Developing Alternate Methods for Determining Route Capacity of Public Transportation in Metro Manila

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Abstract: Metro Manila is the main metropolitan area of the Philippines. Public transportation is the dominant transport mode in Metro Manila, for which Public Utility Vehicles (PUV). The issuance of franchises including the allowed number of operating units for PUVs is governed by a Certificate of Public Convenience (CPCs), for which the Route Measured Capacity (RMC) is the main policy instrument. Most studies have shown that the RMC is unresponsive to land use changes and the resulting travel patterns of public transport riders. The PUVs thus have conflicting and overlapping routes where there are too few units during peak time, and too many units during off peak periods. This study aims to proposed alternate methods to determine the appropriate route capacity for public transportation modes. And one of the more promising methods is the use of land use as a determinant for public transportation fleet size requirements.

Keywords: Public Transportation, Route Capacity, Trip Generation, Trip Distribution, Mode Choice, Fleet Size

1. INTRODUCTION

1.1. Objectives

Metro Manila is the main metropolitan area of the Philippines, which also serves as its primate city. Despite being the center of the Philippines in all aspects of its society, Metro Manila is primarily served by a public transportation system whose routes are conflicting and overlapping. The mobility of people in Metro Manila are therefore constrained by this seeming anarchy of public transportation despite accommodating such a huge travel demand. The rapid urbanization of Metro Manila and its increasing impact to the nearby provinces have resulted to an even more dire situation for public transport riders. Lacking significant improvements to the public transport system, public transport trip makers have been experiencing longer travel times, longer queuing times, capacity constrained modes, and road congestion.

It is thus incumbent to adequately define alternative policy directions for public transportation in Metro Manila. It is in this context that the study aims to develop alternate methods in determining route capacity for public utility vehicles (PUVs), which comprise the greater majority of modes in Metro Manila.

1.2. Related Literature

There are a number of comprehensive transportation studies on Metro Manila, which has become the bases for numerous policy decisions, project appraisals, and project configurations. The Metro Manila Urban Transportation Integration Study (MMUTIS) is one such study, which is a technical assistance of the Japan International Cooperation Agency (JICA) for (then) Department of Transportation and Communication (DOTC) during the 1990s. The MMUTIS comprehensively estimated the trip patterns of Metro Manila and its neighboring provinces – Rizal, Cavite, Laguna, Bulacan. In 2015, JICA and DOTC (now Department of Transportation, DOTr) undertook an update of MMUTIS, which was called MMUTIS Update and Capacity Enhancement Program (MUCEP). The trip generation, trip distribution, modal split and route assignment rates and percentages were updated under the MUCEP, which also provided a training program for DOTr in terms of transportation science. This paper utilizes some of the data from the MUCEP and supplemented by additional information available in the public domain.

Specific studies on route capacity of public transportation modes in the country are limited. There are, however, a number of papers that have reported on the determination of route capacity using the traditional method that have been promulgated by the Philippine Government. Manresa et al (2015) described how the current formula (Route Measured Capacity, RMC) is being utilized as the policy instrument in determining public need of new or additional units for franchises of public transport. They have argued that the "concept and formula being assessed as no longer responsive to the current transport demand." The paper discussed the current use and future prospects for the formulas including the need to come up with a network-based approach in determining the number of vehicles required to serve the estimated passenger demand.

Carreon and Florendo in their 2013 paper applied the RMC formula in determining total passenger demand for the UP Campus – Katipunan public transport route in Quezon City, the biggest city in Metro Manila. Likewise, Mendoza and San Diego utilized the same RMC method for EDSA, the main arterial corridor of Metro Manila. They concluded that there is a 75% oversupply of buses in EDSA.

On the other hand, the study by Domingo et al discussed how the public bus sector became a highly fragmented market of operators to the point that the government has to issue a moratorium on new franchises. They detailed how "the current market operates under a complicated regime where regulation and enforcement is shared by several agencies." They highlighted how market inefficiencies in the public bus sector and coupled with the lack of discipline has added to metropolitan traffic congestion. The fragmented nature of both the sector's regulatory and supply side impedes synchronization among stakeholders and incurs huge costs to industry operators and the riding public.

2. STUDY AREA

2.1. Metro Manila

Metro Manila is officially called Metropolitan Manila and is considered as the National Capital Region (NCR) of the Philippines. Outside the country, it is simply referred to as Manila. It is the seat of government, the 2nd most populous region of the country, and is the most densely populated region of the country. The National Capital Region is composed of Manila, the capital city of the country, Quezon City, the country's most populous city, the Municipality of Pateros, and the cities of Caloocan, Las Piñas, Makati, Malabon, Mandaluyong, Marikina, Muntinlupa, Navotas, Parañaque, Pasay, Pasig, San Juan, Taguig, and Valenzuela.

The National Capital Region, with an area of 619.5 km^2, has a population of 12,877,253. This makes NCR the most populous region in the Philippines, as well as the 9th most populous metropolitan area in Asia. The total urbanized area, referring to its continuous urban expansion into the provinces of Bulacan, Cavite, Laguna, Rizal and Batangas, was listed as having a population of 24,123,000 making it the 4th most populous urban area in the world. These 5 provinces, plus Metro Manila and Pampanga, sum to 30.7 million residents as of the newly counted census of 2015.

The region is the center of culture, economy, education, and government of the Philippines. NCR is one of the 12 defined metropolitan areas in the Philippines according to the National Economic and Development Authority. Designated as a global power city, NCR exerts a significant impact on commerce, finance, media, art, fashion, research, technology, education, and entertainment, both locally and internationally. It is the home to all the consulates and embassies in the Philippines, thereby making it an important center for international diplomacy in the country. Its economic power makes the region the country's premier center for finance and commerce. NCR accounts for 37.2% of the gross domestic product of the Philippines.

The region was established in 1975 through Presidential Decree No. 824 in response to the needs to sustain the growing population and for the creation for the center of political power and the seat of the Government of the Philippines. The Province of Manila, the progenitor to the present-day Metro Manila, is one of the eight original provinces that revolted against the Spanish colonial rule in the Philippines. The province was honored as one of the sun rays in the Flag of the Philippines, with each of the eight sun rays symbolizing one of the eight revolutionary provinces. Figure 1 shows the map of Metro Manila.

Metro Manila and its nearby environs generates and attracts a vast number of trips (travels). JICA and the DOTr has recently conducted a study on Metro Manila transportation called MMUTIS Update and Capacity Enhancement Project (MUCEP). MMUTIS is the comprehensive Metro Manila Urban Transportation Integration Study undertaken in 1998.

Car ownership in this Greater Manila Area (including Bulacan, Rizal, Cavite and Laguna) is estimated to be 2,887,992. The study estimates that there are around 46,818,000 trips in a day within Metro Manila, including trips coming from Bulacan, Rizal, Cavite and Laguna. Majority of these trips are to-home and to-work purpose (see Figure 2).

