SHOPPING CENTERS IN METRO MANILA AND NECESSITY FOR TRAFFIC IMPACT STUDY

Hilario Sean O. PALMIANO
Graduate Student
Dept. of Human Built Environment,
Tokyo Institute of Technology
tel/fax: +81 (045) 924-5651
email: sean@upl.enveng.titech.ac.jp

Takeshi KUROKAWA
Professor
Dept. of Human Built Environment,
Tokyo Institute of Technology
tel/fax: +81 (045) 924-5651
email: kurokawa@upl.enveng.titech.ac.jp

Ricardo G. SIGUA
Associate Professor
College of Engineering, and
National Center for Transportation Studies,
Univ. of the Philippines
tel/fax: +63 (2) 929-5664
email: rsigua@up-ncts.org.ph

(This paper is part of the on-going JSPS Project in Metro Manila)

Abstract: The necessity to develop an appropriate traffic impact study methodology for shopping centers in Metro Manila is the focus of this paper. A background on traffic impact studies in the U.S. is illustrated, focusing on the importance of trip generation and acceptable thresholds in the TIS process. Findings from a questionnaire survey facilitates the description of shopping centers in Metro Manila. Findings show high correlation of Gross Leasable Area (GLA) with the average daily number of visits generated. Patronage reaches as high as about 2,300 visits per 1,000 sq.m. of GLA on weekends. Observed traffic impact items are outlined, giving stress to those items related to public transport users which account for about 70% of the total patrons. The paper concludes with a summary of rationale for the necessity of traffic impact study, examples of negative impact mitigation measures, and recommendation for future research.

1. INTRODUCTION

"Malling" or going to shopping centers or malls has become a popular form of urban activity for residents of Metro Manila. Students, office workers, housewives, families, and other individuals or groups frequently troop the malls not only to purchase basic necessities as food and clothing, but also for recreation and other social activities.

More and more of these activity centers are rising up in the metropolis and their size and variety of goods, services and types of recreational facilities offered are enormously expanding.

As of 1997, there are about 20 major malls or shopping center complexes in Metro Manila with an aggregate area of 1.4 million sq. m. and an aggregate leasable area of about 200 hectares. Individual malls have an average gross leasable area (GLA) ranging from 100,000 to 300,000 sq. m.. Needless to say, these malls are considered major traffic generators with large malls having at least 50,000 to 60,000 visits on a typical weekend with one complex

shopping center claiming to have up to 100% increase in number of visitors during the Christmas season and during special "sale" days. (San Diego 1997)

One can picture immediately that shopping center developments of such magnitude easily translate to significant traffic impact especially on roads immediately adjacent to the malls. Many of the malls are situated along or near major arterials and the trips they generate add to the already heavily traversed arterials, contributing to the aggravation of congestion and delay.

Triggered by these initial observations and concerns, this paper is written with two specific purposes in mind. First is to determine if indeed, there is basis for the need for traffic impact analysis for shopping center developments in Metro Manila. Secondly, to identify some variables or characteristics of shopping centers that will be important in the development of an appropriate traffic impact analysis methodology for the case of Metro Manila.

2. BACKGROUND: TRAFFIC IMPACT ANALYSIS IN THE U.S.

Traffic Impact Study (TIS) had been established for a number of years now in countries with advanced urban planning concerns. Concrete evidence of this is the availability of documents such as those found in Michigan, USA (McKenna Associates, Inc. 1994) , and in the City of Indianapolis, USA (Barton-Aschman Associates, Inc. 1990) which outline specific procedures or guidelines in carrying out the TIS. The WHY's, WHEN's and HOW's of conducting the study are described in detail in such documents.

A simple definition of traffic impact analysis is given as "a specialized study which assesses the effects that a particular development's traffic will have on the surrounding transportation network" (McKenna Associates 1994). "Development" in the above definition will refer to shopping centers or shopping malls in this paper. The special study is done during the planning stages of the development with the purpose of (1) identifying compatibility or appropriateness of the development in the proposed site with constraints such as capacity of the surrounding transportation network as well as land use and zoning restrictions and (2) identifying possible improvements to assure safe and efficient access and traffic flow. The higher goal is to provide concrete measures to mitigate the negative impacts caused by the development on the surrounding area.

