Assessment of the Potential Impact of Bus Rapid Transit (BRT) on Urban Traffic in Metro Manila

メトロ・マニラにおけるBus Rapid Transit (BRT) 導入の潜在効果アセスメント

東京大学 生産技術研究所 大口研究室（交通制御工学） M.G. Mejia, Prof. T. Oguchi

http://www.transport.iis.u-tokyo.ac.jp/

1. Background and Objective

What is Bus Rapid Transit? BRT is a **bus-based transit system** that can achieve high capacity, speed, and service quality similar to that of urban railway/ metro systems but at a fraction of the cost. To achieve this, the important features of BRT include **dedicated and median-aligned bus lanes,** off-board fare collection, platform level boarding, as well ITS elements.

Motivation for BRT in Metro Manila BRT, with its features and advantages, may be a suitable solution to address Metro Manila's urgent transport problems:

- Poor service levels of public transport (low reliability, low capacity, low speeds, poor access, etc.)
- Heavy road traffic congestion during most of the day → increasing number of private vehicles

Fig. 1 Example image of BRT

Source: https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/ (Accessed on 2018/06/04)

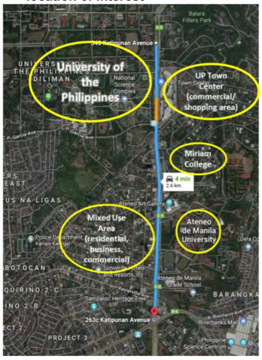
Objective Assess the impacts of implementing BRT to existing road traffic by **microscopic simulation** and **scenario / sensitivity analysis** considering different BRT service level parameters with respect to varying the shift of private vehicle users to BRT. *For this poster, the impacts in terms of travel time and queue length resulting from one BRT scenario is presented.

2. Development of Microsimulation Model in VISSIM

Study Area: Katipunan Avenue

- **2.6 km section**--part of major urban highway traversing N-S of Metro Manila
- **5 lanes per direction**
- **4 signalized intersections**
- **High share of private vehicles** at peak hour (64% cars, 16% motorcycles)
- Public transport available:
  - *Jeepneys* (24 pax capacity)
  - Tricycle / 3-wheelers (3 pax capacity)

Fig. 2 Map of study area with location of interest



Baseline Model: "Without BRT"

- Road geometry based on Google Earth satellite image
- Considered **peak hour** traffic volume from survey data
- Used actual traffic signal timing settings

Fig. 3 Baseline model built in VISSIM

Model Calibration

- Driving behavior parameters are calibrated based on previous research on microsimulation of mixed vehicle traffic in Asian cities similar to that in Metro Manila

Parameter	Calibrated value: Urban (motorized)*	Calibrated value: Urban (motorcycle)*	Default value
CC0 -- Standstill distance (desired distance bet. lead and following vehicle at *v*=0 km/h)	1.00 m	0.25 m	1.50 m
CC1 -- Headway time (desired time in sec bet. lead and following vehicle)	0.60 s	0.25 s	0.90 s
Look ahead distance (maximum)	250.00 m	250.00 m	250.00 m
Look ahead distance (minimum)	20.00 m	25.00 m	0 m
Look back distance (maximum)	150.00 m	150.00 m	150.00 m
Look back distance (minimum)	25.00 m	5.00 m	0 m
Waiting time before diffusion	90.00 s	90.00 s	60.00 s
Minimum headway (front/rear)	0.40 m	0.50 m	0.50 m
Safety distance reduction factor	0.60	0.70	0.60
Minimum lateral distance @0 km/h	0.40 m	0.20 m	1.00 m
Minimum lateral distance @50 km/h	0.90 m	0.30 m	1.00 m

*Note: Urban (motorized) for all vehicles except for motorcycle; and Urban (motorcycle) for motorcycles

Model Validation

1) Comparison of hourly traffic volumes by GEH statistic

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where M = modelled flow, and C = observed flow

- Average GEH: **2.75** (acceptance target: < 5)
- GEH < 5 for **82% (14 out of 17)** of compared flows

2) Comparison of travel time in both directions

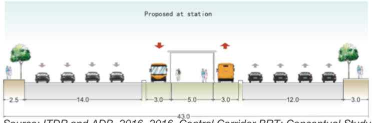
Direction	Survey Result (min)	Survey Result (sec)	Model Result (min)	Model Result (sec)	% Diff
NB	12.00	720.00	12.46	747.74	3.85%
SB	11.00	660.00	11.25	674.96	2.27%

3. Simulation of "With BRT" Scenario

Basic BRT Design/Operation Considerations and Assumptions

- One dedicated lane per direction at median
- Operational speed: 40-45 km/h
- 85 pax capacity per bus unit
- Dwell time at stations: 10-15 sec
- Fixed time schedule
- All *jeepney* users that serve Katipunan Avenue are shifted to BRT
- Vehicles not passing through the considered section are not shifted
- Trucks are not shifted to BRT

Fig. 4 Cross section at BRT station



Source: ITDP and ADB, 2016. 2016. Central Corridor BRT: Conceptual Study

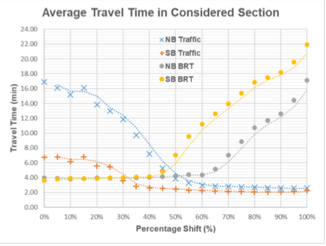
Shifting of Users to BRT

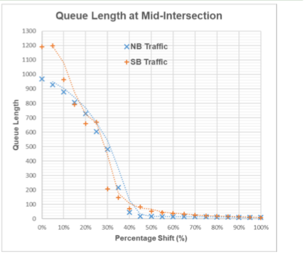
- The percentage shift of private vehicle users (cars and motorcycles) and tricycle users to BRT is controlled progressively in each scenario
- The total shifted users to BRT for i% shift:

$$BRT\ Users_i = (100\% - i\%)[(Vol_{car} * Occ_{car}) + (Vol_{mot} * Occ_{mot}) + (Vol_{tri} * Occ_{tri})] + [Vol_{jeep} * Occ_{tri}]$$

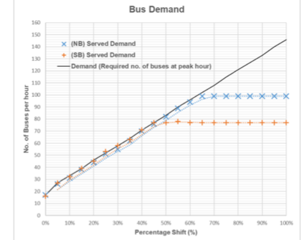
Where Vol_{veh} = volume of considered vehicles at peak hour, Occ_{veh} = ave. vehicle occupancy

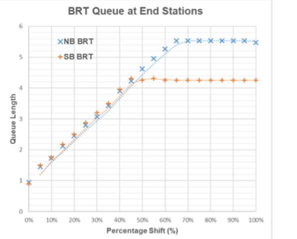
4. Results of Simulation





- The results show that as percentage shift to BRT increase, the travel time and queue length of vehicles decrease in both directions, as expected. A steep descent is seen from the 20 to 40% percentage shift.





- As the shift to BRT increases, the bus frequency also increases up to a point that it can no longer meet the demand (at 65% shift for NB, 50% for SB) given no changes in bus service parameters (passenger capacity, operational speed). In the same way queueing of buses increase indicating bus bunching, which causes more delay to passengers.