Figure 1. Map of Metro Manila

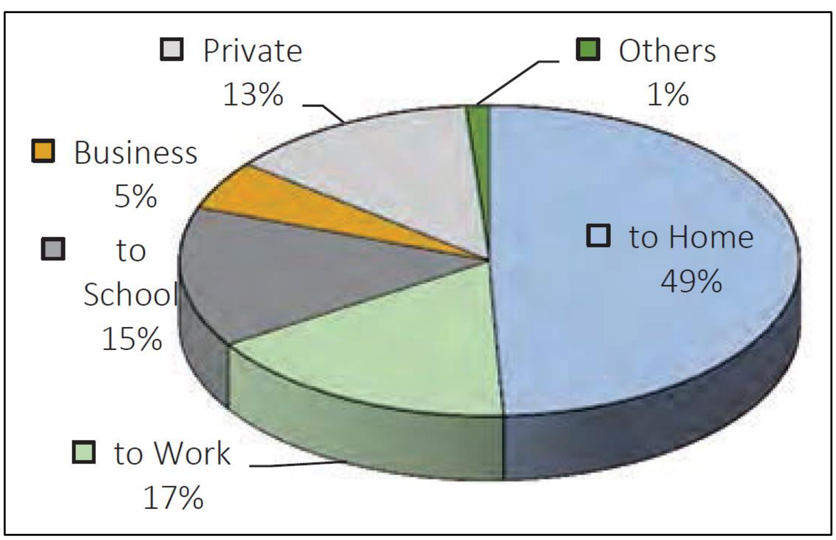

Figure 2. Trips by Purpose in Greater Manila Area

Most of these trips are undertaken through public transportation, for which the majority are using Jeepneys (refer to Figure 3). Makati, Pasig, and Quezon Cities have large agglomerations of business centers and attract a huge number of “to work” and “business” trips. Manila and Quezon Cities attract “to school” trips. The concentration, however, is only a small scale because the majority of students move within the same zone as generated.

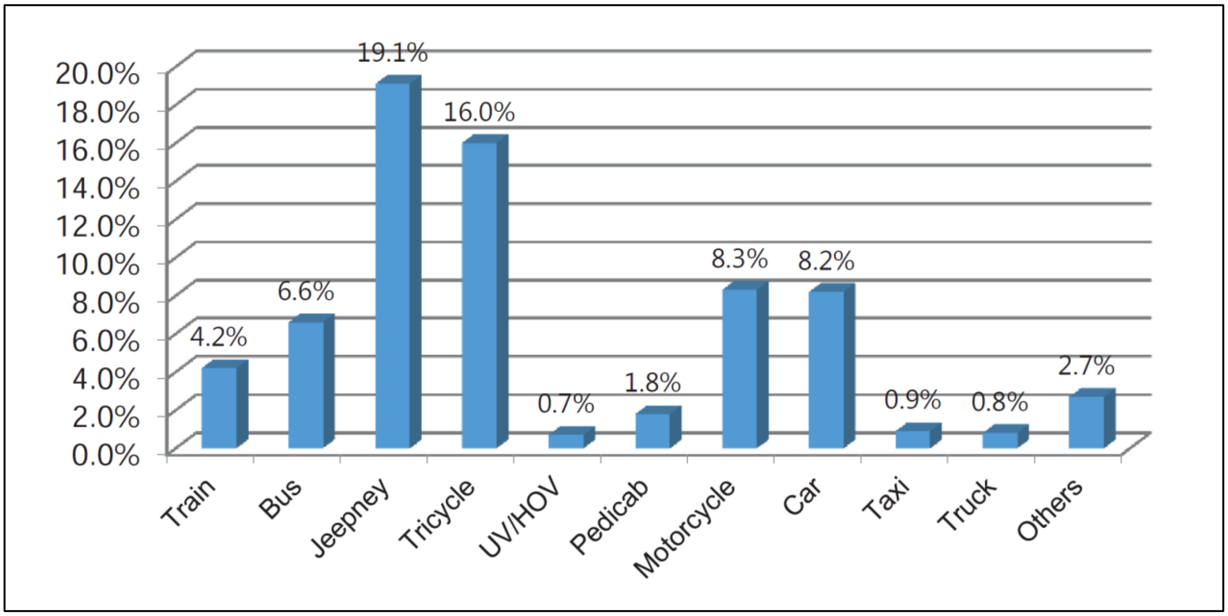

Figure 3. Trips by Transport Modes in Greater Manila Area

2.2. Case Study Site – Katipunan Avenue

The actual site for the case study site is the Katipunan Avenue corridor in Quezon City, which is part of Circumferential Road No. 5 (C-5) – an arterial circumferential road that spans the outer ring of Metro Manila. Quezon City is the biggest city in Metro Manila and second largest in the country in terms of land area. Quezon City used to be the national capital of the country from the the Commonwealth period until 1976, when it reverted back to the City of Manila.

Typical in Metro Manila (as can be seen in the modal split chart in Figure 3), the specific area (zoned collectively as Loyola Heights) is being covered by Public Utility Jeepney (PUJs) that provide services to a public transport route called: UP Campus – Katipunan. Figure 4 shows the location of the Katipunan corridor, which is characterized by three major land uses – (i) Institutional – comprising of the University of the Philippines, Ateneo de Manila University, and Miriam College – the biggest tertiary education centers of the country; (ii) Residential – comprising of middle class subdivisions and condominiums; and (iii) Commercial – commercial services including a major mall. Over-all, the specific study site has an aggregate area of 357 ha. Its population ranges from 51,000 to 59,000 with an average income of Php 16,000 per month (one of the highest in the country) and an average car ownership rate of 17%. The summary of the profile of the case study is listed in Table 1.

The area is also served by 154 units of PUJs comprising of three operator associations and three transport routes. The first two services are regular PUJs, while the third one is an electric PUJs but nonetheless operates similar to PUJs. Outside of these, there are tricycles, which are short distance motorcycle taxi with sidecars but not covered by national franchises.

Taxi services cover these routes but these are typically demand sensitive. Table 2 shows the summary of the PUJ operating units in the study area.

