

Predicting and Analyzing Bus Service Quality in Dhaka City by Choice Model

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Received: 2020/11/11

Accepted: 2025/01/22

Abstract

Bus as a means of transport plays a crucial role in Dhaka city. For being the cheapest means of transport, people rely heavily on bus service. Although people use the available bus service, they are not satisfied with the provided service. Considering the present and future condition of bus service, it is very important to assess the existing bus service and improve its service quality (SQ). This study aims to investigate key service factors influencing the bus SQ in Dhaka city by choice model. For this study, two step methodologies were followed where the first step was to collect data by questionnaire survey and the second step was to develop the model. An interview survey was done at 15 major locations of Dhaka city. The questionnaire had a total 40 service attributes, divided into 7 main parts including 'trip characteristics', 'quality of service', 'quality of bus', 'quality of bus stop', 'safety and security of bus', 'staff behavior' and 'reliability and accessibility of bus'. In the second step, Ordered Probit Model (OPM) was developed. Result indicates that 'Seat comfort level', 'Physical condition of bus' and 'Paying fare/Ticketing system' was the most important and key service attributes influencing bus SQ. The result from the study will be convenient to the bus service providers as it will let them know the improvement opportunities for enhancing bus SQ. Furthermore, findings from this research can be employed to develop rules and regulations to improve bus SQ in developing cities.

Keywords: Bus service quality, Dhaka city, Ordered probit model

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1. Introduction

Public transportation system is one of the most important components for the existence and development of modern civilization to individuals and societies since it contributes for the improvement of living condition especially in urban areas. Effective public transportation system contributes to the development of a country by providing better accessibility to markets, employment and other sectors and thus enhances economic and social opportunities. It is notable that, the countries having efficient public transportation system have shown noteworthy development. The overall success of a city's transportation system largely depends on public transport (PT). Improvement in transportation system positively effects the development of a city. Without effective transportation system a city will certainly lack in development. For the existence of modern civilization, transportation system is an inevitable component [Ali, 2010]. According to Rahman et al. [Rahman et al. 2017], efficient and effective transportation system can substantially contribute to human betterment in a broader perspective.

Megacity Dhaka is one of the fastest growing cities in the world in terms of population. As a result of increased population, Dhaka has registered its name at 13th position on the list of megacities having population more than 10 million [Demographia, 2019]. This highly populated city possesses an area of 175 square miles which has made the city densely inhabited. Therefore, Dhaka has been named as the topper on the list of population density among many urban cities in the world. In terms of total population, Dhaka will become home to more than 28 million people by 2030 which will make Dhaka 4th populated city in the world after Delhi, Tokyo and Shanghai respectively [United Nations, 2018]. The city is attracting more and more people every day since it is the core of economic and political development. Being one of the busiest cities in

the world Dhaka city is facing extra pressure at almost all features compared to other cities in Bangladesh. Nonetheless Dhaka is unable to carry this huge pressure since it does not have adequate infrastructure to deal with it. As a result, the living condition in this city is reducing with the increasing pressure exerted on the city. This condition may retain till the development of adequate infrastructure to support the increasing pressure imparted on the city. Consequently, Dhaka has been ranked as the 3rd least livable city in the world [The Economist Intelligence Unit Limited, 2019]. Among the 7 indicators of infrastructure, quality of PT has been considered as the 2nd indicator. This clearly depicts that the quality of PT is a sector to be improved to attain a more livable city. Hence emphasis should be provided to improve the quality of PT.

In order to improve the quality of PT, assessment is required to be done on PT. In addition, the transportation system needs be developed efficiently and effectively to improve the SQ. To obtain efficiency bus is one of the best choices as a PT since it carries a significant number of passengers and consumes less road space compared to private vehicles in terms of capacity. Besides, Dhaka's transportation system is mainly road based. Therefore, bus service is the best choice as a means of public transport. To obtain effectiveness it is necessary to encourage people for using PT and discourage them to using private vehicle, which is a large contributor to traffic jam. People will rely on bus if the SQ of PT is as good as or better than other mode of transport. Although Rahman et al. [Rahman et al. 2017] has revealed that the perceived SQ of public transport is poor at almost all routes in Dhaka city. This means people are not satisfied with the current SQ of public transport. The same study explored that people use private vehicle when the service of public transport fails to satisfy the passengers [Rahman et al. 2017]. Therefore, it is important to improve the SQ of public

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transport which can be done by improving the factors influencing the SQ. It is notable that bus is a popular mode of transport due to its low travel cost [Rahman et al. 2017].

In order to find out the influencing factors of public transport SQ, assessment is required. Since evaluation is required for the quality improvement of public transport, it must be ensured that the assessment/evaluation is performed from users' perspective as they are the soul judges of the service. Hence satisfying the users from the service is a precondition to ensure quality service of public transport as they are the consumers of the service. Customer satisfaction is highly linked with SQ. According to Kumar et al. [Kumar et al. 2009] SQ leads to customer satisfaction. It is very important to measure SQ as an increase or decrease in SQ largely effects customer satisfaction. Although the rating on SQ varies from person to person as everyone does not have the same condition for achieving satisfaction. Cats et al. [Cats et al. 2015] found that better service of public transportation enhances customer satisfaction. A research by Eboli and Mazzulla [Eboli and Mazzulla 2008] revealed that service is the key influential factor playing a vital role for attracting further users in terms of improvement in service. So, improving SQ is now mandatory to encourage users to use public transport. It is necessary to assess bus SQ not only to make the transportation system effective and efficient but also to make the city more livable. Furthermore, it is required to find out and deal with the issues with bus service to make the users satisfied with the SQ. Thus, the study aims to determine the key influential factors affecting bus SQ since bus is the predominant medium of public transport in Dhaka city.

The remaining of this paper is divided into four different sections. The next section briefly discusses literature review followed by methodology including data collection process, preliminary statistics and Ordered Probit Model (OPM). The section following

methodology presents result and discusses the possible explanations of the result. The last section concludes the study showing the key findings, results from other study and future research directions.

