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Prediction and analysis the causes of increasing an illegal e-taxi in Bangladesh municipalities

A case study of Pabna municipality

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Abstract

Purpose – This study aims to find out the causes for an increase in the number illegal E-taxis and the extent of these vehicles in the municipalities of Bangladesh.

Design/methodology/approach – Based on extensive literature review and field investigation, a set of questionnaires was developed to explore the actual causes for an increase in the number of illegal E-taxis, where ten predicted hypotheses were tested.

Findings – The result proved that the illegal E-taxi is very active in the study area. Besides the socio-economic condition of the commuter, education level of taxi drivers and commuter satisfaction level (safety and comfort) and provision of continuous and door-to-door service system are the main causes for increasing number of E-taxis in the municipality of Bangladesh.

Originality/value – Moreover, this study provides an effective thinking on socio-economic condition of drivers and the legalization of illegal E-taxis in the study area.

Keywords Citizen science, E-taxi, Door to door service, Local public transport

Paper type Case study

1. Introduction

In modern world, the electric taxi (E-taxi) is one of the important local public transportation modes. This taxi is extensively used in many Asian countries. This traffic mode has special characteristics lacking in other public transport (public buses and railway) services. The special characteristics of these vehicles are the individual (chartered by single passengers) and door-to-door service provision for 24 h (Fukumoto *et al.*, 2017). But the unlicensed taxi may create a negative impact on the urban transport environment. In Bangladesh, most of the municipal cities were jam-packed with these unlicensed E-taxis (Chakma, 2018). The introduction of E-taxi can be expressed as a silent rebellion in the transport division of Bangladesh. This E-taxi was first introduced in Bangladesh around 2004, by a private company with the name of "Maa Enterprise" (Mamun, 2015). Since then, the numbers of these vehicles were increasing and spreading all over the country. Numerous such vehicles

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are now playing all over the country, largely in the municipalities and suburban areas. Some measure the figures of a million. Exactly, no one knows the actual figure of these vehicles, as they are not registered or licensed with the transport department.

In the Pabna municipality, about 80 per cent urban people including law administration officers have even been observed to use the illegal E-taxi to travel to certain parts of the city (Chakma, 2018; Mamun, 2015). The municipal authority officially claimed that they gave license to 1,200 E-taxis and 530 rickshaws, and the rest are roaming around the municipality without any license. There is no entry rules and regulations for this E-taxi, any one any time can run this taxi. As a result, these E-taxis are witnessed to illegal parking, traffic rules violation and serious traffic congestion. In some cases, these illegal E-taxis have been involved in serious road accident at the major road intersection. Therefore, there was a need to examine the reasons for the existent of these illegal E-taxis in the face of opposition from the authorities and the latent threat to both drivers and their passengers. The major aim of this study is to find out the actual causes of existent of unlicensed E-taxi and the extent of these vehicles in the local public transport system.

2. Literature review

2.1 Research on an unlicensed taxi in other countries

Mala (2016) wrote a report about the causes of increasing illegal taxi in Fiji, he said that this is because authorized taxis are not providing the required services to the public. Illegal taxi ranks in Fourways city of South Africa have caused concern, and the main reason for creating concern was limited resources of metro police in the city area (Seemela, 2017). The provisions of steady job by taxi service companies have led to an increase in the number of illegal taxi (8,500) in Kingston Metropolitan Area, and day by day the number is increasing, although the law enforcer agents are in the process of trying to analyze and break down the number (Minott, 2016).

Çetin and Eryigit (2011) developed a model to estimate the effect of entry restrictions on the Istanbul taxicab market over real medallion prices and inflation, and they found that entry regulation in Istanbul pressures inflation rates as well. Jun-Zhong (2011) also argues that the taxi industry does not fit for general competition if the government does not fix any entry rules and regulations because if the government regulates the enterprises then the enterprises will regulate taxis and their operations. For improving the taxi services, Baoxing (2006) emphasize the importance of:

- service qualities;
- nature and positioning;
- stability of the taxi industry; and
- the qualifications of the taxi drivers.