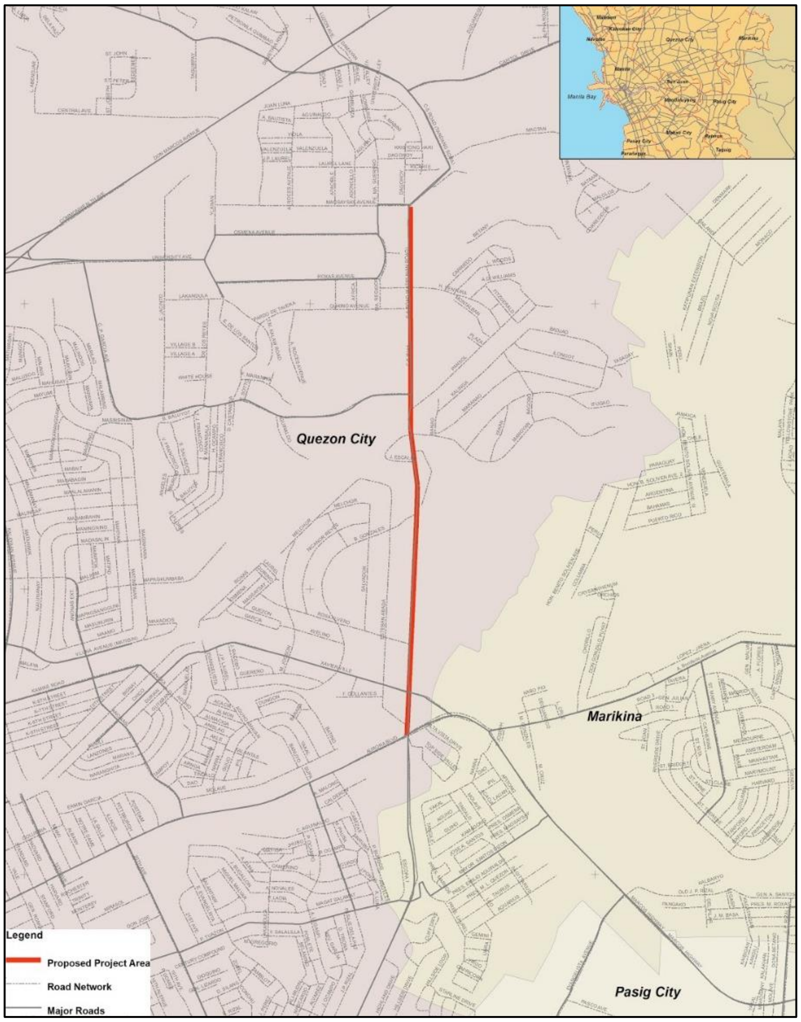

Figure 4. Location Map of Study Area

Table 1. Case Study Profile

Category	Data
Land Area	357.28 ha
Population in 2014 (actual)	59,272 (night) / 51,809 (day)
Population in 2025 (projected)	66,852 (night) / 60,979 (day)
Average Household Income in 2014 (actual)	16,364 Php/month
Car Ownership Rate in 2014 (Actual)	17.2%
Car Ownership Rate in 2025 (Projected)	28.1%

Table 2. Profile of Public Transport Services in the Study Area

Association	Number of Units	Route
Katipunan K-Mart Jeepney Operators and Drivers Association (KKJODA)	80 jeepney units	Katipunan corner Aurora Boulevard-UP Campus
Balara Katipunan Jeepney Operators and Drivers Association (BKJODA)	60 jeepney units	Katipunan corner Aurora Boulevard-UP Campus Gate
Community Optimized Managed Electric Transport (COMET)	14 e-jeepney units (same with Jeepneys with 20 seating capacity)	Katipunan corner Aurora Boulevard-SM North
TOTAL	**154 UNITS**	

3. THE POLICY INSTRUMENT – ROUTE MEASURED CAPACITY (RMC)

3.1. Concept

The Route Measured Capacity (RMC) is a policy instrument being instituted jointly by the Department of Transportation (DOTr, being the policy and planning body for transportation), and the Land Transportation Franchising and Regulatory Board (LTFRB, being the regulatory agency for public transportation). The RMC represents the public necessity requirements in the franchising procedure, for which a certification is required for the issuance of the Certificate of Public Convenience (CPC) by the LTFRB. The CPC is the official franchise or permit from the Philippine Government that allows a private entity to operate public transportation in the country. The RMC is computed by the following formula:

$$RMC = \frac{PD}{ASC \times VLF \times NRT \times u} \tag{1}$$

where:

PD = passenger demand in a route (one-way)

ASC = average seating capacity

VLF = viable load factor

NRT = ideal number of round trips per vehicle per day

u = utilization factor

The RMC embodies the number of services required in a given route that is being operated by any public utility vehicle whether bus, jeepneys or utility vehicles. It is traditionally computed by the Road Transport Planning Division (RTPD) of the DOTr. It is a simple approach that considers the passenger and the public transport operator. It assesses passenger demand on a route and whether additional vehicles are needed to make a profit (financial capability). Normally, the private sector proposes the routes and number of units, where the processes are dependent on the operator’s willingness to enter the market and operate a public transport service. It is highly useful for areas with simple route structures and few trip activities.

3.2. Legal Basis

The Public Service Act of 1936 (Commonwealth Act No. 146) prescribed the framework by which public services were regulated in terms of fare regulation and quality of service. This is the basis for the issuance of franchises for public services called Certificate of Public Convenience (CPC). In 1979, Executive Order No. 546 created the Ministry of Public Works and a Ministry of Transportation and Communications (the precursor of DOTr), which also established the Board of Transportation (BOT) that is responsible for franchising public transport vehicles and setting routes and fares. In 1987, Executive Order No. 202 was issued transforming the BOT into the Land Transportation Franchising and Regulatory Board (LTFRB) with a full mandate to issue, amend, revise, suspend or cancel Certificates of Public Convenience or permits authorizing the operation of public land transportation services provided by motorized vehicles.

The then Department of Transportation and Communications (the precursor of DOTr) instituted Department Order No. 587 in 1992 defining the policy framework on the regulation of transport services, which states that “the route measured capacity test or other similar tests of demand for vehicle/vessel fleet on any route shall be used only as a guide in weighing the merits of each franchise application and not as limit to the merits offered” and that “where there are limitations in facilities such as congested road space in urban areas, or at airports and ports, the use of demand management measures in conformity with market principles may be considered.” In 2011, LTFRB issued Memorandum Circular No. 004 mandating a Revised Terms and Conditions of CPC, which enumerates the terms and conditions for application of franchise by operators of public utility vehicles (PUVs) including the requirement that an operator: (i) must be a Filipino citizen (or if a corporation, 60% of the shares must be Filipino-owned); (ii) must be able to prove financial capability to operate public transport services; and (iii) proof of public necessity for such service (i.e. computing the RMC for the proposed route).

3.3. Gaps and Issues

In general, the RMC has proven to be useful for simple routes as most studies and papers would discussed in their findings. However, there are inherent weakness to the formula as a policy instrument including how the processes is being implemented on the ground. The summary of issues confounding the RMC are the following:

a. Route analysis done by DOTr uses passenger demand resulting from surveys conducted. There is lack in effort or capacity to verify and validate these surveys;
b. Variables inputted in the RMC formula are provided by investors or prospective operators creating an inherent bias;
c. The integrity of using RMC highly depends on the integrity of the user and the inputs;
d. The RMC was treated by LTFRB more as a guide in franchising; and
e. A moratorium on the issuance of RMC for existing routes was declared by DOTr since August 2010. Hence, RMC is used only to validate the number of public transport vehicles on existing routes.

The gaps in the RMC as a policy process is also compounded by institutional weaknesses of the regulating agency (e.g. LTFRB) mandated to oversee public land transportation. These infirmities are as follows:

a. A small unit in DOTr (the RTPD) in charge to compute RMC for the whole country;
b. Congestion of applications/transactions in LTFRB;
c. Lack of database that would provide for easier facilitation of transactions in LTFRB and DOTr;
d. Limited number of personnel in LTFRB and DOTr;
e. Unavailability of signatories in LTFRB, mainly because they are also doing other tasks in relation to their functions; and
f. Too many required documents by LTFRB, the veracity and authenticity of which cannot be determined by the personnel.