2. Literature Review

According to Rozmi et al. [Rozmi et al. 2013] public transport offers several facilities to passengers keeping in mind about safety, easy accessibility and cost efficiency. According to Kamaruddin et al. [Kamaruddin et al. 2012], PT plays a crucial part in commuting to activity places like, school, work, sporting centers and recreation. Efficient use of PT services can lead towards overall development of a country. Due to this reason, Cats et al. [Cats et al. 2015] emphasized on increasing the use of PT services as it has become an important issue around the world. But increasing the use of public transport seems difficult due to its incompetence to draw attention of new user particularly private car users. Ali [Ali, 2010], Banister [Banister, 2007] and Bunting [Bunting, 2004] claimed that 'lack of safety and security', 'long waiting time', 'dirty and unattractive stations', 'delay in service', 'poor personnel behavior', 'inadequate facilities for disabled persons' and 'poor travel information' are some of the main reasons behind the failure of attracting new users. Passengers always expect comfortable, reliable, fast, cheaper, safe and secured services.

SQ is the capability of an organization to meet or surpass customer desires [Parasuraman et al. 1988]. Zeithaml et al. [Zeithaml et al. 1990] stated that the dissimilarity amid customers' anticipation of service and observed service is known as SQ. Perceived service results from the customers' comparison between their predictions of service and the service they obtain from the provider [Zeithaml et al. 1990]. If offered service is less than expected service, then perceived quality may not satisfy customer and thus customer displeasure may

occur [Parasuraman et al. 1985; Lewis and Mitchell, 1990].

Customer satisfaction is the assessment of a service or product based on the capability of the service or product to meet customer needs and desires. Cats et al. [Cats et al. 2015] found that customer satisfaction regarding public transportation can be enhanced by providing better service. Discontentment with a product or service occurs from the inability of the product or service to meet customer needs and desires [Zeithaml and Bitner, 2000]. Kottler and Keller [Kottler and Keller, 2006] stated customer satisfaction as the result of a comparison between the perceived performance of a product and expected performance from the product which makes the customer either happy or disappointed. Only when the performance of the product or service fails to fulfill customer expectations, disappointment occurs. Customer is pleased with the service if the performance of the product or service equals the expectations. Therefore, customer satisfaction occurs. Customer becomes highly satisfied when performance of the product or service surpasses expectations.

Measuring SQ is one of the significant assessment tools for determining customer requirements by studying customers' satisfaction on the provided service [Ghotbabadi et al. 2015]. According to Ojo et al. [Ojo et al. 2014] customer can measure SQ by comparing their perception and expectation from the service or by their experience. The best judgment of the quality of a service can only be done by the users of the service. To determine SQ Parasuraman et al. [Parasuraman et al. 1998] developed gap model which is commonly known as SERVQUAL model. This model not only measures SQ but also determines the important influencing dimensions of SQ based on a five to seven-point likert scale. Including responsiveness, reliability, security, communication and competence, the authors [Parasuraman et al.

1998] developed total five dimensions of SQ. This gap model was employed by many researchers in their study including the work of Eboli and Mazzulla [Eboli and Mazzulla, 2007], Ojo et al. [Ojo et al. 2014] and Rozmi et al. [Rozmi et al. 2013] to determine the satisfaction level of passengers on public transport services.

Customer satisfaction and SQ may seem alike indicators of performance but both the constructs are unique. Researchers (for example see [Dabholkar, 1993] and [Iacobucci et al. 1994]) have questioned whether these two constructs are identical. Studies done by Bitner et al. [Bitner et al. 1990] and Boulding et al. [Boulding et al. 1993] showed that these two concepts are not similar but distinct. A study by Parasuraman et al. [Parasuraman et al. 1988] precisely shows the difference between SQ and customer satisfaction. According to the study, SQ is a viewpoint or global judgment associated with the consumption of the service while satisfaction is associated with a specific transaction. Although these two concepts are different, they are significantly linked with each other. According to Bojanic [Bojanic, 1996], customer is satisfied with the service when the quality of provided service is high. This obtained satisfaction by customer results in repurchase intention which over time makes the customer loyal to the service. Customer loyalty is dependent on SQ as it influences and acts as the determinant to it [Abdullah and Hilmi, 2014]. A study by Borhan et al. [Borhan et al. 2014] showed that users' attitude and behavioral intentions toward public transport are influenced by SQ.

The present bus service in Dhaka city is not enough to cope up with the increasing demand. The service is inefficient, unproductive (due to traffic jam) and unsafe (due to inexperienced driver). Andaleeb et al. [Andaleeb et al. 2007] claimed Dhaka is perhaps the only city of its size which lacks efficient mass transportation system or well-organized bus system. By providing sufficient access and mobility, urban

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transport system can contribute to overall development of a country by ensuring effective and efficient transportation system. As a matter of fact, urban areas of developing countries play a crucial role not only in economic growth but also in the development of the country as a whole. So, it may be expected that an improvement in transportation sector can make a developing city like Dhaka much more resourceful and productive. Essentially public transport is able to transport more people compared to individual cars in terms of road space. So, public bus as a medium of public transport in Dhaka city may play an important role in reducing traffic jam. Among several studies done on bus service in Dhaka city Rahman et al. [Rahman et al. 2015] found that, the main mode of transport in Dhaka city is public bus since the users are low and middle-income people who are unable to afford personal vehicles. It may be anticipated that if the conditions of buses are improved, it may attract high-income people as their mode of transport rather than private cars. This in turn may reduce traffic congestion in Dhaka city. In another research, Rahman et al. [Rahman et al. 2017] indicated that more than half of the respondents in Dhaka city are not satisfied with the present conditions of public bus service. So, the transit system should be enhanced to handle the traffic volume. The transportation structure should be reliable and the suitability of public transport should be enhanced.

Poor service quality provided by city buses is ultimately increasing the demand of paratransits and private vehicles Ahmed [Deb and Ahmed, 2018]. Due to more demand, the number of paratransits and private vehicles are also increasing which will deteriorate the existing traffic condition. Therefore, it is important to improve the service quality of public transport as it has the capability to lower the number of private vehicles [Nwachukwu, 2014]. Deb and Ahmed [2018] also found that people are willing to avail

public bus service instead of private vehicles if the service quality is improved up to their expectations.

Women passengers are most vulnerable in terms of using public bus services. They are always at high risk of getting sexually harassed. According to a study by Smith [Smith, 2008], women often get victim to sexual related crimes such as rape and sodomy. Also, due to overcrowded condition of public buses, women are more often exposed to unwanted sexual touching and rubbing. Apart from sexual harassment, women are more vulnerable to snatching and pickpocketing compared to men [Smith et al., 2000]. Due to these reasons, women don't feel much comfortable using public bus services. [Sultana et al., 2020]. A study by Redman et al. [Redman et al., 2013] indicated that, due poor service quality provided by public bus, people are switching to alternative mode of transport. In many cases, especially women are switching to other mode of public or private transport in spite of being more expensive [Sultana et al., 2020].