A fundamental step in TIS is determining the case when the study must be required from a proposed development. Two important items are essential in this decision. These are trip generation rates and acceptable threshold. If the former exceeds the latter, then the study is required. Acceptable thresholds can be considered as the acceptable level of traffic burdens expected of a new development. Therefore, any value above it is considered as producing an extraordinary traffic burden in the influence area.

As an illustration of acceptable threshold values, in the case of the city of Indianapolis in the U.S., it is taken as a rule of thumb that any development expected to produce 750 trips in an average day must conduct a TIS. In more detail, particularly for traffic engineering purposes, the threshold is defined as 100 peak hour trips for the predominant direction. (Barton-Aschman 1990, McKenna Assoc. 1994)

For shopping centers, a minimum GLA of about 2,700 sq. ft. (or approximately 250 sq. m.) is more or less equated with 750 trips per day trip generation, and GLA of 15,500 sq. ft. (1,440 sq. m.) for 100 directional peak hour trip generation. (McKenna Associates. 1994)

It must be noted that trip generation in this context is defined as the number of vehicular trips. It can be deduced that traffic impact analysis in the U.S. focus on trips made using the private car mode. Therefore, it addresses mainly the impacts related to car trips.

One of the main purpose of this research is development of TIS procedure for Metro Manila or the Philippines as a whole. Definition of trip generation, acceptable thresholds and traffic impacts for the U.S. case is of course expected to be quite different from the Metro Manila case (although there may be similarities). It is necessary therefore to investigate in detail the characteristics of shopping centers in Metro Manila and identify unique features that are related to TIS development.

3. PROFILE OF SHOPPING CENTERS IN METRO MANILA

3.1 Preliminary Questionnaire Survey

In order to get a clear picture of shopping centers in Metro Manila, a simple questionnaire survey was conducted last August, 1998. The questionnaire, was entitled "Shopping Center Characteristics and Traffic-Related Facilities" and was intended to get some general information about shopping centers in Metro Manila. The chairman of the Metro Manila Development Authority (MMDA) endorsed the questionnaire survey with the realization of the merits of the study. The endorsement in effect stressed the relevance of the study and helped increase the return percentage of respondents. The survey was considered as a preliminary data gathering activity for an intended full-scale study on traffic impacts in the near future.

Problems on identifying which shopping centers to include in the initial list of potential respondents were encountered as there is no clear definition and classification of shopping centers in Metro Manila. The definition given by ITE and which appears in Peyrebrune 1996 was made as the basis in drawing up the list of potential respondents. This definition is given below.

> *"A shopping center is an integrated group of commercial establishments that is planned, developed, owned and managed as a unit. Its composition is related to its market area in terms of size, location and type of store. Shopping centers provide on-site parking facilities. Some of the centers included non-merchandizing uses such as office buildings, movie theaters, post offices, banks, health clubs and recreational facilities such as skating rinks or indoor miniature golf courses."(ITE)*

The questionnaires were hand-carried by assigned personnel who are also instructed to explain the contents to mall administrators, follow-up the forms, and finally, pick-up the forms from the willing respondents. The return percentage was 44% (24 out of 57). However, due to problems on incomplete or missing data entries, data from only 11 shopping centers (19% of prospective respondents) were considered and included in conducting statistical analysis. The main criterion of inclusion is whether or not the data entries across important attributes are complete.

For this paper, questionnaire items on year constructed, location, size, tenancy, and the average daily number of visits will be given focus.

It must be stated at this point that all information so far gathered about shopping centers, with particular reference to estimates of average daily visits (or patronage), come from the side of shopping center administration. No actual field counts had been conducted.

3.2 General Description of Shopping Center Respondents

Information on 11 shopping center respondents are given in Table 1. For these respondents, the size ranges from 2,185 to a high of 108,000 square meters of GLA with an average of 44,303 sq. m. The earliest constructed was in the year 1971 and the latest, in 1995. The map in Figure 1 shows the relative location of the centers in Metro Manila.

3.3 Patronage, Average Daily Visits

Table 1 shows data on the average number of visits (person-trips) during typical weekdays and weekends, both during ordinary days and during the Christmas season. The highest visits (except on weekends) are attributed to shopping center F, the largest in GLA and relatively newly constructed (1990s). However, the highest values of visits per 1,000 sq.m. of GLA (Table 2) are obtained for shopping centers H and K which are relatively old and considered well established (1983, and 1976, respectively). H is one of the pioneer shopping malls in Metro Manila and K is located at a very popular commercial center area.