4. METHODOLOGY AND FINDINGS

4.1. Alternate Methods

The formula for route-measured capacity (RMC) as seen in Equation 1 is essentially a demand-capacity equation where the demand for a given route should be approximately accommodated by the total seating capacities of all units serving the said route. That being said, there are alternate methods in estimating both the demand and supply sides of the equation. This study explores such alternative approaches in determining a demand-capacity equation for public transport routes that is foremost responsive to emerging land use and at the same time easily utilized by national and local government agencies. For this research, the following methods were explored as alternate practices for route capacity determination:

a. Origin-Destination (OD) Matrix;
b. Land Use and Trip Generation Rates;
c. Fleet Size Operations; and
d. Traffic Volume Survey.

The succeeding sections below discuss each of the alternate methods above and the results therein after utilizing the same data inputs as much as practicable. It goes without saying that some of the results in some of the other methods are used either way as base material for the next method, where necessary.

4.2. Origin-Destination Matrix

One of the outputs of a standard four-step urban transportation model is the Origin-Destination (OD) Matrix, which disaggregates the person trips and how it corresponds from one zone to another. The specific zone upon which the study focuses is Loyola Heights (Zone 143) as can be seen from Figure 5. Zone 143, on the other hand, is one of the zones comprising the zonal classification made for Metro Manila as part of the MUCEP Study. The OD trips for Zone 143 are taken from the general OD Matrix for Metro Manila as developed by the MUCEP Study.

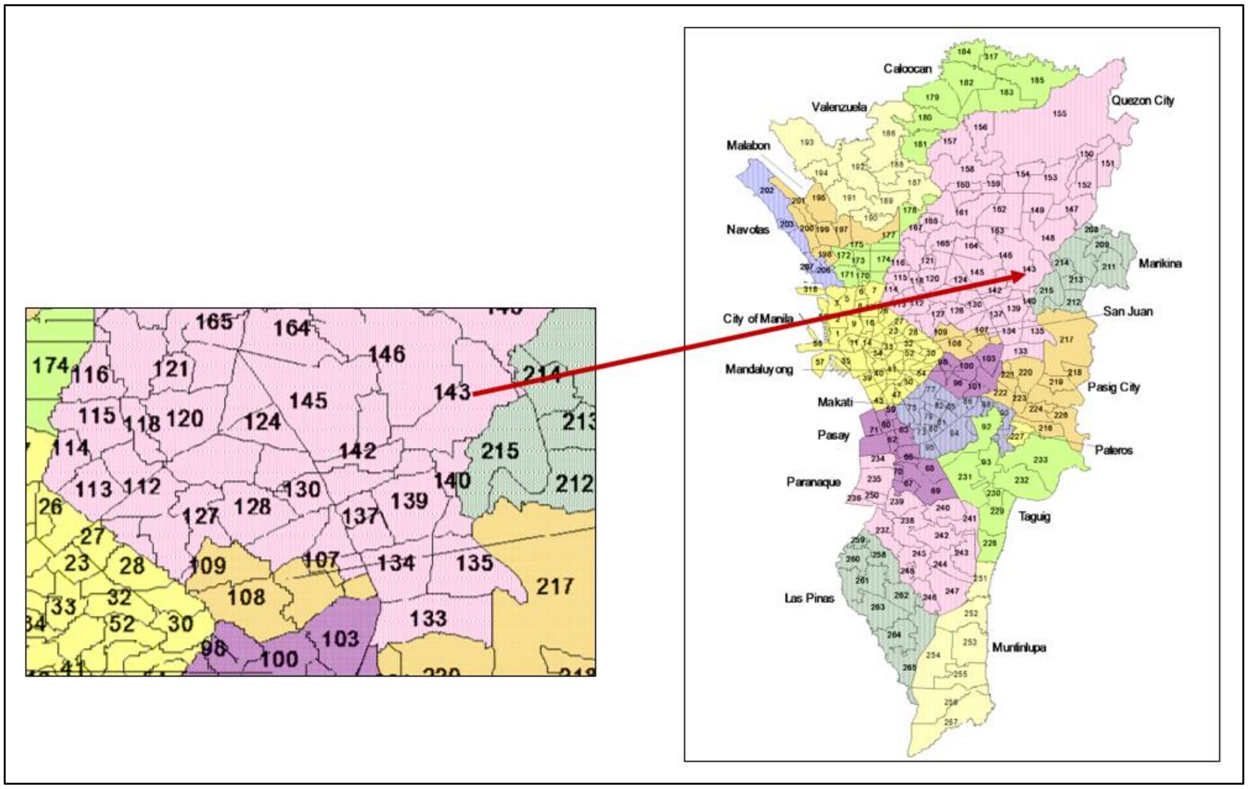

Figure 5. Specific Study Zone (Loyola Heights – Zone 143)) in Metro Manila

As mentioned above, the MUCEP Study developed the standard four-step models for the zones in Metro Manila – Trip Generation, Trip Distribution, Modal Split, and Route Assignment. The study area is composed roughly of 31,000 person trips where the majority of the trip purposes are To-Home, To-Work, and To-School (Figure 6). Most of the trips (Figure 7) in the study area are undertaken through private cars (external and internal trips), followed closely by Bus (external trips), and PUJs (internal trips). The MUCEP Study expects that this modal choice especially in terms of public/private transport split will remain the same over a ten-year period (Figure 8).

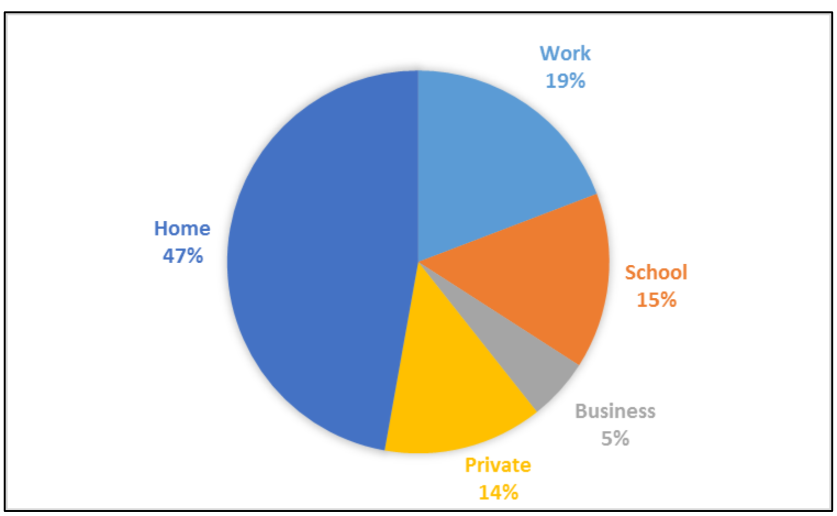

Figure 6. Trip Purpose of the Study Area (Loyola Heights - Zone 143)