Yanshen (2009) said that the key factor of the taxi industry stabilizing is the process of a taxicab license because unbalance taxi supply and demand have increased prices of the taxi license. Ming-Yi (2007) explained that the main reason for increasing the unlicensed taxi in Beijing and Shanghai was the entry regulation, regulation effects and fare control. Unlicensed taxi as a mode of transport is also an important issue in Masvingo and Harare in Zimbabwe (Tichagwa, 2016). Taxi companies provided a steady job to those who operate under the name of the taxi service companies so that they were able to support their families. To prevalence of an informal taxi transport system and the authentication for its existence Tichagwa (2016) recommend particular routes mapped out for them, with a flexible licensing rule to match. Yuan *et al.* (2016) developed a model using real-life data to identify

the unlicensed taxi, better regulate the traffic operation, reduce associated costs and help governments.

2.2 Research on an unlicensed taxi in Bangladesh

Because of the push and pull factor, day by day people from rural areas are migrating in the urban areas of Bangladesh. As a result, population density in urban areas is increasing, and these surplus people are involving in different illegal activities including illegal taxi operation (Shamsher and Abdullah, 2013). Ultimately, these vehicles are creating a pressure on the traffic and transportation system. The volume of the vehicles in the capital city of Dhaka has increased so much that average public transport speed has become 5km/h, which is same as average walking speed (Tribune, 2018). To describe the traffic jam situation in the major city of Dhaka Bangladesh, Rosen (2016) said that "Of all the dysfunctions that plague the world's megacities, none may be more pernicious than bad (really, really bad) traffic."

Not only in the capital city, this problem is now spreading into other municipalities as well. E-taxi and rickshaw are considered as the main causes for this traffic congestion, and the reasons are that slow-moving vehicles occupy much road space and roadside parking by ignoring traffic rules and regulations create congestion (Bari and Efroymson, 2015; Rahman *et al.*, 2004; Rahim *et al.*, 2012). The Government of Bangladesh dismissed the E-taxi and rickshaw in the Third Five-Year Plan in a single sentence: "Slow-moving vehicles such as Auto (E-taxi), pedal rickshaws, push and pull carts etc. should be gradually eliminated through development of automotive vehicles and training of existing operators for such vehicles" (Government of Bangladesh, 1985, p. 302). But in other towns' and municipalities' rickshaw and E-taxi banning procedure has not yet been implemented. These vehicles are increasing in number rapidly (Figure 1) (Chakma, 2018; Mamun, 2015).

Understanding the passengers' socio-economic characteristics can be useful in a variety of applications. It is the main influential factor of travel mode choice. It can also be used to determine the performance of the local public transport network, forecast the levels of demand and the level of service delivery and accommodate variations in ridership across weekdays and seasons (El Mahrsi *et al.*, 2014). Poverty (per capita income is US$351) and necessity of a steady job are considered as one of the major influential factors (Mannan and Karim, 2001; Rana *et al.*, 2013; Uddin and Sano, 2011) of increasing illegal E-taxi in Bangladesh. Poverty imposes people to choose cheap transport mode for daily transportation. On the other hand, taxi industry provides a steady job opportunity which attracts the uneducated people to engage in this illegal business. Chakma (2018) and Mamun (2015) said that cheap travel fee, safety, nonpolluting and comfort are the leading factors for an E-taxi to become popular among the low- and middle-class people. Begum and Momotaz (2014) and

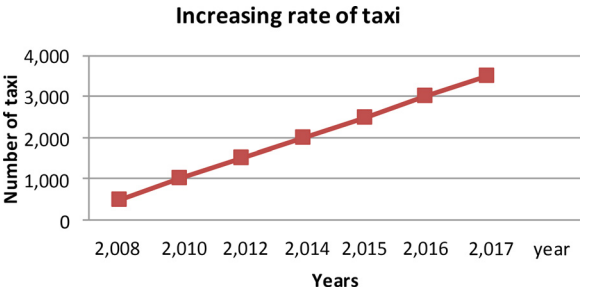

Figure 1.
Increasing rate of E-taxi in the study area

Horsu and Yeboah (2015) said that customer satisfaction (satisfaction variable, e.g. reliability, safety, continuous service, affordability, comfort and drive behavior) is the key influential factor to become a popular traffic mode in a city. Customer satisfaction is a conclusion that a service has provided a pleasurable level of consumption-related happiness (Oliver, 1997).

