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## Perceived service quality of paratransit in developing countries: A structural equation approach

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### ABSTRACT

This paper develops empirical models for evaluating the service quality (SQ) of paratransit. Specifically, several models are developed based on structural equation modeling (SEM) using twenty-four SQ variables. To calibrate those models, a data set of 2008 paratransit users of Dhaka City are utilized, who were interviewed with a structured questionnaire to know their experience, level of satisfaction and opinion about the existing service as well as their expectations. SEM reveals the observed and latent SQ variables and their relationship with the overall SQ of paratransit. Among the different models developed, the best one is selected using statistical parameters and resemblance with real life expectations. Out of twenty-four SQ variables, 'Punctuality and Reliability' and 'Service Features' are respectively found to be the observed and latent variables having the greatest influence on the paratransit SQ. Moreover, the effect of heterogeneity among users on the performance of the best model is investigated. All the study findings support the data collected from the paratransit users. The research outcomes can be utilized by the city transportation officials of developing countries to improve the overall paratransit performance to attract new users as well as retain the current ones.

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## 1. Introduction

Public transportation offers the most efficient means of moving significant numbers of people, especially in densely populated urban areas. In addition to the well-being of its users, public transportation plays a vital role in the productivity of cities. Thus, it has a direct bearing on the national economy (Lyndon and Todd, 2006). According to dell'Olio et al. (2010), an important characteristic of modern society is its concern with promoting viable modes of transportation to replace the excessive use of the private car in urban areas. Although buses play the vital role in any urban area, their services are frequently insufficient to meet demand. Moreover, the facilities that are provided mostly suffer from low output (Ali, 2010). Individuals tend to use their private vehicles owing to lack of contentment they derive from the services of public transportation. If public transportation is in general perceived to be good and cheap, it can suppress demand for private cars as shown by Cullinane (2002). Deng and Nelson (2010) further described that high quality of public transportation can greatly improve the accessibility of its catchment area by shortening time. Eboli and Mazzulla (2007) and Stathopoulos and Marcucci (2014) observed that an improvement in the supplied service quality (SQ) can attract further users. Randheer et al. (2011) argued

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that, in the current scenario of globalization, public transportation service needs introspective sensitivity towards the SQ offered. As a result, the analysis of SQ has become an issue of maximum importance in recent public transportation studies (de Oña et al., 2013).

The primary objective of SQ analysis is to improve facilities such that user expectations and needs can be met. Berry et al. (1990) pointed out that 'customers are the sole judges of service quality', and many authors have supported this theory. However, the services provided by transportation operators may not necessarily satisfy passengers' expectations. As such, understanding of SQ perception is very beneficial for the operators to provide a suitable and better managed transit service for the users. A good comprehension about SQ can guarantee the continuity of the business of public transportation; existing users can be secured, and transit agencies could attract new users with a more positive public image (Hensher and Brewer, 2001). Nonetheless, this SQ is an abstract and subjective construct owing to its unique features, such as intangibility, heterogeneity and inseparability of production and consumption (Parasuraman et al., 1985). Hence, its assessment is rather complex.

Over the years, a number of methodologies have been used by researchers to measure SQ of public transportation systems. Among these, customer satisfaction surveys, usually implemented with a questionnaire, are the most commonly used technique to obtain users' perception towards the services. Data are gathered using different conceptual models like the SERVQUAL (Parasuraman et al., 1988), the SERVPERF (Cronin and Taylor 1992), the Normed Quality (Teas, 1993), and the Zone of Tolerance (Zeithaml et al., 1993). Essentially, these models translate the qualitative evaluations of the users into quantitative measures with the help of different scaling schemes. However, Gatta and Marcucci (2007) identified some critical factors linked to the use of such scales. These factors include psychometric problems, conceptual basis, troubles with the usage of Likert scales (such as the tendency for respondents to choose central response options rather than extreme ones), and difficulty in transformation from ordinal data to cardinal data. To overcome these issues, Stated Preference (SP) survey is adopted for measuring SQ (Gatta and Marcucci, 2007). In SP survey, individuals are asked to choose, according to their preferences, among a set of options so that SQ is linked to the utility achieved by the users. Moreover, in order to overcome the judgmental uncertainties (associated with the coexistence of vagueness, imprecision and subjectivity) of users and stakeholders in strategic transport service analyses, Lupo (2013a, 2013b) respectively proposed the combined use of analytic hierarchy process (AHP) (Saaty, 1980) and fuzzy set theory (FST) (Zadeh, 1965).

For determining the relative importance of the variables considered in SQ measurement, Eboli and Mazzulla (2008) identified two main categories of data processing techniques. The first category includes techniques of statistical analysis, such as quadrant and gap analysis, factor analysis, scatter graphs, bivariate correlation, cluster analysis and conjoint analysis. The second category of methods consists in the estimation of coefficients by relating the SQ variables (independent variables) with the user's satisfaction (dependent variable) utilizing model-based techniques. Some of these models are regression models, structural equation models (SEM), logit models and artificial neural networks. Although the ordinary statistical approaches are simpler in application, to analyze the non-linear relations between the variables and users' satisfaction, estimation of coefficients by modeling has become more popular for the last few decades.

In developing countries, it is necessary to satisfy the mobility needs with sufficient capacity while quality is constrained by various issues. Public transportation vehicles in African and Asian countries are often poorly maintained and overloaded as outlined by Transport Research Laboratory (Jacobs and Aeron-Thomas, 2000). Among the different public transportation modes available in these countries, paratransit plays a vital role, especially where there is insufficient mass transit system. In many cities, more than half of the total public transportation demands are carried by them (Joewono and Kubota, 2005). Paratransit modes are usually demand responsive and provide shared trips. Their services may differ considerably on the degree of flexibility they provide their users. Moreover, the most popular individual type of motorized paratransit has various local names in different countries such as 'tempo' in Bangladesh, 'becak' in Indonesia, 'jeepney' in the Philippines, 'tuk-tuk' in Thailand, 'mammy wagons' and 'matatu' in Africa and 'xiclos' in Vietnam. To have a clear understanding of the types of vehicles used as a paratransit in Bangladesh, the photographs of usual vehicle of each group of paratransit are shown in Fig. 1. Generally, these vehicles are based on three wheeled scooter chassis; its seat arrangement is such that it can carry 10 persons at the back and two persons at the front, beside the driver. Most of these vehicles are indigenously manufactured to fit the market needs; as such, they have various forms and are ill-equipped and non-standardized (Phun and Yai, 2016). Nevertheless, paratransit is highly popular in this country as it goes a long way to reduce the gap between demand and supply generated in response to the lack of mass transit systems. These vehicles usually run along a more or less defined route and then stop to pick up or discharge passengers on request. In Dhaka, Bangladesh there are 32 such defined paratransit routes offering mobility to the users across the whole city.

This study aims at finding the variables influencing the SQ of paratransit in developing countries. To this end, several empirical models are developed based on structural equation modeling (SEM) using a relatively large data set of paratransit users of Dhaka city. SEM is a powerful multivariate analysis technique, allowing the modeling of a phenomenon in which a set of relationships between observed and latent variables are established. To be specific, SEM is a combination of factor analysis and multiple regressions. SEM is adopted in various fields of research and generalized by Joreskog (1973) and Wiley (1973).

The remaining sections of this paper are outlined as follows. Section 2 presents the previous studies on SQ evaluations and empirical models of public transportation including paratransit. Section 3 presents study location, sample size, selected SQ variables and proposed empirical models. Model findings and discussions are presented in Section 4. Section 5 analyzes

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