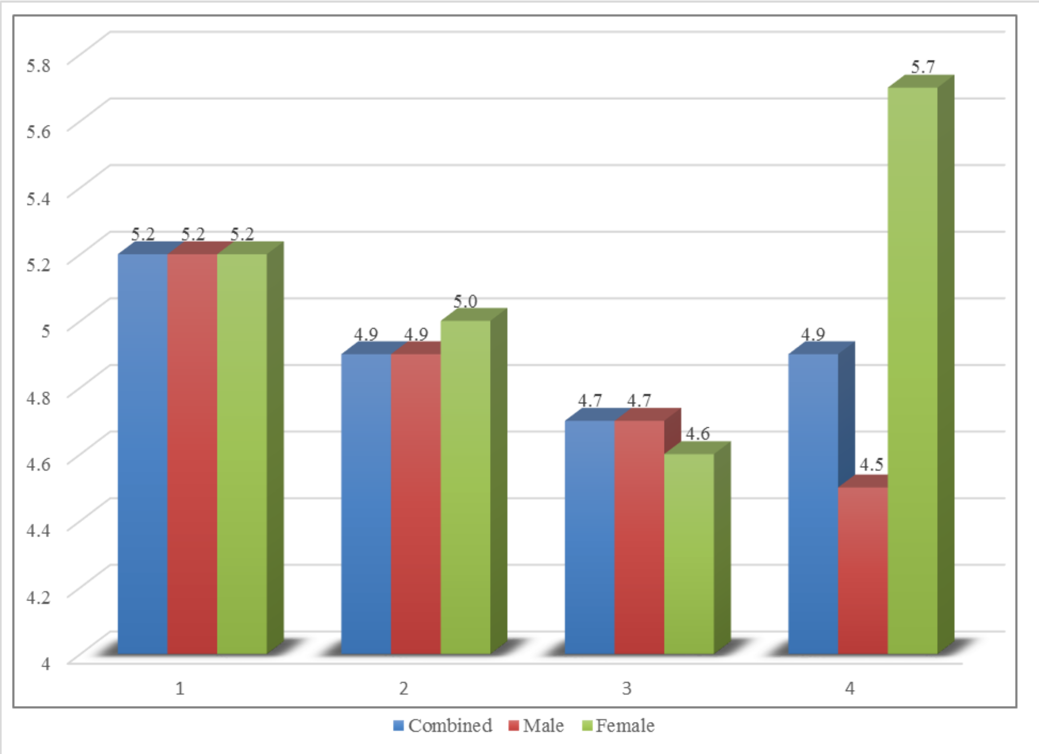

Figure 5. Average Daily Trip Rates of Students by Year Level and Gender

Figure 5 presents the average daily trip rate of students according to their year level disaggregated into the trip rate of all the students in specified year level (combined), and the average trip rates of male and female students. The trend of average trip rates combined and aggregated into male and female are similar to the results of the trip rates separated according to the type of accommodation. This is to compare the average trip rates of male and female studying in the campus and their respective year levels. For the first year students, the results of the average daily trips for the combined, male, and female are the same with 5.2 trips/day. This results indicates that since students in this year are having regular course schedules and are usually fully loaded with certain number of units to take, they usually have similar itineraries/activities, most of it which including going to school/attending classes and doing some school work then going back to their accommodations. For the second year students, the results of the combined and male are identical with 4.9 trips/day while the female have a slightly higher trip rate of 5.0 per day. As compared to the first year students, results indicate that lower batches still have similar schedules but some of them may already have failed a subject or two, which can result into a slightly different schedule pattern. For the third year students, the average trip rates of combined and male are equal with a result of 4.7 trips/day, but the trip rate for females decreased with a result of 4.6 trips/day. Decreased average trip/day indicates that students in the third year level have fewer classes or loads. This can also be due to the fact that students can freely organize their own schedule in accordance to their convenience. For the fourth year students there is a noticeable increase for the combined and female students. The combined had an average trip rate of 4.9 trips/day, the male had an average trip rate of 4.5 trips/day, while the females have an increased average trip rate of 5.7 trips/day. The increase of average trip rates indicates an increase in activity for students who are nearing graduation which needs a lot of requirements and tasks for completion. Frequent trips may also be due to increased school/organizational activities.

4.2 Statistical Model of Trip Rates

The logit model analysis was used to determine the effect of the students' characteristics to their trip rate (trips/day). The resulting regression model is also used to determine the significant factors that could be used to quantify trip rates of students. In a regression analysis we study the relationship, called the regression function, between one variable y, called the dependent variable (in this study the trip rate), and several others xi, called the independent variables. The independent variables in this study include the age, gender, year level, income, type of accommodation, driver's license ownership and car ownership.

After setting up the data for analysis and estimating the linear regression using the Stata software for statistical analysis, the following table summarizes the results. The table presents the corresponding estimated coefficient for each independent variable, the t-stat and the significance of the variable to a certain confidence level. Corresponding independent variables having t-stat value of greater or equal to 1.96 shows that the variable is significant to the 95% confidence level and significance equal or less than 0.05. Results shows that the gender is a variable that significantly influences the number of trip rate. In addition, the presence of driver's license shows significance to the 90% confidence level, that is, significance value is less than 0.1.

