

Planning of Transfer Facilities in and around Metro Stations

Shubhajit Sadhukhan

ABSTRACT

The role of public transportation as a demand management instrument is well recognized by the governing authorities, transport professionals, and researchers in emerging countries such as India in order to minimize road congestion, pollution, and economic downturn. Although the bus is the predominant mode of public transportation in the majority of the Indian cities due to its 'flexibility' in spatial coverage and 'lower capital cost', in the recent years the metro rail has also emerged as an effective mean to serve the 'commuters' need of mobility'. Metro system is now operational in several Indian megacities. Although transfer facilities play an important role in the context of a metro system for providing the 'last mile connectivity', there are glaring deficiencies associated with the transfer facilities at metro stations in the Indian context. Also, most of these transfer facilities are qualitative in nature, and not given due importance with a common perception that the fare is the most important concern to urban commuters. In general, the Governments are hesitant to increase the fare and also not in a position to enhance the financial assistance for various improvements. With this background, the present work aimed to develop an approach for the improvement planning of transfer facilities in and around metro stations. The work has been demonstrated with reference to the metro stations and the commuters of Kolkata city.

As a part of this work, an investigation was carried out to judge the importance of transfer facilities from the perspective of the metro commuters in the study area. A five-point Likert-type ordinal scale rating survey instrument was designed and data were collected from the metro commuters in Kolkata. The data were analyzed using three established statistical methods namely TOPSIS, RIDIT and GRA. The findings from three methods are found consistent and indicate that the perceived importance of the commuters towards qualitative attributes such as visual communication, pedestrian environment, pedestrian pathway are higher than the metro fare which is contrary to the common perception about the fare. The effects of socioeconomic and trip characteristics of the metro commuters on their perceived importance of transfer facilities were also investigated using several non-parametric tests.

The Willingness-to-pay (WTP) of metro commuters for improvement of various transfer facilities was also investigated. For this purpose, a stated choice survey instrument was designed

and responses were collected from metro commuters in Kolkata city. The stated choice responses were analyzed by developing several econometric models namely Multinomial Logit (MNL) and Random Parameter Logit (RPL). The effects of commuters' socioeconomic and trip characteristics on WTP values were also investigated while developing RPL models. The derived WTP values are found statistically significant and substantial as compared to the present metro fare. Using the WTP values a generalized cost (GC) equation was developed in order to calculate the perceived benefit to metro commuters due to the improvement of transfer facilities in and around metro stations.

Finally, various alternative scenarios were developed and evaluated for improvement of transfer facilities inside and outside metro stations in the study area. For improvement of facilities inside metro stations, fare increment was considered as a possibility as these facilities are used exclusively by metro commuters. The required fare increments for various scenarios were calculated, and the rationality of the fare increment was judged by relating fare increment to (i) benefits likely to be transferred to commuters, (ii) present fare, and (iii) average daily income of the commuters. The transfer facilities outside metro stations are also used by other commuters, and therefore, improvement of such facilities was investigated through funding assistance from the Government without any increment of fare to metro commuters. As the Government resource is limited, different metro stations were prioritized as per the need of improvement. For prioritization of metro stations, Fuzzy Analytic Hierarchy Process (FAHP) was used to calculate relative weights of factors describing pedestrian facilities outside metro stations and a Fuzzy Scoring system was adopted to assess the present condition. The rationality of funding assistance from the Government was judged on the basis of social cost-benefit analysis. For this purpose, station specific alternative improvement scenarios were formulated, and associated lifecycle costs were calculated. The benefit resulting from improvement of pedestrian facilities was calculated using the GC equation, and a lifecycle cost benefit analysis was carried out to report the findings in terms of Economic Internal Rate of Return (EIRR).

Overall, the present work demonstrates a comprehensive approach for improvement planning of transfer facilities in and around metro stations giving due considerations to commuters' perceived importance towards transfer facilities, benefits to commuters, the cost for improvement, fare increment to commuters, and funding assistance from the Government. Although the findings of the present study are case specific, the approach demonstrated in the work could also be applied for the improvement of transportation facilities in other contexts.