Table 1: Profile of Shopping Center Respondents

			Average Daily Visits			
Shopping Center	Year	GLA	Weekday	Weekend	Weekday (Christmas)	Weekend (Christmas)
A	1995	43,767	25,000	40,000	35,000	60,000
B	1994	57,951	45,000	60,000	70,000	85,000
C	1982	2,185	300	400	300	400
D	1995	5,409	2,000	4,000	2,000	5,000
E	1977	9,972	1,000	2,000	1,500	2,500
F	~1990s	108,000	90,000	100,000	120,000	150,000
G	1991	78,300	50,000	70,000	70,000	90,000
H	1983	56,488	85,000	135,000	100,000	145,000
I	1995	59,000	45,000	65,000	60,000	85,000
J	1971	26,611	18,000	25,000	40,000	80,000
K	1976	39,653	60,126	83,860	88,258	101,802
	MEAN	44,303	38,311	53,205	53,369	73,155
	Std. Dev.	32,502	32,092	43,691	41,340	52,538

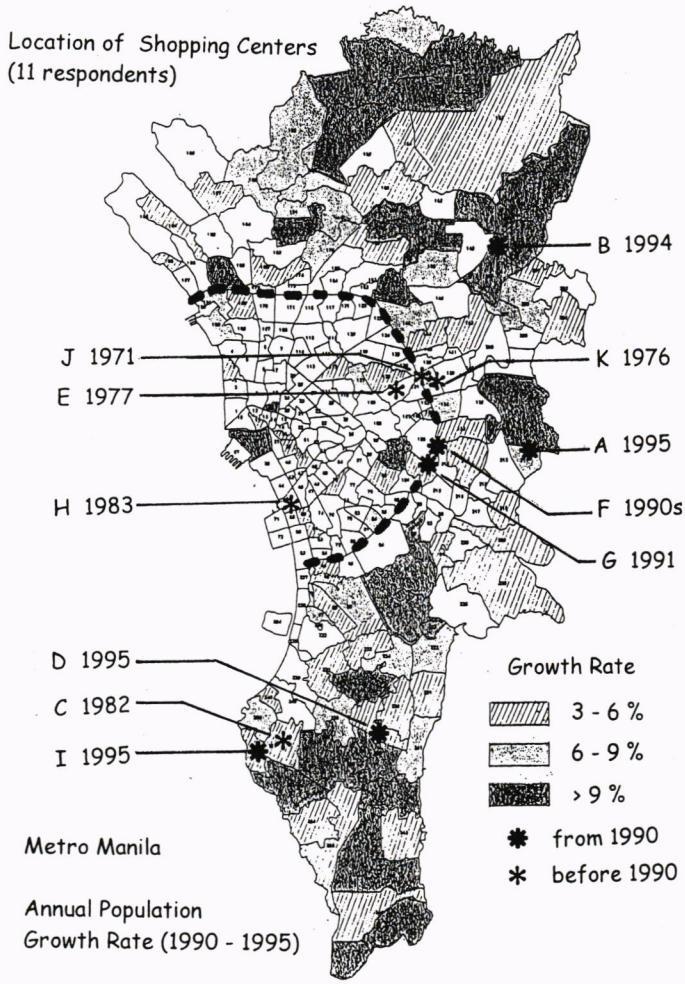


Figure 1: Map of Metro Manila's Annual Population Growth Rate (1990-1995) With Location and Year of Construction of 11 Shopping Center Respondents

The Metro Manila map showing annual population growth rate for the period 1990-1995 was obtained from MMUTIS 1997 Progress Report.
Heavy broken line divides Metro Manila into inner and outer core.

The Christmas season in the Philippines can be considered as one of the longest in the world which starts as early as late November and extends up to early January. The shopping frenzy reaches a climax during the middle two weeks of this period which includes both Christmas Day and New Year's Day. It is a common observation among Metro Manila dwellers that traffic substantially increases during this special holiday period.

Table 3 shows the ratios of weekend to weekday visits and Christmas season to rest-of-the-year (ordinary) visits. On the average, weekend trips are about 1.5 times higher than weekday trips while Christmas season trips are about another 1.4 times higher. The highest average Christmas season trips can reach to up to more than twice the average trips during ordinary weekdays.