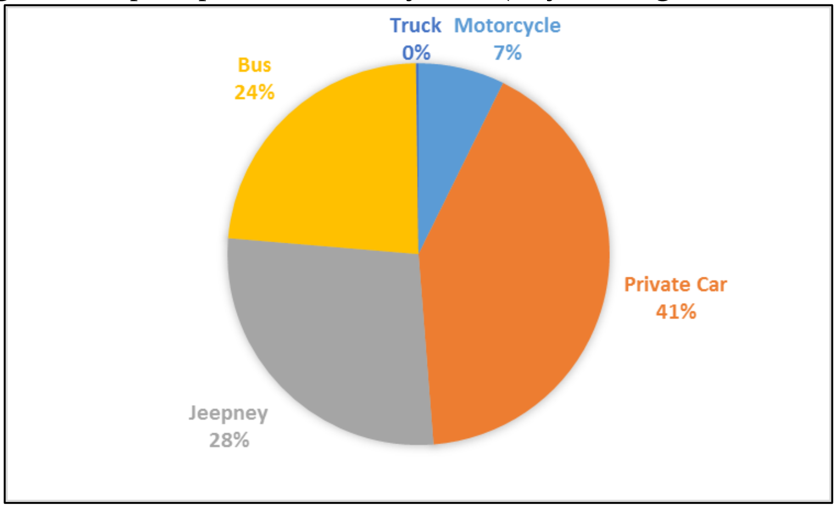

Figure 7. Modal Split for the Study Zone (Loyola Heights – Zone 143)

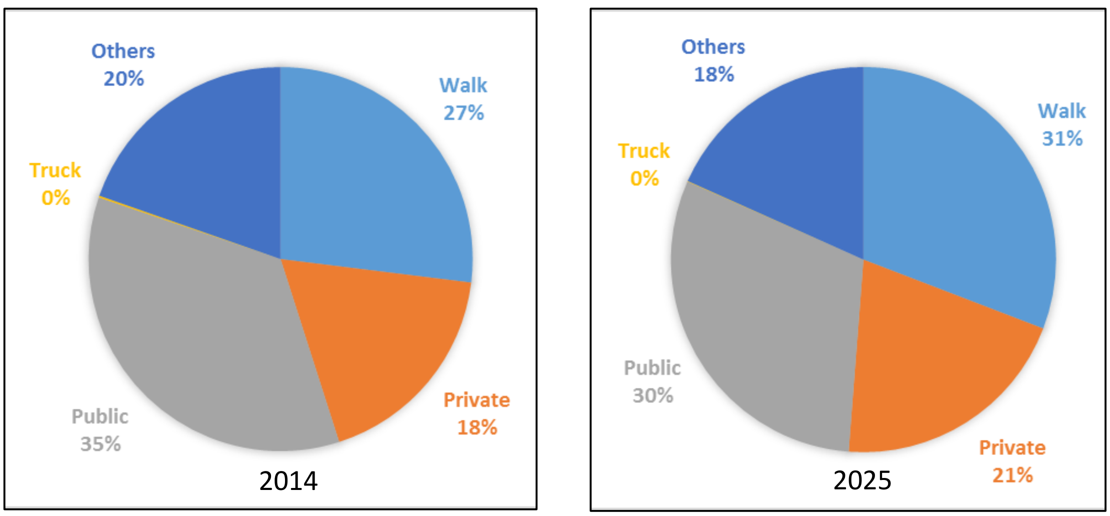

Figure 8. Public/Private Modal Split for 2014 vs 2025

The person trip demand for PUJs for Zone 143 (31,446 trips) is then assessed against the estimated total capacity of the route (UP Campus – Katipunan), which is 27,720 taking into account load, utilization and seat capacity factors for the total operating PUJ units. The results of this particular method (Table 3) would illustrate that the Demand/Capacity Ratio is 1.13, which means that total capacity of the PUJ route is not adequate to fully accommodate the travel demand for PUJs. This is evident in the long queue of passengers in PUJ terminals during peak hours in the morning and in the afternoon.

Table 3. Results of Using the OD Matrix for the Study Zone for Route Capacity Analysis

Parameter	Value
Demand	31,446
Capacity	27,720
D/C	1.13

4.3. Land Use and Trip Generation Rates

This alternative method focuses on the relationship between land use and trip generation. Local governments are mandated to define the existing land use and the future land use that it aspires to consistent with its development vision within a planning horizon. The generated person trips are computed by multiplying a trip generation rate unto a land use area. This paper used the trip generation rates developed by the MUCEP Study for Metro Manila (see Table 4). The land use areas are estimated using Geographic Information System (GIS) that can easily compute gross floor areas for the study zone. The present (actual) and proposed future land use (from the Quezon City Land Use Plan) of the study zone are illustrated in Figures 9 and 10, majority of which are defined by office, residential and commercial land uses.

Table 4. Land Use Trip Generation Rates (from MUCEP Study)

Land Use Classification	Trip Rates		
	Production	Attraction	Unit
Office	0.0027	0.0176	trips / sq.m. of GFA
Commercial	0.0576	0.0735	trips / sq.m. of GFA
Hotel	2.00	2.55	trips / hotel room
Residential	2.42	1.52	trips / dwelling unit
Mixed Use	0.0172	0.0243	trips / sq.m. of GFA