High quality service of PT is required to be ensured for fulfilling customer's needs and to satisfy them [Anable, 2005]. In order to ensure high service, assessment of public transport is necessary. In many countries of the world, researchers have studied upon user satisfaction on public transport and attributes affecting service demonstrating different research result. Tyrinopoulos and Antoniou [Tyrinopoulos and Antoniou, 2008] revealed the level of user satisfaction on public transport in Athens, Greece. The study showed that the initial target of the policy makers should be to creating a well-structured and well-coordinated transportation environment in Athens by improving different service attributes such as waiting time, service frequency, vehicle cleanliness and accessibility. Ali [Ali, 2014] studied passenger satisfaction on public bus services in Abuja, Nigeria and revealed that the passengers are not satisfied with the

provided service. Result showed that ‘Safety of passenger on board’ and ‘Drivers and conductors well behavior’ are the only two service attributes among seventeen that could fulfill user’s expectation. The study also indicated that comfort, bus stop facilities, bus capacity adequacy and accessibility are the four major influencing factors affecting user’s satisfaction by principal component analysis. A study by Shaabana and Khalilb [Shaabana and Khalilb, 2013] assessed bus service in Qatar which showed that passengers are not quite satisfied with the service. Even if the bus service is affordable and clean, it may not be reliable to the passengers.

Nowadays, to perceive service of mass transit different types of models are used by researchers. For example, Dell’Olio et al. [Dell’Olio et al. 2010], Kamaruddin et al. [Kamaruddin et al. 2012], Ojo et al. [Ojo et al. 2014] and Quddus et al. [Quddus et al. 2019] adopted regression model (ordered probit model), structural equation model (SEM), SERVQUAL model, and discrete choice model respectively, and likewise various researchers adopted different types of models in their studies. Ojo et al. [Ojo et al. 2014] employed SERVQUAL model to explore customer satisfaction with intercity bus services in Ghana. The study showed that passengers were not satisfied with 15 out of 26 service attributes resulting in poor service. SEM has been employed in many studies regarding service of public transport. De Oña et al. [De Oña et al. 2013] used SEM to determine perceived service of bus in Granda, Spain. The study showed that ‘Speed’, ‘Punctuality’, ‘Frequency’, ‘Fare’, ‘Proximity’ and ‘Information’ is linked to the latent variable ‘Service’ which greatly influences the overall bus SQ. On the other hand, ‘Comfort’ and ‘Personnel’ (exogenous latent variable) were found to have little effect on bus SQ. Stuart et al. [Stuart et al. 2000] applied SEM to determine the factors influencing customer satisfaction for the subway system in New

York City. Results of the study revealed that factors like ‘Predictability’ directly influence overall satisfaction. Other factors like ‘Crowding’, ‘Speed’ and ‘Personal Security’ were found significant to influence the overall customer satisfaction.

In this study, ordered probit model has been adopted for analysis due to its certain advantage over other models. According to Abdel-Aty [Abdel-Aty, 2001], the dependent variable accounts more than two values with a natural ordering in ordered probit model which is one of the positive sides of this model. Sadri et al. [Sadri et al. 2013] stated that among the ordinal categories in the dependent variable, the model can account for the unequal differences. Though other models of probability could be employed (e.g. standard multinomial discrete model), the efficiency of the model would be lost as the ordered nature of the variable would be disregarded and counted as nominal data [Amemiya, 1985]. As the same, other methods like ordinary least square regression or multinomial logit model would fail to account for the ordinal nature of the dependent variable. Due to these reasons Nkurunziza et al. [Nkurunziza et al. 2012] stated that, to study the (perceived) SQ of mass transit and the factors influencing transit ridership, the ordered probit model has been proven useful among other analysis techniques. Other model like structural equation model certainly has appealing features but it cannot be employed to ascertain that a model is accurate [Tomarken and Waller, 2005]. Moreover, it cannot compensate for inadequately designed studies and even a well fitted SEM model can exclude a significant variable having lower-order components. Model like SERVQUAL model have drawback as its differentiation between dimensions and results of gap analysis is poor due to which it is not easy to generalize it to other areas [Baki et al. 2009].

Due to ordered probit model’s advantage over the other models, it is widely used for different

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research purposes. Many researchers in their studies like Antoniou and Tyrinopoulos [Antoniou and Tyrinopoulos, 2013], Dell'Olio et al. [Dell'Olio et al. 2010], Choocharukul [Choocharukul, 2004] and Abdel-Aty [Abdel-Aty, 2001] employed ordered probit model to determine SQ and passengers' characteristics in relation to transit and service attributes. Not only for investigating SQ but also for other studies like analyzing seismic intensity data [Cameletti et al. 2017] and predicting financial crisis [Singh, 2010]; ordered probit model has been used. Similarly, for analyzing accident severity on highways [Siddique, 2018], ordered probit model was adopted in Bangladesh.

3. Methodology

3.1. Data Collection

Data collection for this study was accomplished by a questionnaire survey in 15 major locations in Dhaka city. The survey was carried out face to face among bus service users on major bus stands and bus routes in Dhaka city. The questionnaire had 7 main parts involving 'Trip Characteristics', 'Quality of Service', 'Quality of Bus', 'Quality of Bus Stop', 'Safety and Security of Bus', 'Staff Behavior' and 'Reliability and Accessibility of Bus'. The respondents were asked to provide their opinion on different bus service attributes by rating each attribute ranging from 1 to 5 (where 1 represents Excellent; 2, 3, 4 and 5 represents good, satisfactory, poor, and very poor respectively). Eight skilled surveyors conducted the survey during weekdays at

morning and evening peak periods in March 2019. One weekend was also considered for the survey. For sampling purpose convenience sampling method was adopted. This is a non-probability sampling technique suitable for exploratory research and at the same time it is cost effective and time efficient. Finally, data of 956 respondents were used after scrutinizing their completeness.