Table 2 : Average Daily Visits Per 1,000 Square Meters of Gross Leasable Area (GLA)

			Average Daily Visits per 1,000 sq. m. of GLA			
Shopping Center	Year	GLA	Weekday	Weekend	Weekday (Christmas)	Weekend (Christmas)
A	1995	43,767	571	914	800	1,371
B	1994	57,951	777	1,035	1,208	1,467
C	1982	2,185	137	183	137	183
D	1995	5,409	370	739	370	924
E	1977	9,972	100	201	150	251
F	~1990s	108,000	833	926	1,111	1,389
G	1991	78,300	639	894	894	1,149
H	1983	56,488	1,505	2,390	1,770	2,567
I	1995	59,000	763	1,102	1,017	1,441
J	1971	26,611	676	939	1,503	3,006
K	1976	39,653	1,516	2,115	2,226	2,567
	MEAN	44,303	717	1,040	1,017	1483
	Std. Dev.	32,502	463.10	676.09	656.99	912.49

Table 3: Weekend to Weekday Patronage Ratios

	Ordinary	Christmas Season
Weekend to Weekday	1.51 (0.28)*	1.54 (0.41)

	Weekday	Weekend
Christmas to Ordinary	1.40 (0.33)	1.45 (0.60)

Christmas Weekend to Ordinary Weekdays	2.17 (0.84)

**standard deviation in parenthesis*

3.4 Tenancy

Figure 2 shows the breakdown of floor area into different types of tenants. Usual tenants of shopping malls in Metro Manila are eating places (restaurants, fast food chain and stalls, and food courts), groceries (or supermarkets), department stores, clothing shops, movie houses, amusement centers, and bookstores. From the figure it can be seen that the cumulative floor area of these tenant types, in most cases, constitute the larger part of the centers.

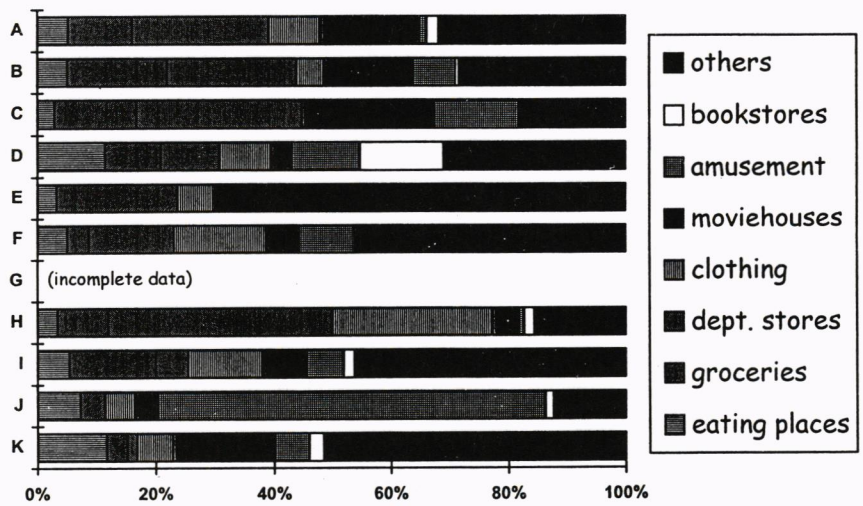


Figure 2: Breakdown of Shopping Center Area Into Some Major Tenants (expressed in percentage of total floor area)

However, it is also true that a considerable part of the total area is occupied by other important tenants. This only shows that there can still be wide variability in the overall image of the shopping centers depending on some other special features that they can offer. The composition of the remaining floor area which are referred to as "others" in the figure include novelty shops; public areas for resting; multi-purpose stage; non-merchandizing uses such as banks, telecommunication and computer products and services, health clubs; and recreational facilities such as skating rinks, bowling alleys, and indoor parks. It is also common, especially during weekends and holidays, for shopping malls to feature live shows (variety shows, game shows, beauty contest, promotional shows and contests) to attract more patrons. Finally, the usual lures such as special offers, discounts and sales during holidays and end-of-the-month sales (specially catering to workers who receive their salaries at the end of the month) are launched to further boost patronage.