The value of coefficients was estimated using the maximum likelihood method of estimation. As presented in Table 4, the sign of the coefficient of age is negative which means that older students are less likely to make a trip compared to younger ones. In addition, the gender has a negative sign which means that female students are less likely to travel than male students. This might be related to safety consideration of female students. For the year level, which also has a negative sign, the lower the year level, the less likely they travel which is related to their fixed schedule of taking courses in school, while those who are higher level are more likely to travel due to may requirements such as on the job training (OJT), and other school requirements.

On the other hand, income shows a positive coefficient which means that the higher the income/allowance of the student, the more likely he/she travels. The same is true to license and car ownership which have both positive coefficient.

Table 4. Result of the model parameter estimation

Variables	Coefficients	t-stat	Significance
Constant	5.234	15.044	.000
AGE	-0.238	-1.181	.238
GENDER	-0.338	-2.077	.038
YEAR LEVEL	-0.026	-0.217	.828
INCOME	0.157	1.155	.249
ACCOMODATION	-0.147	-0.897	.370
LICENSE	0.349	1.820	.070
CAR OWNERSHIP	0.053	0.285	.776

Model goodness of fit	
Number of samples	
R^2	441
Log Likelihood	0.30
	1,068

*significant at 5% level; **significant at 10% level

4.3 Mode Used for the Trips

Trip modes recorded were grouped into 6 categories including walking, use of 4 to 6-wheel public utility vehicles including bus, jeepney, van and fx, light rail transit (LRT), personal car (PC), taxi and a combination of 2 or more types of mode (multimode). As shown in Figure 7, most of the students (63.2%) travel by walking. This is reasonable as student activities are mostly made inside the campus where students walk from one place to another. Also, students who live in dormitories near the school walk home. Furthermore, using multiple modes such as a combination of walking and other types of mode comprise of 21.8% of the total. Students who go back home to their own house and some other who are living far from school usually take more than 1 type of mode to travel back home. Examples of recorded combinations are (walk, bus, LRT), (bus, LRT), (jeepney, LRT), (walk, jeepney, LRT), and (jeepney, LRT, fx, walk).

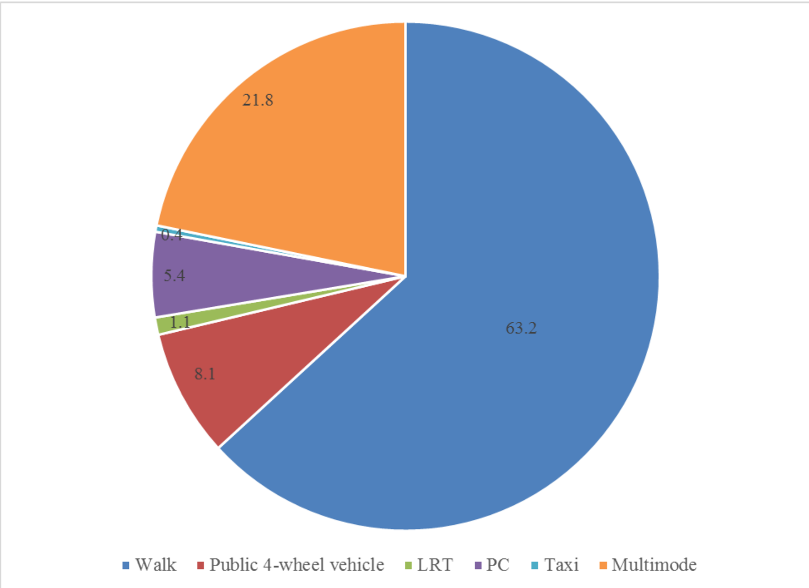

Figure 6. Percentage of Transportation Mode Used in Trips

4.4 Student Activities

A total of 2,160 activities were recorded from the data collected. These were grouped into 12 type of activities including traveling to school, attending class, rest/break, taking meals, recreation/leisure, schoolwork (which include research work, assignments, studying at the library, doing school project, etc.), training, work (include the student assistantship work and formal employment), social/organizational activity, shopping, picking up someone and going back to the accommodation. The frequency and total percentage of each of these group of activities are presented in Table 5 below. Attending class have the highest percentage of activities, which is predictable to students as their main activity. Traveling to school (20.5%)

and back home (20.4%) is almost the same, which should be as students usually take 2-way trip when doing these activities.