However, this study investigates motivational factors for illegal E-taxi services in the municipalities of Bangladesh by considering the users socio-economic condition.

3. Materials and methods

The main attention of the research is to explore the influential factors regarding the causes of increasing illegal E-taxi in Pabna municipality. The questionnaire was based on extensive literature review and field investigation. The study involves an overview of study area, design of questionnaire, data collection and statistical analysis of the collected data.

3.1 Study area

The study area of Pabna municipality located at 24.99° North latitude and 89.23° East longitude (Figure 2). It is about 219 kilometers away from the capital city (Dhaka). The total area is about 18.64 sq. km where 142.86 km is the road network and serves as a home to 181,939 people (Chakma, 2018; Mamun, 2015). According to UGIIP (2007) report, the

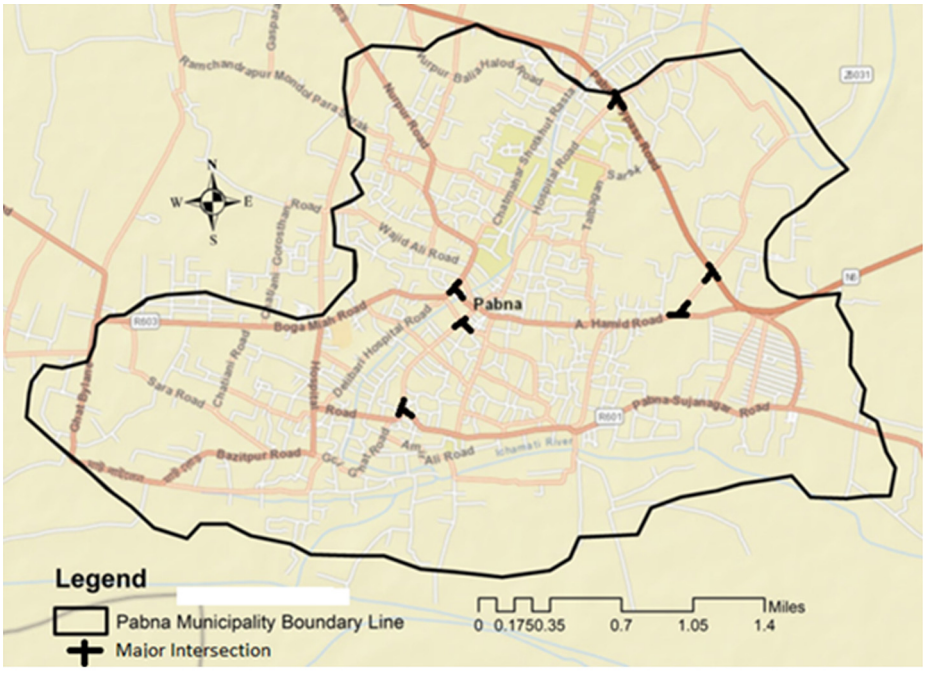

Figure 2.
Survey location of the study area

Source: Authors (2018)

population density of the study area is higher than the other municipalities (30 persons per acre). The major transport modes of the municipality are E-taxi, rickshaw, tempo, van, bicycle and motor cycle. The E-taxi was first introduced in the Pabna municipality around 2005 (Mamun, 2015; Saha *et al.*, 2013). Since then, the numbers of these vehicles were increasing (Figure 1). Now, many people guess the number of this vehicle is around 5,000; exactly, no one knows the actual number of these vehicles because these vehicles are unlicensed. For this reason, the municipality is completely jam-packed with these surplus vehicles.