3.5 Shopping Center Location Related To Metro Manila's Growth Pattern

The locations of shopping center respondents were plotted on a Metro Manila map (Figure 1) showing the annual population growth rate from 1990 to 1995 (MMUTIS, 1997). The years of construction of the center s are also indicated.

New shopping centers, or those constructed in the 1990's, mostly lie on the outer core or near high population growth areas (usually near high growth residential areas) which is an affirmation that location of new shopping center development follows the general growth pattern of Metro Manila.

Although this describes the general pattern of shopping mall development, it is also true that there is continuing development and renovation in the traditional and established commercial center areas which lie along the boundary between the inner and outer cores (along EDSA, a major arterial highway) as well as occasional developments in the inner core, usually in areas undergoing revitalization.

3.6 Trip Generation Characteristics

Four measures of shopping center size were used in the questionnaire. These are: total floor area (TFA), total building area (TBA), total floor area (TFA), and Gross Leasable Area (GLA). These variables were correlated with daily average visits quoted by the shopping center administrators and the results are shown in Table 4.

The correlation coefficients are all significant and among all measures of size, the GLA showed the highest correlation values. This result affirms that the GLA is a good determinant of trip generation for shopping centers in Metro Manila as is the case in developed countries like the U.S., where shopping center size variables have been conventionally used.

Table 4 : Correlation Coefficients Between Measures of Size and Patronage

Average Daily Visits on ...	Total Land Area (TLA)	Total Building Area (TBA)	Total Floor Area (TFA)	Gross Leasable Area (GLA)
Weekday (Ordinary)	0.65	0.75	0.76	0.86
Weekend (Ordinary)	0.76	0.84	0.65	0.78
Weekday (Christmas Season)	0.57*	0.66	0.76	0.88
Weekend (Christmas Season)	0.66	0.74	0.72	0.85

**t-test: significant at 90%; all other coefficients are significant at 95% for 9 degrees of freedom (Edwards 1967)*

Even with such high correlations however, it was observed from the scatter plots of the same variables that some data points tended to deviate from the regression line. Such shopping center respondents may represent special classification of centers corresponding to higher levels of patronage. Because of this, it is still advisable to gather more samples, and consider multivariate analysis in developing appropriate trip generation models.

Finally, previous exploratory study on Metro Manila shopping center trip generation showed that among four shopping centers studied in that research, the share of patrons using the public transportation mode ranged from 69% to 80% (Ortiz 1996). This shows an important difference in characteristic between shopping centers in Metro Manila and in developed countries like the U.S. where private cars are predominantly used for shopping center trips.

4. OBSERVED TRAFFIC IMPACT ITEMS

Commonly observed traffic impact items of shopping centers in Metro Manila can be summarized into four points. These are outlined and explained below.

4.1 Vehicular Conflict And Delays At Entrance And Exit Points

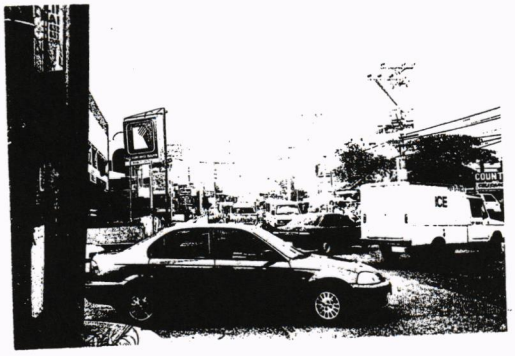
Most shopping center compounds are located right flush along major arterials roads or adjacent to major intersections. The obvious reason for this is for accessibility, and thus, higher patronage. Because of this, shopping center entry/exit access gates feed directly into the through stream of vehicles running down the arterial road (Pictures 1 and 2). Because of the high volume of vehicles going to or coming out of the compound, vehicular conflict with the through vehicles plying the arterial road and the delay caused by such conflict can sometimes cause localized traffic jams and increase accident hazard.

Many shopping center administrators are aware of this problem. It is encouraging to note that the administrators try to do their part in alleviating the problem. The more common measure they implement is hiring their own troop of traffic enforcers who are expected to facilitate access internally and at the entry/exit points. However, sometimes, even with the hired traffic enforcers, the problem still persists.

