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Introduction of public bus transit in Indian cities

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Abstract

Introducing public bus transit system in Indian cities raises many challenging issues of different nature ranging from technical to operational. The present study examines the impact of a new public bus transit system by applying a binary logit analysis for assessing the possible variation in modal shift behavior. The case study of mode-choice was developed, calibrated, and validated using socio-economic data collected on six proposed corridors in the city of Bardoli, Gujarat, India. Traffic quality parameters, such as average speed, delay, congestion, travel time, and travel cost were modeled to investigate the impact of the new bus transit system in VISSIM environment. The probability of an overall modal shift to proposed bus transit system corridors ranges from 45% to 51%. The maximum modal shift ranges from 80.58% to 87.40% for three-wheelers (para-transit) followed by bicycle and walking mode. However, cars have the least modal shift ranging from 6.78% to 11.49% and 37.38% to 45.46% for two-wheelers. The average speed of the bus transit system in both directions could reach 47.75–49.59 kmph with 15 min frequency. Likewise, mean travel time was estimated from 1.3 to 1.6 min per km and average commuter cost of less than Rs. 1.0 per km for bus transit with insignificant delay and congestion. Introduction of the new public bus system shows promising results and has to play a significant role in developing a sustainable urban public transportation system. These findings can be used to form the basis for the implementation of the new public bus transit in peer cities with relatively similar sizes, which may impact an inhabitant sustainable choice on ridership in due course.

Keywords: Bus transit system; Cities; Preference survey; Mode shift; India

1. Introduction

One of the major thrusts of the new public bus transit system is to reduce commuter's overwhelming dependency on private vehicles to make the urban transportation system sustainable. India's cities have witnessed rapid urban growth and correspondingly travel demand in post-economic reforms. According to census 2011, there was an increment in million plus cities from 35 in 2001 to 55, consisting of 107.9 million urban (39%) population (Census of India, 2011). Urbanization in Indian Cities is putting enormous pressure on transportation infrastructures to respond to an increasing travel demand with greater strength and efficiency of the public transport system (Madhav and Haide, 2007). Post-economic reforms, Indian cities are recognizing the need and importance of infrastructure for economic growth, and better living, which has likewise increased travel demand (Chaddchan and Shankaar, 2012). Existing lack of urban transportation infrastructures fueled high growth of private vehicles such as cars, two-wheelers and para-transit modes (auto-rickshaw) (Tiwari, 2003). The land use patterns in

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current Indian cities and growing motor vehicle ownership also increased trip distances and encourage shifts to private vehicles. The effect of the longitudinal growth of cities is more and more dependent on private vehicles and two wheelers (2-W) and may aggravate congestion and accidents in the city (Pucher and Korattyswaroopam, 2004; Electricwala and Kumar, 2013).

In response, the National Urban Transport Policy (NUTP, 2006) and JnNURM (Jawaharlal Nehru National Urban Renewal Mission) phase-2 were introduced by the Ministry of Urban Development (MOUD), Government of India (GOI) in 2005. Studies show that a well planned bus transit system encourages the highest level of modal shift from private vehicles to public vehicles with low cost. Factors which greatly influence the modal shift are age, gender, time to walk to the station, and travel time difference between private and public transits. The trip purpose and travel cost could also affect the modal shift (Vedagiri and Arasan, 2009; Yuanqing et al., 2013). A bus transit system with efficient travel time, economical trip cost, and well connected transfer with system quality service attract ridership (Vaishali et al., 2007; Vimal et al., 2012). Accessibility is one of the major issues for the successful operation of public transit system in cities. The convenience is deeply biased towards favoring those with access to private vehicles users (Litman and Burdwell, 2006). However, the accessible public transit system has a potential to attract a large number of private vehicle commuters. Since commuter travel time is a function of both urban and transport development patterns, the route specific public transit system can reduce travel time and consequently encourage private vehicle users to use public transport system (Tiwari and Jain, 2012). Neighborhoods designed with housing, jobs, schools, and locations of other activities conveniently connected or proximate to major transit lines support public transit systems. People being in more compact, mixed-use, and pedestrian-oriented neighborhoods, conduct more non-work trips by walking, bicycling, and transit modes rather than people living in the less dense areas. Compact, mixed-use neighborhoods are associated with reduced vehicle and personal miles traveled, as well as more trips with fewer stops and low household vehicle ownership rates (Krizek, 2003).

An understanding of the attitudes and behaviors of commuters is a necessary condition for the development of an effective transportation system intended to encourage a more efficient use of the city's public transportation system. Attitudes and perceptions of transportation systems are important in mode choice decisions encountered in encouraging automobile commuters to switch to public transit (Gilbert and Forester, 1977). In fact attitude may be more strongly correlated with auto ownership than with built environment. This will help to incorporate a policy measure and attributes of travel that influence individual's choice of mode. Alignment and bus stop play a very important role in the planning and design of the transit system and also encourage a modal shift. Regional connectivity, operation cost, local ridership, trip duration, distance right of way and political viability, environmental cost and capital cost are the decisive factors used to select the best alignment substitute (Pahs et al., 2002; Kennedy et al., 2005). The transit capacity estimation model for planning a public transit system with various variables, including the structure of bus stops, fare collection system, bus stop interval and employment cost was revealed by Yabe and Nakamura (2005). It is important to introduce a public transit system that is accessible, reliable, convenient and affordable in Indian cities. Therefore, at this stage where the city is growing from small to medium and so on, public bus transit system intervention in the city is vital to check the growth of private vehicles and geometrically growing 2-W. An attempt has been made in this work to analyze the impact on traffic quality and mobility by implementing a new bus transit system in the present Indian urban traffic context.

2. Data collection and network development

The study area, Bardoli, may be categorized as a small to medium sized city with a population of 6,75,963 (as per census 2011) covering a city transport area of 46 sq km, mostly business and working trip in the state of Gujarat, India. At present, the city is not having a public transport system and commuters use para-transit (3-wheelers) and private vehicles to commute to their destination with an average trip length of 6.0–12.0 km. The zoning system adopted in this study is in coherence with that adopted by the local planning body, Bardoli Municipal Corporation (BMC), Bardoli. The bus route corridors within the study area were defined based on physical characteristics like carriageway width and future expansion scope. The node 6_1–6 i.e., corridor no 6 is the central business district (CBD) corridor and is of 4-lanes divided with a 16 m carriageway width and other five corridors are with 4-lanes, undivided with a 14 m carriageway width as mentioned in Table 1. All other five corridors share some distance with the CBD corridor i.e., from node 6_1–6. In this analysis, it was assumed that each corridor is moving differently with each other to reach the respective node.

The traffic study has been designed based on commuter mobility by private and para-transit modes. The 7-day traffic volume count, 3-day turning movement count, 3-day Origin and Destination (O–D) survey and 1-day stated preference (SP) survey were conducted on all seven un-signalized intersections lying in the CBD corridor. Speed and delay survey has been carried out along the potential corridors of the bus transit. The field travel times and speed of these six corridors have been used to adjust the parameters of the speed-flow relationships of various road links. These travel times also gave the extent of travel time saving that one could expect on the bus transit system.

The socio economic profile has also been obtained on six corridors from Home Interview survey (HIS) covering all types of Income Groups, Gender and Vehicle ownership