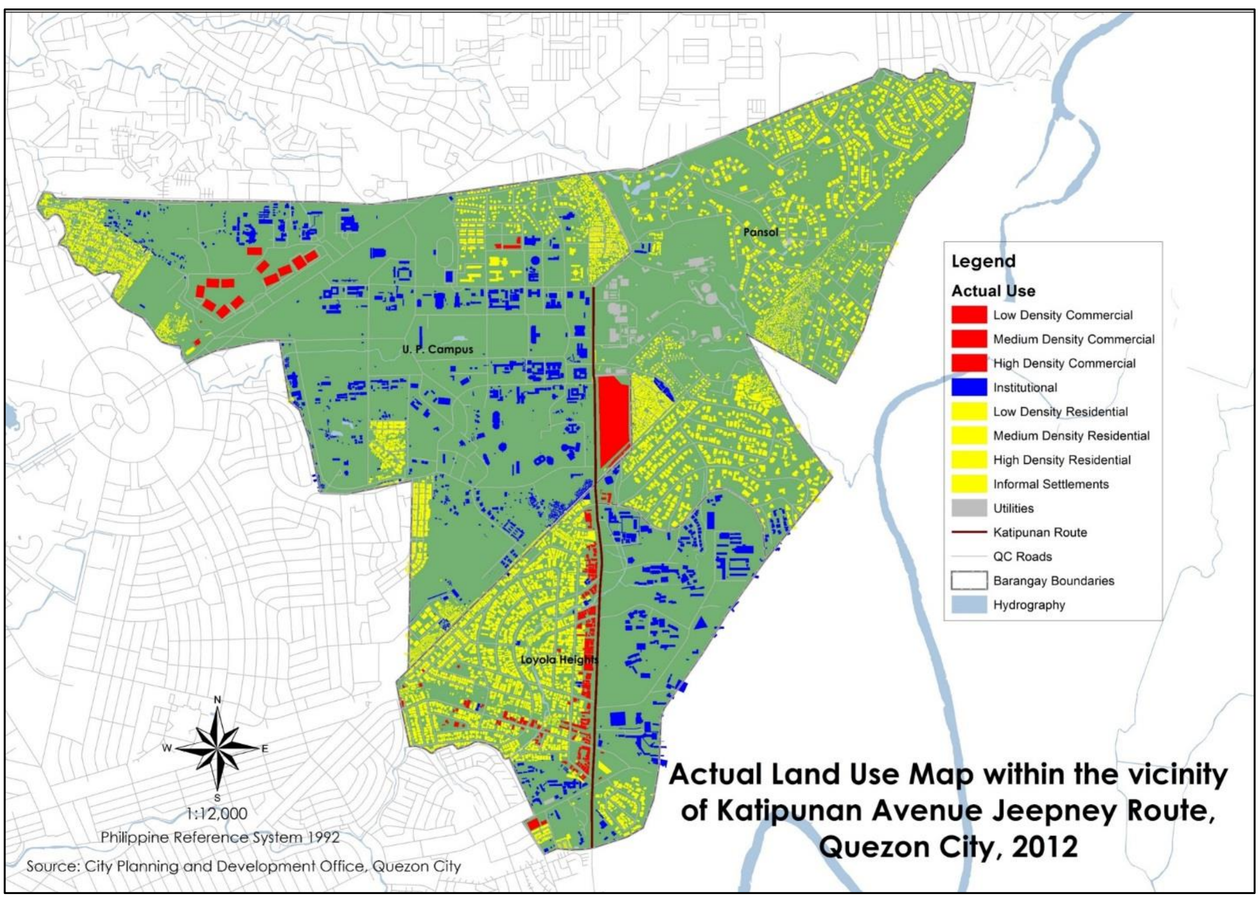

Figure 9. Actual Land Use of the Study Zone

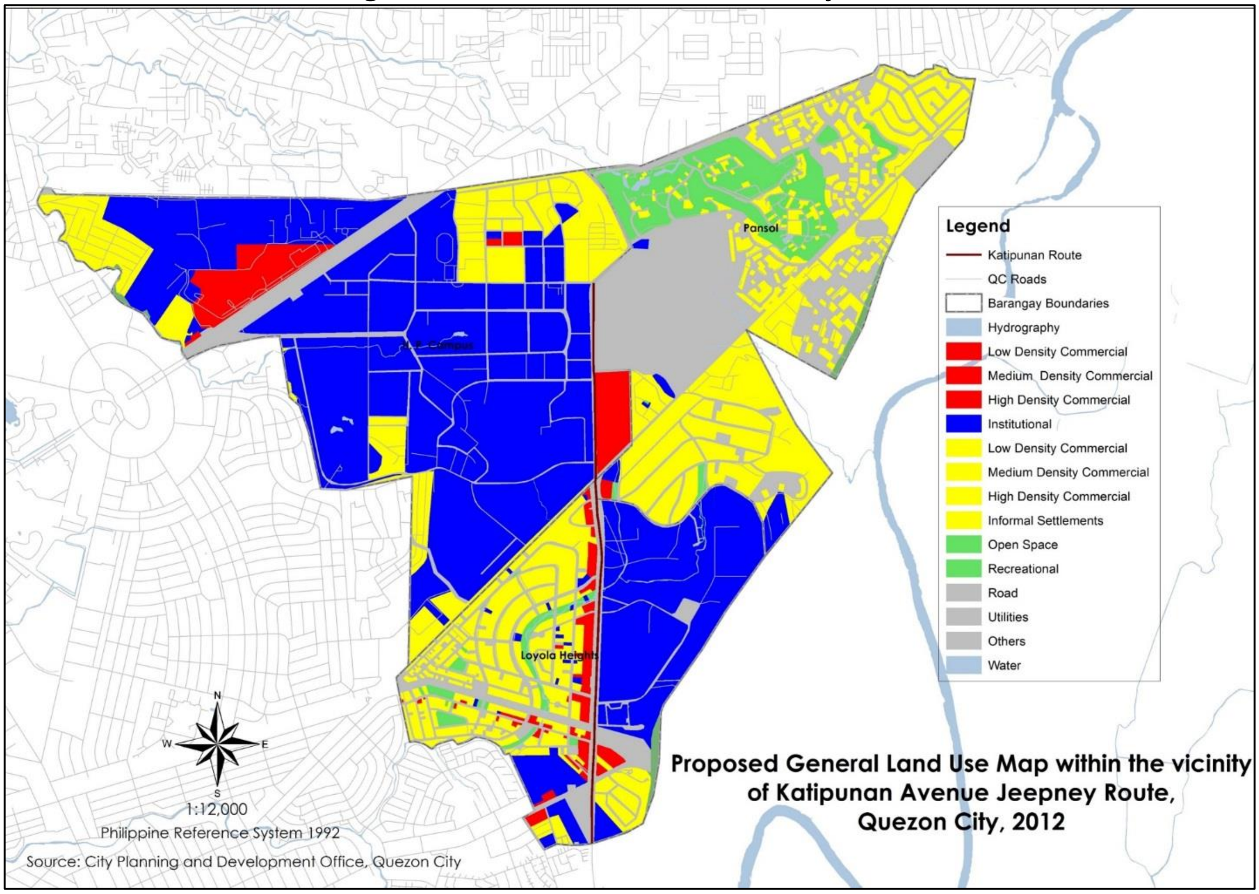

Figure 10. Proposed Land Use of the Study Zone (from the Quezon City Land Use Plan)

The following processes were used in GIS in estimating the actual and future land use areas of the study zone:

a. Building Footprints were extracted from LIDAR-derived Digital Surface and Digital Elevation Models;
b. Building Heights were calculated by normalizing heights values of both Models;
c. Building Footprint Land Areas were calculated using GIS;
d. Number of Floors were estimated using Calculated Building Height/Average Height per Floor; and
e. Average Height was assumed based on characteristics of building actual use.

The estimated actual and future land use areas (Tables 5 and 6) are multiplied against the corresponding trip generation rates from the MUCEP Study, which will give an estimate of the person trips generated for the zone. The modal split for PUJ in the previous section is used as the mode share factor in determining the ultimate demand for PUJs for the corridor. The results of this alternate method would show that there may be roughly 43,000 person trips for PUJ that are generated from the actual land use of the study zone (Table 7). The demand/capacity ratio would then be 1.59 for the same total PUJ operating capacity of 27,000. This would mean that demand is more than 50% of the total capacity of the PUJ units if the land use is used as the determinant.

Table 5. Estimated Actual Land Use Areas for the Study Zone

Actual Use Classification	Estimated Floor Area (sqm)
Low Density Commercial	9,853.63
Medium Density Commercial	156,947.04
High Density Commercial	367,062.25
Institutional	930,106.17
Informal Settlements	371,927.47
Low Density Residential	731,607.57
Medium Density Residential	303,008.77
High Density Residential	516,702.92
Utilities	97,865.98

Table 6. Estimated Future Land Use Areas for the Study Zone

Proposed Land Use Classification	Land Area (sqm)	Assumed Average Number of Floor/s	Projected Max. Floor Area (sqm)
Low Density Commercial	1,345.43	1	1,345.43
Medium Density Commercial	141,922.82	2	283,845.65
High Density Commercial	277,649.61	4	1,110,598.42
Institutional	3,988,572.16	3	11,965,716.47
Low Density Residential	1,238,033.71	1.5	1,857,050.57
Medium Density Residential	367,664.44	4	1,4706,57.76
High Density Residential	614,096.07	7	4,298,672.52
Informal Settlements	628,081.91	1	628,081.91
Recreational	397,694.56	1	397,694.56

Table 7. Results of Using Land Use and Trip Generation Rates for Route Capacity Analysis

Parameter	Value
Demand	43,965
Capacity	27,720
D/C	1.59

4.4. Standard Fleet Size Operations

Determining the appropriate number of units for PUJ can be viewed as computing for the standard fleet size operational requirements for a transport provider. The fleet size requirements is computed as roundtrip time over the headway, where the headway is the vehicle capacity (multiplied by a factor of 60) divided by the peak hour demand. This of course assumes that a proper headway can be attained given existing road conditions for the study zone. Table 8 shows the fleet size operational requirements for the base period of 2014, and Table 9 lists the fleet size requirements for the horizon period of 2025. Both tables used the derived peak hour demand from the OD Matrix and Land Use-Trip Generation Alternate Methods. There are presently 154 operating units servicing the subject route. Both alternate methods would show that the current number of operating PUJ units could be enough if compared to the ranges of fleet size requirements (between 126 to 176 units) if computed using the alternate methods. However, the emerging and future land use would dictate that the current operating PUJ units are certainly not adequate to accommodate the future projected demand, which would require between 212 to 297 units (if using the alternative methods).