4.2 Congestion Of Access Roads

Roads providing access to the shopping center compound (either major arterials or small access roads) are likely to be congested because of both, the high volume of private cars generated on top of the existing traffic, and the problematic loading and unloading practices of public utility vehicles servicing the shopping center patrons. The root of the problem may be hypothesized as one of incompatibility between the capacity of roads and public transport facilities servicing the center and the size of shopping center development.

Picture 3 shows a congested access road leading to the back entrance gate to a large shopping center complex. This road is primarily a residential road (notice the row of subdivision houses). Since the development of the shopping center, it became the main

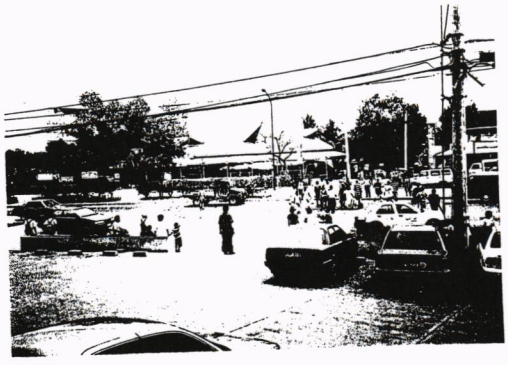


Picture 1: Vehicular Conflict at Exit/Entry Gates of Shopping Center Complex

Picture 2: Vehicular Conflict at Entry/Exit Gates of Shopping Center Complex

Picture 3: Congestion of Access Roads

Picture 4: Passenger and Pedestrian Accumulation; Safety Concern



Picture 5: Safety Issue for Pedestrians

Picture 6: A Shopping Mall in Metro Manila

back access road. A relatively high traffic congestion level in residential areas such as shown clearly poses negative impact such air pollution caused by vehicle exhaust, disturbance of neighborhood peace by vehicle noise and vibration, and traffic accident hazard, especially to children living in the residential subdivision.

4.3 Accumulation Of Public Transport Passengers And Pedestrians Obstructing Traffic Flow

It was mentioned in the previous section that a characteristic of shopping center trip generation for shopping centers in Metro Manila is the high percentage of public transport users (about 70%). It is not hard to imagine therefore the swarm of passengers that accumulate on the area just outside the shopping center building waiting for their public rides home or elsewhere. During peak hours, the swarm increases in volume causing passengers to encroach into the carriageway, causing congestion and delay and exposing themselves to accident hazard (Picture 4). The encroachment of passengers in the carriageway is aggravated further more if the setback or space between the road and the shopping center boundary is not enough.

Some shopping centers, out of original design or as added facility later on because of revealed demand, provide public terminals (for jeepneys, tricycles, taxis, and FXs) within the boundaries of their centers. Some even sacrifice sections of the customer parking area for that function. They willingly provide the terminal facility because this means higher accessibility, resulting to higher patronage. This can help solve the problem described in the previous paragraph because passengers are "contained" inside the compound. However, although they provide such facilities, it is seldom that all public transport users will find their desired public transport line among the terminals inside the center. Not all destinations are served or sometimes public transport capacity is inadequate. Therefore some passengers still need to go out of the compound and get their rides from the stops and terminals outside. This means that the passengers are not fully contained, thus, there is still accumulation of passengers just outside the center. Furthermore, public terminals inside the compound can mean an increase in frequency of vehicles coming in and out of the access gates. This adds to the vehicular conflict problem at entry/exit points described in item no. 1 above.

4.4 Safety Concerns For Pedestrians And Public Transport Riders

Safety issue for public transport users had already been described above particularly due to their tendency to use the carriageway while waiting for public rides. Pedestrians are likewise exposed to danger when crossing the road in order to get to the shopping center on the other side of the road (Picture 5). Some shopping centers initiate the provision of zebra pedestrian crossing (some even provide pedestrian overpasses), and hire traffic enforcers to help those people crossing the road.

5. RATIONALE FOR THE NECESSITY OF TRAFFIC IMPACT STUDY FOR SHOPPING CENTERS IN METRO MANILA

Evidences and findings presented so far lead to several rationale for pursuing further the implementation of traffic impact analysis for shopping centers in Metro Manila. The main points are summarized below.