3.2. Information of Respondents

General information about respondents is shown in table 1. 67% of the respondents were male and 33% were female. This means only one third of the respondents were female which is due to their unwillingness in participating in the questionnaire survey. Half of the respondents were aged between 20 to 30 years. Students (34%) and private service holders (34%) are the majority of respondents who participated and provided their opinion in the survey. About half (46%) of the respondents earn between BDT10000 to BDT30000 per month. 87% of the respondents use bus service as their main mode of travel which means bus service is very popular in Dhaka city. 59% of the respondents travel by bus every day. 49% of the respondents use bus to reach their office/business. Respondents said that they use bus service because they don't have any own transport (31%), any other alternative (31%) and due to low cost (31%) of bus service. 54% of the respondents reach bus stop by walking. 31% of the respondents need 10 minutes to reach the bus stop.

Table 1. General Information of Respondents

Characteristics	Statistics
Gender	Male (67%), Female (33%)
Age (Years)	10-20 (7%), 20-30 (50%), 30-40 (29%), 40-50 (10%), 50-60 (3%), >60 (1%)
Occupations	Students (34%), Private service (34%), Public service (11%), Housewife (8%), Labor (2%), Businessman (11%)
Salary range (BDT)	<10000 (32%), 10000-30000 (46%), 30000-50000 (17%), 50000-70000 (3%), >100000 (2%)
Main mode of travel	Bus (87%), Rickshaw (3%), Para transit (1%), Motor/bi-cycle (4%), Car (5%)
Frequency of travel by local	Every day (59%), More than twice a week but not every day (17%), Once or

Characteristics	Statistics
bus	twice a week (15%), Less than once a month but more than twice a year (5%), Less often (4%)
Time to reach bus stop	5 min (21%), 10 min (31%), 15 min (27%), 20 min (11%), 25 min (10%)
Trip purpose	School/ College/ Polytechnic/ University (31%), Office / Business (49%), Emergency/ Hospital (4%), Park/Zoo/ Museum (1%), Others (15%)
Reason of using bus	Low cost (31%), No own transport (31%), No other option (23%), Safety (7%), Fast travel (8%)
Mode to get to bus stop	By walking (54%), Rickshaw (39%), Para-transit (5%), Motor cycle/Cycle (0%), CNG (2%)

[1 US \$ = 83 BDT]

[Rickshaw is a three wheeled light passenger vehicle which moves using the cycling mechanism. The cyclist driver sits in the front to paddle the rickshaw while the passenger sits in the back]



Figure 1. Rickshaw

3.3. Preliminary Statistics

Preliminary statistics of the dependent variable and independent explanatory variables have

been shown in table 2. The mean value of the dependent variable ‘quality of bus service’ was high (3.76). Each variable has minimum score of 1 and maximum score of 5 which means each service attribute was rated ‘excellent’ to ‘very poor’ at least for once. From preliminary statistics it is visible that almost all the service attributes are ‘poor’ as perceived by the respondents. Only the variable ‘bus remain always crowded’ has the lowest mean value (1.99) as for this service attribute 1 to 5 indicated ‘strongly agree’ to ‘strongly disagree’. So, this result indicates that respondents agreed (mean is almost 2) that bus remains always crowded. It is quite clear from this preliminary statistic that the overall perceived bus SQ of Dhaka city is poor.

Table 2. Preliminary statistics of bus service variables

Variable	Mean	Std. Dev.
<i>Dependent Variable</i>		
Quality of bus service	3.762	0.934
<i>Independent Variables</i>		
Convenience of service	3.537	0.971
Frequency of service	3.333	0.935
Punctuality of transport	3.685	0.902
Movement flexibility (on road)	3.723	0.875
Sitting arrangement	3.725	0.944
Speed of bus	3.429	0.919
Availability of information	3.762	0.940
Paying fare/ticketing system	3.686	0.952
Transport cost	3.479	0.969
Fitness of bus	3.779	0.956
Seat condition	3.726	0.935

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Variable	Mean	Std. Dev.
Cleanness of bus	3.760	0.971
Bus remain always crowded	1.990	0.984
Lighting facility	3.279	0.889
Noise level	3.733	0.953
Movement flexibility (inside)	3.752	1.000
Seat comfort level	3.735	0.910
Physical condition of bus	3.742	0.923
Safety at bus stop	3.740	0.935
Cleanliness of bus stop	3.814	0.915
Condition of bus stop	3.743	0.885
Accessibility of bus stop	3.559	0.919
Security in bus stops (belongings)	3.679	0.930
Level of personal safety	3.485	1.028
Ease of entry and exit	3.755	0.984
Driving safety (drivers skill)	3.627	0.961
Behavior of driver	3.565	1.001
Courtesy of helpers and conductors	3.872	0.923
Reliability of bus service	3.399	0.997

3.4. Ordered Probit Model

An ordered probit model estimates the relationship between a set of independent variables and an ordinal dependent variable. It is a widely used model. For ordered data analysis, OPM has been broadly adopted as a methodological framework since pioneering work of McKelvey and Zovoina [McKelvey and Zovoina, 1975]. In an OPM there is an unobserved dependent variable which is a function of an independent categorical variable. The basic formula of ordered probit regression is

$$y^* = x'\beta + \varepsilon \quad (1)$$

Where y^* is unobserved variable and

$$y=0 \text{ if } y^* \leq 0$$

$$=1 \text{ if } 0 < y^* \leq \mu_1$$

$$=2 \text{ if } \mu_1 < y^* \leq \mu_2 \quad (2)$$

$$=J \text{ if } y^* \leq \mu_{J-1}$$

Here, μ' are unknown threshold parameters to be estimated with β . Threshold parameters determine the estimations for different observed value of y . These threshold parameters can be interpreted as intercepts in equation (1).

An ordinal scale of 1-5 was used in the questionnaire survey (1, represents 'excellent'

and 5 denotes 'very poor'). The respondents choose the cell most closely which represented their feeling or perception for a certain question. It is assumed that ε is normally distributed with an expected value of zero and variance of unity.

One has the following probabilities:

$$\text{Prob} (y = 0 | x) = \Phi (- x' \beta) \quad (\mu_0 = 0)$$

$$\text{Prob} (y = 1 | x) = \Phi (\mu_1 - x' \beta) - \Phi (- x' \beta)$$

$$\text{Prob} (y = 2 | x) = \Phi (\mu_2 - x' \beta) - \Phi (\mu_1 - x' \beta) \quad (3)$$

$$\text{Prob} (y = J | x) = 1 - \Phi (\mu_{J-1} - x' \beta)$$

For all the probabilities to be positive, one must have

$$0 < \mu_1 < \mu_2 (\dots\dots\dots) < \mu_{J-1} \quad (4)$$

The analytical framework presented above represents OPM. The list below shows the notations of equation for developing OPM.