Table 5. Frequencies of activities by Students

Activity No.	Activity Description	Frequency	% of Total Activities
1	Travel to school	444	20.5
2	Attend class	818	37.9
3	Rest/Break	99	4.6
4	Meal	233	10.8
5	Recreation/leisure	32	1.5
6	Do schoolwork	40	1.8
7	Attend training	10	0.5
8	Go to work	12	0.6
9	Social/organization activity	20	0.9
10	Shopping	8	0.4
11	Pick up someone	3	0.1
12	Travel back home	441	20.4
	TOTAL	2160	100%

4.5 Time Allocation of Activities

Table 6 presents the average number of activities per students per day, their average time allocation for activities and the average travel time when doing the activities. The average number of attending class is the most frequent activity equivalent to 1.9. This means that students attend class in a day more than once. In addition, students go to school and travel back home atleast once in a day. Continue describing average number of activities per activity

As presented in the table, the average activity duration is 46.6 minutes. The average duration for attending classes as well as the travel time to and from the school takes the biggest percentage of time allocated by students. Continue putting details on percentage of average duration per activity

Going to school and travelling back home has the highest average time allocated. Students living outside the campus usually travel for atleast 1 hour.

The overall average travel time for activities is 12.5 minutes. This indicates that the majority of trips, are within or near the campus where students walk. Activities such as class, study, meals, social-recreation, and shopping occurred mainly on or near the campus and they have similar average travel times.

Table 6. Average Activity Duration and Travel Time

Activity No.	Activity	Ave. Number of Activities	Average Duration (min)	Ave Travel Time (min)
1	Travel to school	1.0	74.7	63.6
2	Attend class	1.9	306.4	11.0
3	Rest/Break	0.2	23.3	2.0
4	Meal	0.5	41.7	3.9
5	Recreation/leisure	0.1	9.3	1.5
6	Do	0.1	11.7	0.8

	schoolwork			
7	Attend training	0.02	4.8	0.6
8	Go to work	0.03	4.3	0.7
9	Social/organization activity	0.1	5.7	0.6
10	Shopping	0.02	2.0	0.4
11	Pick up someone	0.01	0.3	0.1
12	Travel back home	1.00	75.4	65.0
	Total Average	4.93	46.6	12.5

5. SUMMARY AND CONCLUSIONS

This study analyzed the activities of the students and their travel characteristics in terms of trip rates, travel modes and activity duration and allocation. Specifically, this study aimed at understanding the current transportation demand and travel needs of students at Mapua Institute of Technology by the use of activity-based analysis. This study provides some implications for activity-based travel demand analysis of students in universities. It provides important implications for the development of comprehensive travel demand model for universities in Manila, Philippines. Trip rates, that explicitly address student travel patterns was developed and a logit model was estimated.

Conclusions that can be drawn from this study include the following. First, for the trip rate, the average trip rate of students at Mapua is around 5.0 trips/day. This include the major activities including traveling to and from school and attending classes. The duration and time allocation for these activities has also the highest percentage. Second, for the trip rate logit model, the gender and presence or not of driver’s license are important predictors of students trip rates. Third, for the travel modes, walking is the most dominant mode of transportation used by the students. This shows that students are already using sustainable mode of transport for most of their travels which could help in reducing the emissions and travel delays. Students also prefer walking in short distances which is also related to the cost and time it takes for taking motorized mode of transport.

It is recognized in research that activity based modeling of travel demand is more realistic in terms of results it presents. Although this study is an initial step towards development of activity based travel demand model in university setting in the Philippines, the results give insight of how students choose their mode of transport. Also, it estimates the number of trips students make from their activities, which is related to determination of travel demand. Hence, results of this study, when validated, is helpful for future demand modeling. It can serve as a model input for travel demand modeling.

For future research, travel activities of faculty and staff members in the campus should also be considered. In addition, further investigation whether the trip rate model estimated in this study could be generalized to model the trip rate of students in Metro Manila.

REFERENCES

Eom, J., Stone, J., Ghosh, S. (2009) Daily Activity Patterns of University Students. *Journal of Urban Planning and Development*, 135, 141-149.

Ettema, D.F. and Timmermans, H. (1997) *Activity Based approaches to Travel Analysis*. 1st ed. Elsevier Science Ltd.

Irawan, M.Z., Sumi, T. (2011) Promoting Active Transport in Students' Travel Behavior: A Case from Yogyakarta (Indonesia). *Journal of Sustainable Development 4*, 1, 45-52.

MacNally, M.G., 1997. *Activity Based approaches to Travel Analysis*. In Progress in Activity based Analysis, 1st ed. Elsevier Science Ltd.

Mapua Institute of Technology Development Office for Information Technology (2013) Enrollment Statistics for School Year 2013 term 3. DOIT Helpdesk

Ortuzar, F., Willumsen, O. (2011) *Activity Based Models. Modelling Transport*, 4th ed. John Wiley and Sons: United Kingdom, 473-487

Papacostas, C.S., Prevendourous, P.D. (2005) Transportation Planning. In *Transportation Engineering and Planning*. SI ed. Pearson Education South Asia, 318-343.

Soltani, A., Zamiri, M. (2011) Investigation of School Students' Travel Patterns, Two Case Areas of Mashhad, Iran. *Modern Applied Science*, *5*, 5, 184-195.

Timmermans, H. (2005) *Activity-Based Approaches: Models, Data and Applications.* In Progress in Activity based Analysis. Elsevier Science Ltd.

Train, K. (2nd Ed.). (2009). *Discrete choice methods with simulation.* New York: Cambridge University Press.