1. From the observed phenomenon on passenger and pedestrian accumulation just outside the centers' premises and Ortiz's finding on approximately 70% share of public transport users for shopping center patrons, it is easy to see that more careful study on public transport generated trips must be given appropriate consideration. The U.S. example on impact studies mainly focus on generated private car trips primarily because private car modal share is very high in U.S. shopping centers. A focus on the generated public transportation trips, impacts, and related facilities can be considered a unique feature.

2. For private car trips, a rough comparison of acceptable threshold for impact studies in the U.S. and the visits per GLA from the findings in the questionnaire reveals another rationale. As earlier stated, an example of threshold when developments must be required to conduct a TIS is 750 generated vehicle trips per average day. Assuming that this threshold applies also to Metro Manila and using Ortiz's finding of about 30-70% split of private car to public transport usage for shopping center patrons, any shopping center with about 6,250 average daily visit satisfies the criterion. (Value of 6,250 average daily visit is equivalent to generating 750 private car trips, assuming 30% of visits use private car and occupancy is 2.5, the average car occupancy for Metro Manila in 1996 (MMUTIS, 1998).) Table 1 shows that the average daily visit among the shopping center respondents is about 38,000 visits per weekday, a value much higher than the computed example threshold of 6,250.

3. Related to item no. 1 above, issues on safety of pedestrians and public transport passengers must be given appropriate consideration.

4. Many major cities, especially those in the developed world and those experiencing fast urban growth recognizes the need for traffic impact studies as part of city transport and infrastructure planning (Barton-Aschman 1990). In Metro Manila, we saw that the location of new commercial developments follow the urban growth pattern. An efficient transportation network is becoming more and more important for these high growth areas. This leads to the need for more careful planning and design of facilities with regard to location and extent of development put up in those zones so that the transportation network will not experience bottlenecks and so that negative traffic impacts are mitigated.

6. MITIGATION OF NEGATIVE TRAFFIC IMPACTS

Section 4 described some traffic conditions which can be considered negative traffic impacts caused by the shopping centers in the immediate surrounding transportation network. Section 5 provided rationale for establishing a TIS system for shopping centers in Metro Manila. It was stated earlier also, in the background discussion of TIS, that the

higher goal is to provide concrete measures to mitigate the negative impacts caused by the development on the surrounding area.

In the case of Metro Manila, the issue on mitigation of negative impacts becomes all the more urgent and essential because the centers are already well established and therefore, the impacts are actually being felt and not simply predicted. (In contrast to impacts identified in the output of TIS where they are only forecasted before the development is constructed.)

Table 4 shows a concise outline of negative traffic impacts and some sample mitigation measures that may be implemented.

Aside from the traffic engineering and traffic management mitigation measures shown in Table 4, the role of policies and local government ordinances and enforcement of existing traffic ordinances and regulations are also important. For example, strict enforcement of no jaywalking for pedestrians will assure that pedestrians use the proper pedestrian crossing and will thus assure their safety. Enforcement of no loading and unloading areas near bottleneck areas like those areas in front of shopping centers can help reduce delays and obstruction due to passengers. Furthermore, policies or regulations against using subdivision (residential) roads as access to shopping centers can also be drawn up.

Table 4: Negative Traffic Impacts and Examples of Mitigation Measures

Negative Traffic Impact Item	Sample Mitigation Measures
• delay and conflict at entry/exit points	• right turn only (no left turn) traffic circulation • provision of left turn ramps • proper design and location of entry/exit points
• congestion of access roads	• widening of roads fronting the center • providing frontage roads • maintaining adequate setback from the road right of way to reduce traffic friction • selection of appropriate access roads
• hazard to pedestrians	• provision of pedestrian overpasses • proper location of pedestrian crossing or proper location of shopping center main entrance for pedestrians • safe and pleasant pedestrian paths/walkways
• hazard to public transportation passengers • delay and obstruction of vehicular flow due to passenger encroachment on carriageway	• provision of adequate and better public transport terminals and/or loading & unloading facilities inside the shopping center compound • adequate sidewalk width or public transport waiting area outside the center • proper location of terminals and stops

Another possibility is that additional amenities can be provided to offset the effects of the negative impacts. For example, if it is inevitable that a residential road (or any road for that matter) will be used as one of the main accesses to the center, effort to enhance the environment for the area affected must be required. For example a line of trees or shrubs

can be planted along the road to make the environment more pleasant and the air less polluted, or some noise buffers (perhaps a thick row of shrubs and trees) may be put in place to diminish noise pollution.