List of notations used in equations

y^* indicates unobserved dependent variables

x' indicates the vector of independent variables

ε indicates error terms

β indicates coefficient

μ indicates particular threshold point

Φ indicates Cumulative Distribution Function

PCA is one way of re-expressing the data and allows reorienting the data so that the first few dimensions give the maximum information possible. To test the suitability of application of this method, Bartlett's test of sphericity was applied. In this research, the varimax rotation method was applied. Factor loading indicated the role of each variable plays in describing each factor. Factor loadings are the association of each variable and the factor. Loading indicates the degree of correlation between the variable and the factor, with higher loadings referring the variable representative of the factor (Hair et al., 1998). The importance of the variable is revealed by its loading. Variables with higher loadings are judged more important and have more influence on the factor. Bartlett's test of sphericity showed a p-value as zero for all factor analyses, which means a high suitability test of the data. Moreover, the result shows that all loading is larger than 0.65, which means the variable was significant at 0.05 levels.

4. Results and Discussion

During the model estimation process due to low frequency of the category "excellent", was merged with the category "good" for better result. Only for the variable "bus remain always crowded" the category "strongly disagree" was merged with the category "disagree" due to low frequency of "strongly disagree". "satisfactory/neutral" category was considered as benchmark category for this model. Many of the included explanatory variables are statistically significant at 95% confidence level. The overall model's goodness of fit is acceptable (Pseudo R-square = 0.2728) for identifying the factors affecting the bus SQ. 29 service attributes (independent variables) were considered for this model. For convenience, only the significant variables (P value less than 0.05) have been sorted out as model result. Statistical software STATA (Version 14.2) was employed to develop the model. Result of ordered probit regression is provided in table 3.

Table 3. Results of Ordered Probit Model

Quality of bus service	Coefficient (β)	Std. Err.	z	P> z	95% Conf. Interval	
<i>Punctuality of transport</i>						
Very poor	0.375	0.156	2.400	0.016	0.068	0.681
<i>Movement flexibility (on road)</i>						
Very poor	0.304	0.149	2.040	0.041	0.012	0.596
<i>Paying fare/ticketing system</i>						
Very poor	0.522	0.144	3.620	0.000	0.239	0.805
<i>Bus remain always crowded</i>						
Agree	-0.328	0.128	-2.560	0.010	-0.579	-0.077
Disagree	-0.555	0.174	-3.180	0.001	-0.896	-0.213
<i>Lighting facility</i>						
Good	0.262	0.128	2.050	0.040	0.012	0.512
Very poor	0.400	0.189	2.110	0.034	0.029	0.771
<i>Noise level</i>						
Poor	0.324	0.119	2.730	0.006	0.091	0.557
<i>Seat comfort level</i>						
Good	0.354	0.172	2.060	0.039	0.018	0.690
Poor	0.605	0.133	4.540	0.000	0.344	0.866
Very poor	0.891	0.172	5.190	0.000	0.554	1.227
<i>Physical condition of bus</i>						
Good	0.415	0.183	2.260	0.024	0.056	0.775

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Quality of bus service	Coefficient (β)	Std. Err.	z	P> z	95% Conf. Interval	
Poor	0.409	0.128	3.200	0.001	0.159	0.660
Very poor	0.833	0.166	5.020	0.000	0.507	1.158
<i>Cleanliness of bus stop</i>						
Good	0.491	0.213	2.310	0.021	0.075	0.908
<i>Security in bus stops (belongings)</i>						
Very poor	0.340	0.148	2.300	0.022	0.050	0.629
<i>Ease of entry and exit</i>						
Very poor	0.393	0.149	2.640	0.008	0.102	0.685
<i>Behavior of driver</i>						
Fairly poor	-0.339	0.113	-3.010	0.003	-0.560	-0.118
Very poor	-0.364	0.143	-2.550	0.011	-0.645	-0.084
<i>Courtesy of helpers and conductors</i>						
Very poor	0.303	0.147	2.070	0.039	0.016	0.590
<i>Reliability of bus service</i>						
Fairly Poor	0.291	0.109	2.670	0.008	0.077	0.505
Very Poor	0.346	0.154	2.240	0.025	0.044	0.649

(Name of the variables are written in *Italic form*)

Summary Statistics

Number of observations = 956

Log likelihood = -892.26

Prob > chi² = 0.0000

Pseudo R² = 0.2728

Result shows that, 'seat comfort level' is the most significant variable (P-value 0.00) among others revealing higher correlation with SQ. In most cases people experience narrow seat, lack of space between rows of seat, worn-out seat, lack of sufficient leg space resulting the journey uncomfortable. Since this variable has a positive coefficient, an improvement in seat comfort level will positively influence the overall SQ. Which means it will result in an improvement of bus service quality (BSQ). BSQ is highly related to overall passenger satisfaction (OPS). Hence, an increase in seat comfort level will increase OPS.

'Physical condition of buses is another very important and crucial service attribute. In Dhaka city, most of the buses are old and broken with very poor physical condition. Bus often collide with other and get damaged due to rush commuting. As a result, color coating of bus gets damaged; body of bus becomes disfigured and deformed. Sometimes the glasses of bus get cracked and broken. So, bus loses its aesthetic beauty and becomes fragile

after a certain time. Due to lack of maintenance the engine, stairs, deck, seats, windows get damaged after a certain period and becomes risky for the users. Hence 'physical condition of bus' is highly related with bus SQ (P-value=0.000). Since this variable has a positive coefficient, an improvement in physical condition of bus may improve overall BSQ and increase OPS.

'Paying fare/ticketing system' is also found very poor from result. The possible reason may be majority of the local bus do not have appropriate fair paying system. Although the fare chart has been provided by the government to be followed by the bus service providers; it is not practiced by local bus. As a result, users start arguing about fare resulting in unpleasant situation. Moreover, users are being overcharged sometimes if they are not aware of fare. Most of the time people find it difficult to pay the fare and get exact amount of exchange when they have notes which worth more than BDT 100. Sometimes in local bus, passengers get disturbed and annoyed with bus staff when

they ask for fare repeatedly. So, an appropriate fair paying system is urgently necessary to satisfy the users' needs. As this variable has a positive coefficient, an improvement in fare paying/ ticketing system is more likely to improve the overall bus SQ.