Table 8. Fleet Size Operational Requirement for 2014 for the Study Zone

Base Model	OD Matrix Method	Land Use / Trip Gen Rate Method
Peak Demand	2,516	3,517
Headway	0.48	0.34
Roundtrip Time	60	60
Fleet Size	126	176

Table 9. Fleet Size Operational Requirement for 2025 for the Study Zone

Base Model	OD Matrix Method	Land Use / Trip Gen Rate Method
Peak Demand	4,241	5,929
Headway	0.28	0.20
Roundtrip Time	60	60
Fleet Size	212	297

4.5. Traffic Volume Survey

The traffic volume survey alternate method is essentially using a classified traffic volume count to estimate the PUJ share given the level of service conditions of the subject road. Figures 11 and 12 charts the traffic volume count and the modal split of the northbound and southbound routes of Katipunan Avenue, which covers the study zone. The northbound peaks (towards Quezon City) are 7:00 am, 3:00 pm and 7:00 pm with an 8% public transport split (mostly PUJs).

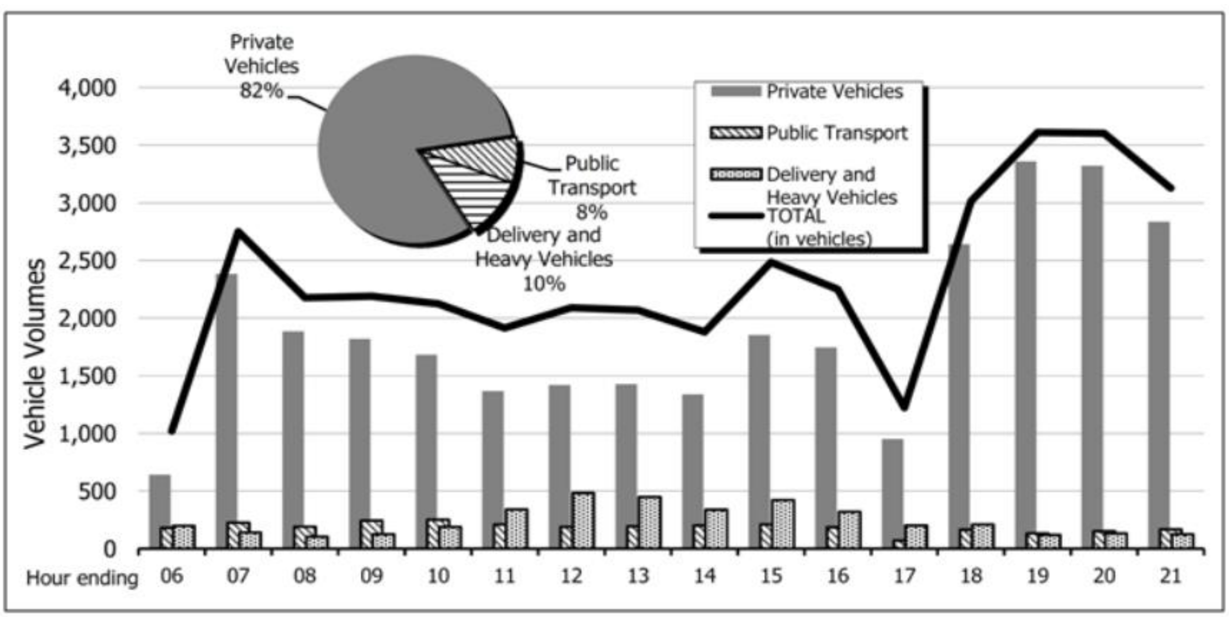

Figure 11. Traffic Volume Count of Northbound Route (Katipunan Avenue)

In contrast, the southbound peaks (towards Makati City) are 7:00 am to 8:00 am with an almost even distribution throughout the rest of the day. Both traffic conditions correspond to the general travel pattern of Metro Manila, which is the morning peak flowing towards the south, and the evening peak flowing towards the north. In terms of Level of Service (LOS) conditions, most of the Katipunan Avenue are congested throughout the day especially the southbound route as can be seen in Figure 13.

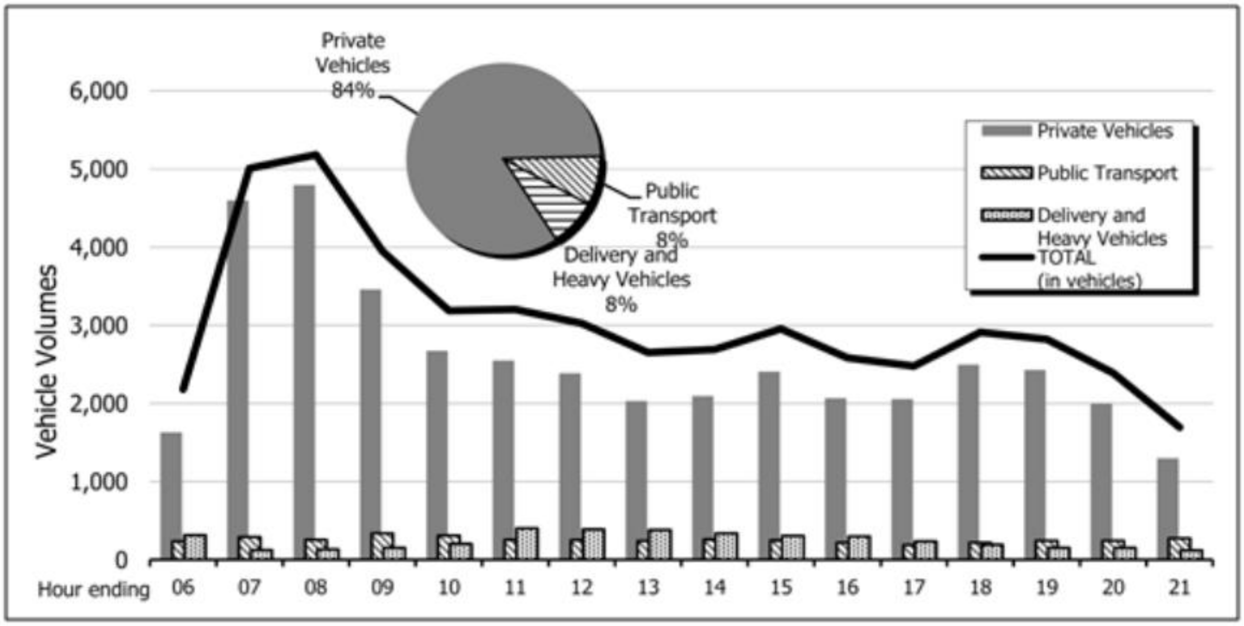

Figure 12. Traffic Volume Count of Southbound Route (Katipunan Avenue)