Many shopping centers are put up near residential areas. Perhaps one effective measure which is environment-friendly and favorable to both the shopping center developer and the residents (the potential patrons) alike is to provide a very good system of pedestrian access to the center from the residential area. The facility can be pictured as a network of pedestrian walkways with plenty of greeneries and small parks. A bicycle lane can also be included. The developer can even provide cart rentals or home delivery services so that the necessity for trips using cars or even public transportation can be minimized.

Finally, one last critical issue is on who will burden the cost of mitigation. This is actually beyond the scope of this paper but this issue must be confronted in future research. In general, the key "players" in the realm of shopping center traffic impact so far discussed are: the users (shopping center patrons), the shopping center developer, the local government, and the public transportation operators.

7. CONCLUSION

Enough evidence had been presented to show that there is a need to further study and concretize traffic impact analysis for shopping center developments in Metro Manila. For the long term, this means that a system or methodology for conducting traffic impact analysis must be developed. Furthermore, it is hoped that the process of requiring new shopping center development to submit TIS for impact analysis and evaluation process must become a regular feature of Metro Manila's transport and infrastructure planning practice. This paper is expected to be the first step in developing the appropriate TIS methodology for shopping centers in Metro Manila.

For future studies related to this research topic, the following are further recommended:

1. Consider the role of GLA in developing appropriate trip generation models for shopping centers. However the composition of tenants and the variety and wide range of activities offered in the centers must be investigated also. A highly divergent tenancy may draw visitors from different socio-economic cross sections and result in varying trip characteristics (Landis 1993).

2. Acceptable thresholds serve as basic criteria for conducting TIS, and therefore, such values must be identified for Metro Manila's case. Defined thresholds must address also the trips generated using public transportation.

3. Shopping center design and lay-out as well as transportation facilities provided must be studied and evaluated in detail in order to identify possible improvements in design to assure efficient and safe access to the shopping centers, and to mitigate the negative impacts. Some example of design elements are setbacks, provision of frontage roads, proper location of public transport terminals and stops, loading and unloading facilities, pedestrian facilities, etc. ⌘

ACKNOWLEDGMENTS

JSPS Metro Manila Project (This paper was carried out as part of the on-going project being conducted by Tokyo Institute of Technology in cooperation with the University of the Philippines.)

Metro Manila Development Authority (With special thanks to Chairman Jejomar Binay and Director Cora Cruz.)

U.P. National Center for Transportation Studies (With special thanks to Dr. Hussein Lidasan, Ms. Sheilah Gaabucayan and the graduate students.)

REFERENCES

Barton-Aschman Associates, Inc. (1990) Applicant's Guide: Transportation Impact Studies for Proposed Development. Division of Planning, Department of Metropolitan Development, City of Indianapolis.

Edwards, A.L. (1967) Table IV. Values of the correlation coefficients for various levels of significance, **Statistical Methods**. Holt, Rinehart and Winston, Inc., Seattle, Washington.

Landis, B.W. (1993) Improved Sampling Techniques to determine trip characteristics for traffic impact analyses. **Transportation Research Record 1400**, 78-81.

McKenna Associates, Inc. (1994) Evaluating Traffic Impact Studies - A Recommended Practice for Michigan Communities. Michigan Department of Transportation Studies.

MMUTIS Study Team (1997) Metro Manila Urban Transport Integration Study Progress Report I. JICA-DOTC Project.

MMUTIS Study Team (1998) A factbook on Metro Manila's transportation and traffic situation. JICA-DOTC Project.

Ortiz, G.R.C. (1996) An exploratory study on shopping center trip generation. College of Engineering, University of the Philippines, Diliman, Quezon City.

Ortuzar, J.D. and Willumsen, L.G. (1990, 1994) **Modelling Transport**. John Wiley and Sons, England.

Peyrebrune, J.C. (1996) Trip generation characteristics of shopping centers. **ITE Journal**, June 1996, 46-50.

San Diego, B.S. Jr. (1997) Special Report: It's a mall world, after all. **Mabuhay Magazine**, December 1997, 60-64.

Takyi, I.K. (1990) Trip generation analysis in a developing country context. **Transportation Research Record 1285**, 9-21. ⌘