'Punctuality of transport' was found to be very poor from this study. In Dhaka city, local bus does not follow any fixed time schedule. Although there are few bus services having counter ticketing system, they do not maintain any precise time schedule either. Thus ideally 'Punctuality of transport' in Dhaka city is absent. Even if bus service providers decide to maintain any schedule, they may ultimately fail to operate bus according to timetable due to traffic jam. Since this service attribute has positive coefficient, an improvement in punctuality of transport is more likely to improve overall bus SQ and satisfy its users.

'Security of belongings in bus stop' is always a concern for passengers. In most cases passengers lose their purse and mobile phone during boarding and alighting during peak periods when people literally compete to get on the bus due to high passenger load. Even people waiting at bus stop are experiencing pickpockets. Thus security of belongings in bus stop has been found to be very poor from model result. Since the variable has a positive coefficient value, a better security of belongings at bus stop may satisfy users and improve overall BSQ.

Cleanliness of bus stop has been found to be 'good' from model result. Bus stops are cleaned regularly by city corporation cleaners as a part of their job. So, passengers are satisfied with this service attribute. As it has a positive coefficient, improvement in cleanliness of bus stop may positively influence and improve overall BSQ.

Since, Dhaka city's roads are traffic jam prone, movement flexibility (on road) has significant influence on BSQ. From this study, movement flexibility has been found as very poor which is more likely due to traffic jam. An increase in

movement flexibility is more likely to improve the BSQ which may increase the level of OPS. Due to poor movement flexibility, users sometimes feel to get down from bus and walk to their destination which will result in a reduction of BSQ and OPS.

Variables like, 'lighting facility', 'noise level', 'ease of entry and exit', 'courtesy of helpers and conductors' and 'reliability of bus service' have been found to be either poor or very poor. These variables are also related with BSQ. As these variables have positive coefficient value an improvement in these service attributes are more likely to improve BSQ and increase OPS. Behavior of driver was found to be fairly poor as in most cases they do not behave quite well with the passengers. Although an increase in this service attribute should have positively influenced BSQ but as the coefficient of this service attribute is negative, an increase in this variable will probably reduce the BSQ which reflect the opposite of the real scenario. The possible reason may be due to the fact that passengers are really not concerned up to that extent about behavior of driver despite of this service attribute being statistically significant.

For the variable 'Bus remains always crowded' the category 'Disagree' came out most significant. The most possible reason can be - the bus is not always crowded. In Dhaka city, bus seems to be crowded only during the peak period. At off peak period, the buses are not as crowded as peak period. As it has a negative coefficient, a decrease in crowdedness may positively influence the overall bus SQ and satisfy users.

5. Conclusion

Dhaka, the core of majority of the organization contributing for the development of this country which has become a megacity requires efficient transportation system mostly. Well planned, organized and improved transportation system eventually results in efficient transportation system. Aiming to improve transportation system eventually, this

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study analyzed the key service attributes influencing the overall bus SQ. From this study, it was found that ‘seat comfort level’, ‘physical condition of bus’ and ‘paying fare/ticketing system’ is the most important and key service attribute which are highly related with bus SQ. All these service attributes were rated ‘very poor’ by the respondents. Alike these three service attributes, ‘noise level’, ‘ease of entry and exit’, ‘punctuality of transport’, ‘behavior of driver’, ‘bus remain always crowded’, cleanliness of bus stop’, ‘security of passengers (belongings)’, ‘lighting facility’, ‘courtesy of helpers and conductors’ and ‘movement flexibility (on road)’ were identified as influencing service attribute to bus SQ. Providing necessary effort according to the requirement of each service attribute shall improve the overall bus SQ.

For improving the transportation system, specially the bus service system, many researches have been done to identify the key influential factors affecting bus SQ. A study by Quddus et al. [Quddus et al. 2019] found ‘punctuality of service’, ‘comfort level’, ‘level of safety from crimes’, ‘drivers’ skill’ and ‘condition of vehicle’ as the key service attributes affecting bus SQ which as well supports the findings of this study to a greater extent. Another study led by Rahman et al. [Rahman et al. 2017] found that ‘lack of cleanliness’, ‘lack of good standard bus’, ‘lack of law enforcing agencies surveillance’ and ‘poor customer service’ had strong relationship with the satisfaction of bus users of Dhaka city. These findings also support the outcomes of this study to some extent.

Although the result of the OPM identifies the significant attributes regarding bus SQ but it has some limitations. The sample was uneven in terms of gender equality. Therefore, the result of the analysis is gender biased as around two-third of the respondents were male and the rest were female. Besides, the result of the analysis could vary depending on the

sample size since the actual number of bus users in Dhaka city is significantly higher compared to the sample size considered for the study. In addition, around one-fifth of the respondents had no other choice than using bus. Availability of other transport could possibly influence their perspective towards bus service which could perhaps influence the result of the study. However, overlooking these limitations, the findings of the study are significantly important for improving the bus SQ in Dhaka city.

The findings from this study can be used by the city transportation officials of Bangladesh for improving the overall SQ of bus. The result from the study will be helpful to the bus service providers as it will let them know the improvement opportunities for enhancing bus SQ so they can retain current users of the service and catch the attention of further users. Furthermore, findings from this study can be utilized to develop policies and regulations to improve bus SQ in Dhaka city. For instance, to ensure seat comfortability, regulations should be made regarding the seat dimension, leg space and seat materials. Emphasize should be given on policies regarding ‘physical condition of bus’ and should be strictly followed to provide people with a safe transportation system. Also, the “fair/ticketing system” of bus should be upgraded to digital platform and be made acceptable as optional fair paying system alongside with regular payment system primarily in the city level. Moreover, to provide better ticketing system, handheld ticketing machine should be made available in every bus. In a traffic jam prone city like Dhaka where maintaining punctuality of transport is difficult, it would be convenient to people if provided with an approximate arrival/departure time of bus according to real time traffic condition by bringing the system online via installing GPS tracker in every bus, initially at city transportation level.

Findings of this research may provide beneficial information to concerned authorities

which can be employed to improve the BSQ in Dhaka city. Improved SQ will retain the current users of bus service and attract new users by satisfying users which in turn improve the living condition of the city by making the transportation system effective and efficient.