3.2 Questionnaire design and survey

Six major road intersections (Terminal, Maril bypass, traffic more, Nimtola more, Edward College and Judge Court) were selected for traffic volume survey and road side interview survey in Pabna municipality (Figure 2). Two sets of questionnaires were designed for both commuters and E-taxi drivers to acquire more in-depth information about the issue. Randomly, 50 household were surveyed to observe their socio-economic and demographic conditions and their satisfaction level while traveling by an E-taxi; road side interviews were taken with 30 drivers to analyze their socio-economic and demographic conditions and their satisfaction with the income incurred by driving an E-taxi. In the household survey, author tries to find out why, when, how and where people are traveling. Commuter satisfaction level includes safety, comfort reliability, affordability, continuous service and driver behavior. The questionnaires were pre-tested before administration (Table I). After

Table I. Variables considered in the questionnaire survey

Section	Variables
Socio-demographic information	Sex (male or female) Age range (under 20, 20-25, 25-30, 30-35 and above 40) Profession (unemployed, self-employed, private sector, government sector, business and student)
Commuter satisfaction Safety	*Scale*
a) Low probability of accident	Strongly agree%, agree %, disagree %, strongly disagree %
b) Low probability of fallen	Strongly agree%, agree %, disagree %, strongly disagree %
c) Low probability of assault	Strongly agree%, agree %, disagree %, strongly disagree %
Comfort	
a) Comfortable seat	Strongly agree%, agree %, disagree %, strongly disagree %
b) Smooth ride	Strongly agree%, agree %, disagree %, strongly disagree %
c) Sheltered waiting area	Strongly agree%, agree %, disagree %, strongly disagree %
Continuous service	
a) Service on weekends	Strongly agree%, agree %, disagree %, strongly disagree %
b) Service on weekdays	Strongly agree%, Agree %, Disagree %, Strongly Disagree %
c) Service on public holiday	Strongly agree%, agree %, disagree %, strongly disagree %
d) Door-to-door service	Strongly agree %, agree %, disagree %, strongly disagree %
e) Service in evening	Strongly agree %, agree %, disagree %, strongly disagree %
Affordability	
a) Cheap fares	Strongly agree%, agree %, disagree %, strongly disagree %
b) No tickets required	Strongly agree %, agree %, disagree %, strongly disagree %
Driver behavior Reliability	Strongly agree %, agree %, disagree %, strongly disagree %
a) Arriving on time	Strongly agree %, agree %, disagree %, strongly disagree %
f) Waiting away from home	Strongly agree %, agree %, disagree %, strongly disagree %
g) Delay on route	Strongly agree %, agree %, disagree %, strongly disagree %

some modification, the questionnaires were administered on larger samples by hiring some research assistant.

3.3 Statistical approach

A statistical model was introduced to predict and analyze the causes of increasing number unlicensed E-taxi in the study area. Ten hypotheses were tested to predict the causes. Before running the model, reliability of the data was tested. The reliability test guarantees that each of the scales used is being evaluated to set up the inner consistency of the present investigation (Peterson, 1994; Merriam, 2009). Cronbach's alpha is the most common measure of internal consistency (reliability). The alpha values indicate a high level of reliability (Table II):

H1. Age of the respondent has a positive and a significant influence to operate an unlicensed E-taxi.

H2. Educational level of the respondent has a positive and a significant influence to operate an unlicensed E-taxi.

H3. Marital status of the respondent has a positive and a significant influence to operate an unlicensed E-taxi.

H4. Family member support to the respondent has a positive and a significant influence to operate an unlicensed E-taxi.

H5. Safety as observed by commuters has a positive and a significant influence to increase the number of unlicensed E-taxi.

H6. Continuous service as provided by unlicensed E-taxi has a positive and a significant influence to increase the number of unlicensed E-taxi.

