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Truck-Only Lanes on Urban Arterials: A Value of Time Approach

Malvika Rudra[a]*, Matthew Roorda[a]

[a]University of Toronto, 35 St. George Street, Toronto, M5S 1A4, Canada

Abstract

This study evaluates the travel cost benefits of truck-only lanes (TOL) on arterial roads, from a value of time perspective. A simple three-lane TOL corridor is developed and demand and value of time scenarios are systematically analysed using a user equilibrium assignment procedure. It is concluded that implementing a TOL when truck proportions are too low results in significantly higher travel costs than if all lanes are left as general purpose lanes. Implementing a TOL when truck proportions are too high also does not result in travel cost benefits. Based on travel cost considerations, TOL on arterial roadways appear to be marginally justifiable only under quite specific traffic volume, truck percentage and value of time conditions.

Keywords: Truck only lane; value of time; user equilibrium

1. Introduction

Recent rapid growth in employment and population in the Greater Toronto and Hamilton Area (GTHA), Canada, has led to increasing demands on the transportation network from both the goods movement and the passenger travel sectors. The GTHA has also experienced an increase in urban goods movements due to the increased adoption of just-in-time (JIT) delivery practices, which has resulted in a greater number of lighter weight shipments, and the increased use of air and rail intermodal shipments, each of which begin and end with a truck trip (iTRANS, 2004). The majority of urban freight trips in the GTHA occur on local or regional roads. Sixty seven percent of truck trips in 2006 between the City of Toronto and the adjacent regions of York and Peel were

* Corresponding author. Tel.: +1-416-869-3600 ext. 5369.
E-mail address: malvika.rudra@metrolinx.com

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not on freeways (DMG, 2006). Due to this high proportion of non-freeway truck trips in the GTHA, the local and regional road networks face increased pressures related to congestion, safety, delay, and productivity losses for the trucking industry and other users (i.e. auto, bus, etc.) of the road, thereby negatively impacting the economic vitality of the region.

One potential strategy that has recently emerged to improve the efficiency of goods movement is the segregation of trucks from other users of the road. Studies done internationally have shown that truck-only lanes (TOL), which restrict trucks to certain lanes of the roadway, have the potential to alleviate congestion for both light vehicles and trucks (De Palma, 2008). Truck-only lanes impact three main aspects of the transportation system: safety, mobility, and cost. First, large trucks pose a safety hazard in mixed traffic because of their lack of manoeuvrability, their larger size, and their unique acceleration characteristics (Middleton & Lord, 2005). Second, if trucks experience reduced traffic volumes on truck-only lanes, they will incur less congestion delay. Third, designing infrastructure for trucks requires higher road-design standards than for light vehicles, in terms of pavement thickness, grades, etc. (Holguin-Veras, Sackey, Hussain & Ochieng, 2003). If trucks travel in a dedicated lane, the rest of the road network can be built to a lower standard, thus resulting in cost savings.

Reich, Davis, Catala, Ferraro & Concas (2002) developed a methodology to select potential sites for exclusive truck facilities based on the following criteria: truck-related crashes; truck volume; percentage of trucks; highway level of service; proximity to seaports; and proximity to other intermodal facilities. Abdelgawad, Abdulhai, Amirjamshidi, Whaba, Woudsma & Roorda (2011) and Bachmann, Roorda & Abdulhai (2011) used microscopic traffic simulation to assess travel time and safety impacts on freeways.

Little formal analysis has been done to quantify the economic benefits of truck-only lanes on arterial roadways. The purpose of this study is to evaluate truck-only lanes on arterial roadways from a travel cost perspective. To accomplish this goal, this research pursues two objectives. First, a simple truck-only lane arterial corridor is analysed to compare travel time savings for trucks against travel time increases for non-trucks through the implementation of truck-only lane. Second, demand conditions (total volume and truck percentage) are identified that would be needed to justify the implementation of a TOL from a value of time perspective.

2. Literature Review

General purpose lanes (GPL) dominate road transportation systems for two main reasons. First, for road capacity in a single direction, two GPL permit higher throughput than two separate lanes (Poole, 2009). Second, if the number of vehicles permitted to use a dedicated lane is much higher or lower than the capacity of that lane, the dedicated lane may provide too little or too much capacity for the designated subset of vehicles (Poole, 2009). Poole refers to this as the "lumpiness" of a lane's capacity, implying that the risk of building the wrong amount of capacity is less if all the lanes can be used by all vehicle classes. Despite these factors, Poole argues that some corridors could benefit from truck-only lanes, given appropriate truck volume conditions.

When assessing the feasibility of TOL or any other managed lane strategies, the concept of value of time (VOT) is important. Value of time is defined as the opportunity cost of the travel time on a trip, and value of travel time saving is the maximum amount of money that travellers would be willing to pay, in order to reduce their travel time (Qing, Wang & Adams, 2011). Route choice, time of day choice and location choice decisions made by motorists and carriers depend on their perceived value of time, particularly when tradeoffs are being made between cost and time, for example, when a tolled route is available.

Commuter value of time has been widely studied since the concept was introduced by Becker (1965). Time was hence converted to a monetary value, with less cost being assigned to recreation time and more to working time. Mackie, Jara-Diaz & Fowkes (2001) suggested several factors that influence an individual's value of travel time savings: the time at which the journey is made, the characteristics of the journey, the journey's purpose, the journey's length, and the mode of travel.

Value of time for commercial vehicles has been largely neglected in part because it is more challenging to assess. There are two main reasons for this. First, several actors may decide the travel arrangements of commercial vehicles, in contrast to passenger transport where travel choices are generally made by the drivers alone. Second, private firms resist releasing confidential information that may be of significance for their own competitive