6. References

- Abdel-Aty, Mohamed A (2001). "Using ordered probit modeling to study the effect of ATIS on transit ridership." *Transportation Research Part C: Emerging Technologies* 9, no. 4, pp. 265-277.
- Abdullah, Haslyn Nasuha, and Mohd Faiz Hilmi (2014). "Service Quality as Determinant of Customer Loyalty." *International Journal of Business and Innovation* 1, no. 6, pp. 1-11.
- Ali, Alphonsus Nwachukwu (2010). "An assessment of the quality of intraurban bus services in the city of Enugu, Enugu State, Nigeria." *Theoretical and Empirical Researches in Urban Management* 5, no. 6 (15), pp. 74-91.
- Amemiya, Takeshi (1985) "Advanced econometrics", Harvard university press.
- Anable, Jillian (2005). "'Complacent car addicts' or 'aspiring environmentalists'?" Identifying travel behaviour segments using attitude theory." *Transport policy* 12, no. 1, pp. 65-78.
- Andaleeb, Syed Saad, Mahmudul Haq, and Rubina I. Ahmed (2007). "Reforming innercity bus transportation in a developing country: A passenger-driven model." *Journal of Public Transportation* 10, no. 1, pp. 1.
- Antoniou, Constantinos, and Yannis Tyrinopoulos (2013). "Factors affecting public transport use in touristic areas." *International Journal of Transportation* 1, no. 1.
- Baki, Birdogan, Cigdem Sahin Basfirinci, Ilker Murat AR, and Zuhul Cilingir (2009). "An application of integrating SERVQUAL and Kano's model into QFD for logistics services." *Asia Pacific Journal of Marketing and Logistics*.
- Banister, David (2007) "Unsustainable Transport", Routledge: London.
- Bitner, Mary Jo (1990). "Evaluating service encounters: the effects of physical surroundings and employee responses." *Journal of marketing* 54, no. 2, pp. 69-82.
- Bojanic, David C (1996). "Consumer perceptions of price, value and satisfaction in the hotel industry: An exploratory study." *Journal of Hospitality & Leisure Marketing* 4, no. 1, pp. 5-22.
- Borhan, Muhamad Nazri, Deprizon Syamsunur, Norliza Mohd Akhir, Muhamad Razuhanafi Mat Yazid, Amiruddin Ismail, and Riza Atiq Rahmat (2014). "Predicting the use of public transportation: a case study from Putrajaya, Malaysia." *The Scientific World Journal* 2014.
- Boulding, William, Ajay Kalra, Richard Staelin, and Valarie A. Zeithaml (1993). "A dynamic process model of service quality: from expectations to behavioral intentions." *Journal of marketing research* 30, no. 1, pp. 7-27.
- Bunting, P. M (2004) "Making public transport work", McGill-Queen's Press-MQUP.
- Cameletti, Michela, Valerio De Rubeis, Clarissa Ferrari, Paola Sbarra, and Patrizia Tosi (2017). "An ordered probit model for seismic intensity data." *Stochastic*

Predicting and Analyzing Bus Service Quality in Dhaka City by Choice Model

Environmental Research and Risk Assessment 31, no. 7, pp. 1593-1602.

– Cats, Oded, Roberto F. Abenoza, Chengxi Liu, and Yusak O. Susilo (2015). "Identifying priority areas based on a thirteen years evolution of satisfaction with public transport and its determinants." *Transportation Research Record: Journal of the Transportation Research Board* 2, no. 2323, pp. 99-109.

– Choocharukul, K (2004). "Passengers' perspective of bus service quality in Bangkok: an ordered probabilistic modeling approach." In *Australasian Transport Research Forum (ATRF)*, 27th, 2004, Adelaide, South Australia, Australia, vol. 27.

– Dabholkar, Pratibha A (1993). "Customer satisfaction and service quality: Two constructs or one." *Enhancing knowledge development in marketing* 4, pp. 10-18.

– De Oña, Juan, Rocío De Oña, Laura Eboli, and Gabriella Mazzulla (2013). "Perceived service quality in bus transit service: a structural equation approach." *Transport Policy* 29, pp. 219-226.

– Deb, Saikat, and Mokaddes Ali Ahmed (2018). "Determining the service quality of the city bus service based on users' perceptions and expectations." *Travel Behaviour and Society* 12, pp. 1-10.

– Dell'Olio, Luigi, Angel Ibeas, and Patricia Cecín (2010). "Modelling user perception of bus transit quality." *Transport Policy* 17, no. 6, pp. 388-397.

– Demographia (2019) "Demographia World Urban Areas : 15th Annual Edition: 201904", St. Louis, MO: Demographia. Retrieved from: <http://www.demographia.com/db-worldua.pdf>. Last accessed: 02 June 2019.

– DESA, UN (2018) "The World's Cities in 2018 - Data Booklet (ST/ESA/ SER.A/417)". Retrieved from: https://www.un.org/en/events/citiesday/assets/pdf/the_worlds_cities_in_2018_data_booklet.pdf. Last accessed: 17 June 2019.

– Eboli, Laura, and Gabriella Mazzulla (2007). "Service quality attributes affecting customer satisfaction for bus transit." *Journal of public transportation* 10, no. 3, pp. 2.

– Ghotbabadi, Ali Ramezani, Setareh Feiz, and Rohaizat Baharun (2015). "Service quality measurements: a review." *International Journal of Academic Research in business and social sciences* 5, no. 2, pp. 267.

– Iacobucci, Dawn, Kent A. Grayson, and Amy Ostrom (1994). "The calculus of service quality and customer satisfaction: theoretical and empirical differentiation and integration." *Advances in services marketing and management* 3, no. C, pp. 1-67.

– Kamaruddin, Rohana, Ismah Osman, and Che Anizaliana Che Pei (2012). "Public transport services in klang valley: customer expectations and its relationship using SEM." *Procedia-Social and Behavioral Sciences* 36, pp. 431-438.

– Kotler, Philip, and Kevin Lane Keller (2006) "Marketing Management 12th edition", Prentice Hall of India, New Delhi.

– Kumar, Mukesh, Fong Tat Kee, and Amat Taap Manshor (2009). "Determining the relative importance of critical factors in delivering service quality of banks." *Managing Service Quality: An International Journal*.

