TRANSPORTATION SYSTEM OF DELHI: A MODELING APPROACH

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Urban transportation has been the subject of renewed interest and increased attention in recent years. The continued growth in scale and complexity of urban transportation activities and their impact on the urban environment have renewed the decades long search for solutions to the urban transportation problem. The problems are the inadequacy in public transport service as well as the exorbitant growth in private vehicles without proportionate augmentation of transportation infrastructure. High rate of fuel consumption and pollutant emission are other problems in urban transport system. The growing number of road accidents is also an area of concern. In view of these problems, the thesis estimated the future growth of motor vehicles and projected the subsequent increase in fuel demand, air pollution and road accidents in Delhi up to year 2020-21. Besides the thesis also develops a model that optimizes the mode of travel between origins and destinations in a route network of Delhi. Finally, it suggests the scope for reduction of such problems.

The thesis comprises seven chapters. Chapter 1 is introductory, which discusses the urban transport system and its problems in general with particularly reference to Delhi. The objective, scope and methodology adopted in the study are briefly described. Chapter 2 examines the past and projects the future trend in the growth of four-wheelers, two-wheelers, auto rickshaws, taxis, buses and goods vehicles. The logistic model fits well in projecting the growth of four-wheelers and auto rickshaws, while in case of the growth in two-wheelers, taxis, buses and goods vehicles, the Gompertz model is better. In the year 2020-21, total motor vehicles will be 1.17 crores, which will be nearly 50 per cent of the projected population of Delhi. Of the total motor vehicles, 96 per cent will be private vehicles. The rapid growth of private vehicles is due to rise in personal income and lack of efficient public transport service, is established by regression model. An improvement in bus transit system and expansion of metro route will slow down the growth of private vehicles in future marginally.

The Chapter 3 estimates the demand of transportation fuel up to the years 2020-21 by using Holt's exponential smoothing and scenario approach. The scenario approach estimates the demand with the help of explanatory variables such as the growth of petrol consumed vehicles and diesel consumed vehicles. Holt's model claims, the CNG demand will be more than that of petrol and diesel in the years 2010-11 and 2020-21,

respectively. However, the diesel and petrol demand will be more than 50 per cent and 100 per cent in the year 2020-21 as compared to 2005-06 under scenario approach. The conversion of private four-wheelers from petrol into CNG engine and expansion of metro rail will reduce the petrol demand marginally, but the conversion of goods vehicle from diesel into CNG engine will reduce diesel demand significantly. The analysis of pollutants such as carbon monoxide and sulphur dioxide with respect to their sources type vehicles (petrol, diesel and CNG) and the sulphur content in fuel is discussed using regression model in Chapter 4. It is observed that the level of carbon monoxide and sulphur dioxide has drastically come down in the ambient air after 1995 and 2000 respectively. The further reduction will be possible under the conversion of petrol four-wheelers and diesel goods vehicles into CNG engine, expansion of metro rail and decrease of sulphur content in diesel.

To understand the nature and the extent of the causes of road accidents, in Chapter 5, the thesis analyze the past trend using the concept of Smeed's and Andressen's equations. Finally a prediction is made up to the year 2020 by extending the Andressen's equation with adding one explanatory variable i.e. prosecuted vehicles. The analysis shows a decline trend in road accidents after 1995. Similarly, the road accidents can also be possible to control under stringent implementation of traffic rules, controlled growth of motor vehicles and expansion of metro rail. Chapter 6 devises a model that maps a few strategic locations of Delhi using bus and metro rail modes of public transport system. Based on distance, time and cost, Floyd's algorithm determines the most optimum mode of travel between two locations viz. Kapashera Border to Mayur Vihar Ph-3 and Rohini to Karolbagh under shortest and fastest path scenarios. Metro route comes out to be the most optimal route under fastest path scenario. Therefore, to avoid congestion, best possible route one should be taken is metro route at peak hours, which is found to be higher traveling cost than bus route. It can be minimize by reducing waiting time and restructuring fare.

The conclusions are set out in Chapter 7. It contains a brief overview, important results, recommendations and limitations of the study. It also identifies the research gaps, which depicts the scope for further research in the important areas. This chapter is followed by bibliography and appendix. Appendix contains raw data and outputs of all the models.

Published paper related to the thesis:

1. Importance of Metro Rail in Public Transport Network: A Case Study of Delhi. Indian Journal of Transport Management. Vol. 31. No. 3. pp 223-236. (2007) Pune, India
2. A Prediction Model for Motor Vehicle Growth and Road Accidents. International Journal of Operations & Quantitative Management. Vol. 14. No. 2. pp 101-114. (2008) Huston, USA.
3. Personal Vehicles in Delhi: Petrol Demand and Carbon Emission. International Journal of Sustainable Transportation. Vol. 3. Issue 2 pp 1-16. (2009) Philadelphia, USA.