Investigating the Impact of Parking Violations on the Performance of a Curbside With-Flow Bus Priority Lanes: A Simulation-Based Approach

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DECLARATION OF ORIGINALITY

I declare that this is my own work, and this thesis/dissertation does not incorporate any material previously submitted for a degree or diploma in any other University or institute of higher learning without due acknowledgement and to the best of my knowledge and belief, it does not contain any material previously written or published by another person except where due acknowledgement is made in the text.

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Dr. T. Sivakumar

Extended Abstract

A Bus Priority Lane (BPL) is a lane where priority is given to buses over other traffic. Travel time reduction is one of the main benefits expected from implementing a BPL. Literature reveals that the success of a BPL in achieving its expected benefits depends entirely on the adherence by motorists and the enforcement by the enforcement authority of the BPL Rules. Literature classifies BPL violations into two types, namely parking and driving violations (Agrawal, Goldman, & Hannaford, 2012; Mundy, Trompet, Cohen, & Graham, 2017). The impact of Parking Violations (PV) is explored in this study. A PV is when an unauthorised vehicle enters the BPL and parks in the BPL for a period of time. A driving violation is when an unauthorized vehicle drives in the BPL without stopping. Curbside with-flow BPLs, such as in the case of Colombo, Sri Lanka, are most at risk for parking violations due to high number of curbside activities.

Experimenting PVs on the ground is not only costly but also risky. Microsimulation is a valuable traffic engineering tool that offers many benefits in evaluating traffic scenarios before implementation. However, as it is an approximation of the real world, the models should closely reflect the real world for the outputs to be credible. This credibility is achieved by calibrating parameters influencing the vehicle trajectory decisions in the simulations. Many studies have used microsimulation to analyse bus priority strategies by calibrating several parameters. These include vehicle-specific parameters such as dimensions, speed, lateral and longitudinal gap acceptance, etc., and simulation model-specific parameters such as car-following and lane-changing models. “SUMO TraCI” has been used successfully to simulate the stopping of a vehicle in a lane for a predetermined time period, which was used to simulate the PV s in this study.

The output showed that the average travel time of buses increases exponentially with increasing frequency of PVs, duration of PVs and the flow of buses (headways). While both increase of duration of PVs and flow of buses causes the average bus travel times to increase at an increasing rate, further analysis showed that the duration of PVs increases the travel time at an increased rate higher than that of the flow of buses increases (shorter headways).

The investigation of the impact of PVs on the travel time of buses in BPLs is identified as a research gap. Anwar, Fujiwara, & Zhang (2011) modelled the impact of illegal on-street occupancy on the

impact of link travel time as a reduction in the link capacity using the Bureau of Public Roads (BPR) function developed in the USA. The parameters of BPR function have been recalibrated considering the effect of illegal on-street occupancy on travel time prediction.

The microsimulation model developed in this study has been calibrated for Sri Lankan Traffic conditions. The model comply with Greenshield's traffic flow model. Microsimulation is used to obtain the average travel time of buses in the BPL for varying flow of buses, frequency of PVs and the duration of parking. The output is then used to calibrate the BPR function to model the impact of PVs on the travel time of buses in a BPL.

The α and β values of the calibrated BPR function are 3.403 and 2.493, which is similar to the parameters used by the authorities who estimate travel time on national roads in Sri Lanka. Thus, the overall travel time in BPLs increases more than three times (340%) compared to that in free-flow conditions due to PVs, while the increase is random as of occurrence of PV.

Since the study is focused on modelling the travel time of buses on BPLs, the impact of violator vehicle movements on the travel times of the general traffic is not investigated. Another limitation of this study is that it considers only one vehicle type to perform PVs. Therefore, expanding this study to include different types of vehicles as violators and investigating the impact of PVs in BPL on the general traffic on other lanes in the same direction is recommended as future research avenues.

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Abbreviations

BPL	Bus Priority Lane
PV	Parking Violations
SUMO	Simulations of Urban Mobility
TraCI	Traffic Control Interface
BPR	Bureau of Public Roads
HCM	Highway Capacity Manual

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