– Lewis, Barbara R., and Vincent W. Mitchell (1990). "Defining and measuring the quality of

customer service." *Marketing intelligence & planning*.

– Nkurunziza, Alphonse, Mark Zuidgeest, Mark Brussel, and Martin Van Maarseveen (2012). "Modeling commuter preferences for the proposed bus rapid transit in Dar-es-Salaam." *Journal of public transportation* 15, no. 2, pp. 5.

– Nwachukwu, Ali Alphonsus (2014). "Assessment of passenger satisfaction with intra-city public bus transport services in Abuja, Nigeria." *Journal of Public Transportation* 17, no. 1, pp. 5.

– Ojo, Thomas Kolawole, Dickson Okoree Mireku, Suleman Dauda, and Ricky Yao Nutsogbodo (2014). "Service quality and customer satisfaction of public transport on Cape Coast-Accra Route, Ghana." *Developing Country Studies* 4, no. 18, pp. 142-149.

– Parasuraman, Ananthanarayanan, Valarie A. Zeithaml, and Leonard L. Berry (1988). "Servqual: A multiple-item scale for measuring consumer perceptions of service quality." *Journal of retailing* 64, no. 1, pp. 12.

– Parasuraman, Ananthanarayanan, Valarie A. Zeithaml, and Leonard L. Berry (1988). "Servqual: A multiple-item scale for measuring consumer perc." *Journal of retailing* 64, no. 1, pp. 12.

– Parasuraman, Anantharanthan, Valarie A. Zeithaml, and Leonard L. Berry (1985). "A conceptual model of service quality and its implications for future research." *Journal of marketing* 49, no. 4, pp. 41-50.

– Quddus, Mohammed, Farzana Rahman, Fredrik Monsuur, Juan de Ona, and Marcus Enoch (2019). "Analyzing Bus Passengers' Satisfaction in Dhaka using Discrete Choice

Models." *Transportation Research Record* 2673, no. 2, pp. 758-768.

– Rahman, Farzana, Tanay Datta Chowdhury, Tanvir Haque, Rezwanur Rahman, and Aminul Islam (2015). "Analyzing Customer Satisfaction of Bus Service in Dhaka City". *International Conference on Recent Innovation in Civil Engineering for Sustainable Development (IICSD-2015)*.

– Rahman, Farzana, Tanay Datta Chowdhury, Tanvir Haque, Rezwanur Rahman, and Aminul Islam (2017). "Identifying existing Bus service condition and analyzing customer satisfaction of Bus service in Dhaka city." *Journal of Transportation Technologies* 7, no. 2, pp. 107-122.

– Deb, Saikat, and Mokaddes Ali Ahmed (2018). "Determining the service quality of the city bus service based on users' perceptions and expectations." *Travel Behaviour and Society* 12, pp. 1-10.

– Nwachukwu, Ali Alphonsus (2014). "Assessment of passenger satisfaction with intra-city public bus transport services in Abuja, Nigeria." *Journal of Public Transportation* 17, no. 1, pp. 5.

– Sharmin, S., Rouf, K. B. A. R Sakib Sarwar Ahmed, Hossain, M., and Mahboob, D. H., (2020). "Redesigning the interiors of public buses in Dhaka city: Exploring the gender-based perceptions and preferences of young public bus users." *Asian Transport Studies* 6: 100010.

– Lauren, R., Friman, M., Gärling, T., and Hartig, T., (2013). "Quality attributes of public transport that attract car users: A research review." *Transport policy* 25, pp. 119-127.

Predicting and Analyzing Bus Service Quality in Dhaka City by Choice Model

- Rozmi, I., H. H. Mohammad, and M. N. Rahim (2013). "Passengers Preference and Satisfaction of Public Transport in Malaysia, Part II: A Comparative Analysis of Komuter and LRT Network." *Research Journal of Applied Sciences, Engineering and Technology* 6, no. 8, pp. 1450-1456.
- Sadri, Arif Mohaimin, Satish V. Ukkusuri, and Pamela Murray-Tuite (2013). "A random parameter ordered probit model to understand the mobilization time during hurricane evacuation." *Transportation Research Part C: Emerging Technologies* 32, pp. 21-30.
- Shaaban, Khaled, and Rania F. Khalil (2013). "Investigating the customer satisfaction of the bus service in Qatar." *Procedia-Social and Behavioral Sciences* 104, no. 2, pp. 865-874.
- Siddique, Md Tanvir (2018). "Accident severity analysis on national highways in Bangladesh using ordered probit model." *Scientific Research and Essays* 13, no. 14, pp. 148-157.
- Singh, Thangjam Rajeshwar (2010). "An ordered probit model of an early warning system for predicting financial crisis in India." *IFC Bulletin* 25, pp. 185.
- Smith, Martha J. (2008). "Addressing the security needs of women passengers on public transport." *Security Journal* 21, no. 1-2, pp. 117-133.
- Smith, Martha J., and Ronald V. Clarke (2000). "Crime and Public Transport." *Crime and Justice* 27, pp. 169-233.
- Stuart, Kenneth R., Marc Mednick, and Johanna Bockman (2000). "Structural equation model of customer satisfaction for the New York City subway system." *Transportation Research Record* 1735, no. 1, pp. 133-137.
- The Economist Intelligence Unit Limited (2019) "The Global Liveability Index 2019 A free overview", The Economist Intelligence Unit (EIU). Retrieved from: https://www.greenme.it/wp-content/uploads/2019/09/report_citta_piuvivibili.pdf. Last accessed: 02 June 2019
- Tomarken, Andrew J., and Niels G. Waller (2005). "Structural equation modeling: Strengths, limitations, and misconceptions." *Annu. Rev. Clin. Psychol.* 1, pp. 31-65.
- Tyrinopoulos, Yannis, and Constantinos Antoniou (2008). "Public transit user satisfaction: Variability and policy implications." *Transport Policy* 15, no. 4, pp. 260-272.
- Zeithaml, Valarie A. and Bitner, Mary Jo (2000) "Services Marketing: Integrating Customer Focus Across the Firm, 2nd edition", Irwin/ McGraw-Hill, Boston, M.A.
- Zeithaml, Valarie A., Ananthanarayanan Parasuraman, Leonard L. Berry, and Leonard L. Berry (1990) "Delivering quality service: Balancing customer perceptions and expectations", Simon and Schuster.