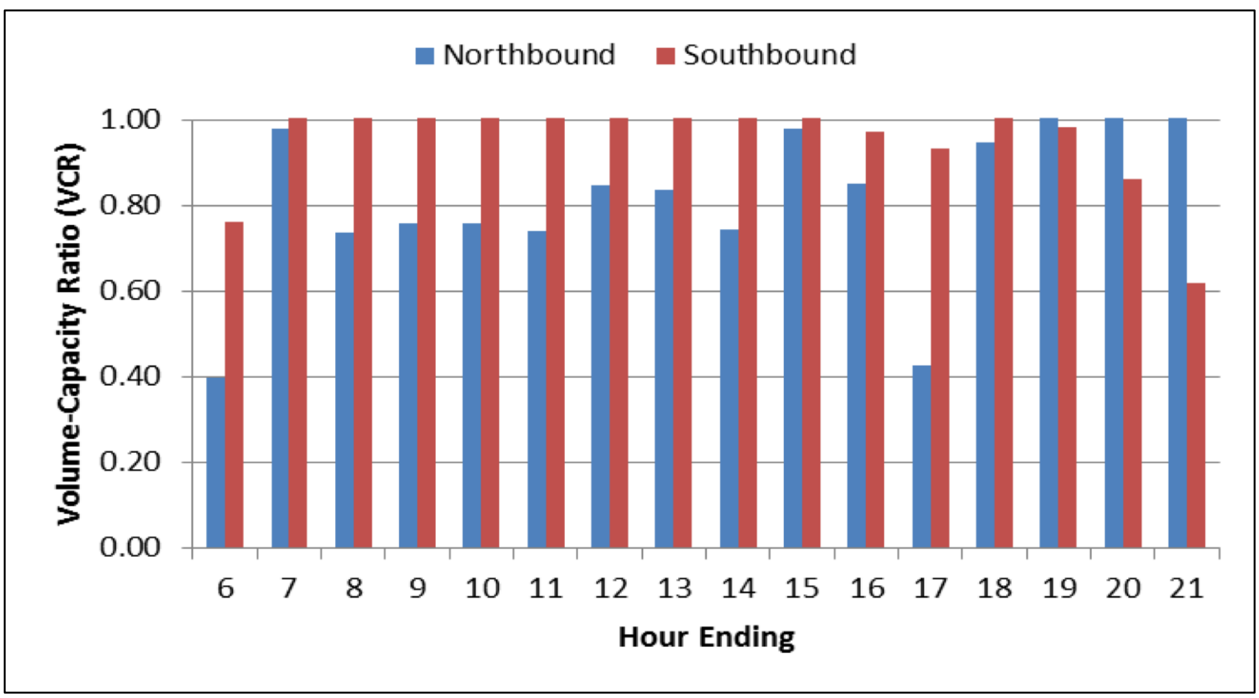

Figure 13. Levels of Service for the Nortbound & Southbound Routes (Katipunan Avenue)

5. CONCLUSION AND RECOMMENDATIONS

To summarize, this study used alternative methods in determining the route capacity for public transport based on Origin-Destination, Land Use and Trip Generation, and Traffic Volume Conditions. Table 10 summarizes the ranges of fleet size requirements derived from the different methods both for present and future demand. The original number of operating units are actually the amount officially approved by the government in the different franchises of private operators. The determination of the number of the units are based on the original formula of the Route Measured Capacity.

Table 10. Summary of Results for Route Capacity Requirements

Method	Base Traffic	Future Traffic
Original / Actual	154	-
OD Matrix	126	212
Land Use / Trip Gen Rate	176	297
Traffic Volume Survey	157	262

The original formula of the Routed Measured Capacity is not without its advantages and uses. It is applicable to simple routes and easy enough to compute. However, it has been shown that the RMC has been unresponsive to emerging land uses and travel patterns resulting to overlapping or conflicting routes. Table 11 shows the comparative assessment of the alternative methods explored in this paper. The OD Matrix and Land Use / Trip Generations Rate Methods, respectively, follow the Standard Four-Step Urban Transportation Model, which would be relevant enough for emerging land uses. However, this may require a more robust understanding of this modeling process on the part of the government agencies. The Traffic Volume Method is relatively simple to collect and compute, however, it will get more complicated as routes pass through multiple corridors. The Fleet Size Operations Standard computation should be one of the metrics in determining route capacity as this provides a measure of how frequent (the inverse of headway) a public transport unit can service the passengers of the given route.

Table 11. Comparative Assessment of Alternate Methods for Route Capacity

Method	Main Advantages	Main Disadvantages
Original (RMC Formula)	• Applicable to simple route • Easy to compute	• Unresponsive for complicated routes • Does not consider land use
OD Matrix	• Captures all stages of travel demand – generation, distribution, modal split, route choice	• Difficult to compute • Requires software (Cube, Strada)
Land Use / Trip Generation Rate	• Considers present and future land use and LGU inputs thereof	• Requires GIS to easily determine land use and usable areas
Traffic Volume Survey	• Easy data collection	• Not applicable for routes passing on multiple corridors
Fleet Size Operations (PPHPDP)	• Considers system operations (headways, fleet size)	• Public transport operators are highly fragmented and have very low fleet size

The results of the study show that alternative methods can be develop in determining the route capacity of public transportation in a specific corridor that is defined by a set of land use. The current RMC is certainly useful albeit for simple routes. However, it is not responsive to emerging land use that consequentially affect travel patterns. In summary, this study found the following implications:

a. The land use of the study area (Loyola Heights) changed dramatically over time which caused a large effect on transportation;
b. The RMC formula only focuses on the supply (vehicles) and demand (passengers), producing data which is sufficient for only a short period of time. This is not consistent with an area that has an emerging land use such as those of the study zone;
c. To produce an efficient long-term transportation plan, there is a need to project the change in supply and demand by incorporating land use in the formula;
d. Since land use cannot be quantified, the RMC formula will have to be restructured on how the variables are gathered to take into account land use changes; and
e. This method can be still be used to determine the number of units for franchise in a specific route but with land use changes being incorporated therein.

Be that as it may, there are policy directions that may be taken to improve the franchising processes for public land transportation. Foremost of this is empowering the local government units (LGUs) in investigating public land transport demand as they are the frontline agency upon which land use and travel patterns are seen on the ground. The moratorium on new franchises can be lifted by developing a local transport plan for the local government, which will properly study and delineate private and public transport demand based on the present and future land use of the locality. The DOTr can provide technical assistance to LGUs in the development of local transport plan, which will become the basis for the LTFRB in recalibrating existing franchises of public land transportation, including the issuance of new ones when the necessity actually exists based from emerging and future land uses.

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