H7. Comfort as observed by commuters has a positive and a significant influence to increase the number of unlicensed E-taxi.

H8. Affordability of service as provided by an unlicensed E-taxi has a positive and a significant influence to increase the number of unlicensed E-taxi.

Independent variable	Cornbrash's alpha
Age of the respondent	0.503
Educational level of respondent	0.807
Marital status of the respondent	0.626
Family member support	0.509
Safety	0.851
Comfort	0.765
Reliability	0.633
Affordability	0.714
Continuous service	0.907
Driver behavior	0.683
Commuter satisfaction	0.708

Table II.
Reliability test result

H9. Reliability of service as observed by commuters has a positive and a significant influence to increase the number of unlicensed E-taxi.

H10. Good driver behavior observed by commuters has a positive and a significant influence to increase the number of unlicensed E-taxi.

4. Exploratory analysis

4.1 The extent of an unlicensed electric taxi in the study area

A comprehensive socio-economic household survey revealed that 90 per cent of daily trips in Pabna municipality are made by E-taxis (Figure 3) and bicycles, while another 7 per cent are made on foot and rest of the 3 per cent are made by cars. In all, 90 per cent of all retailers and wholesalers' foodstuff and workers are using this vehicle for their daily transportation (UGIIP, 2007).

Traffic volume survey revealed that the unlicensed E-taxi was very active in the study area and adversely affecting the roadway level of service (LOS). LOS measures the operating

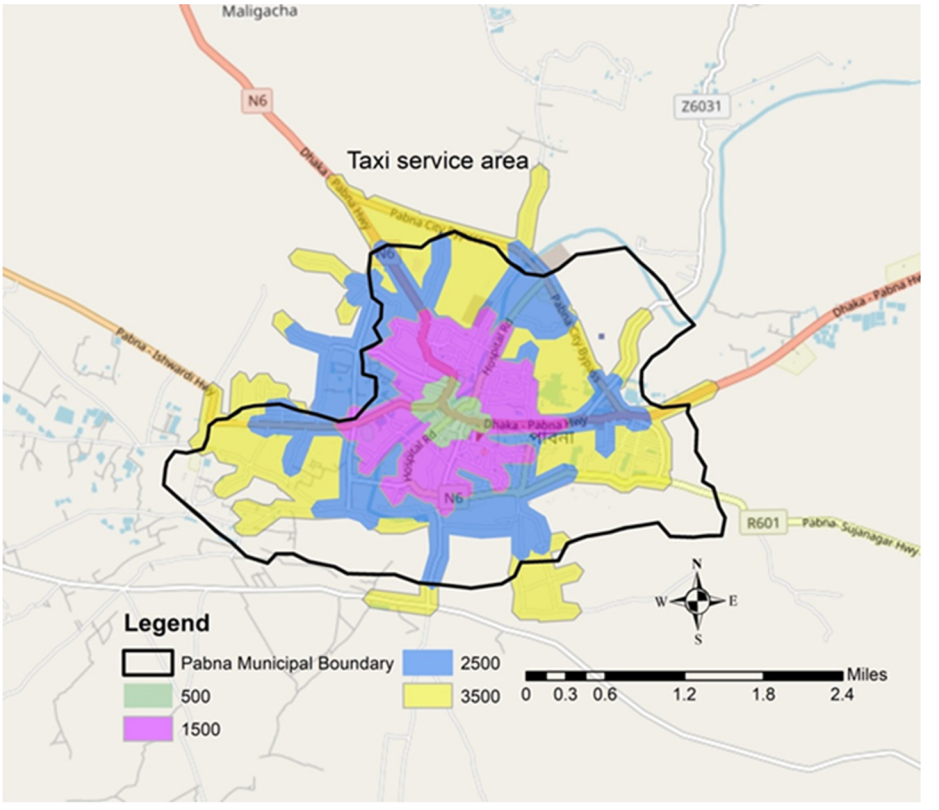

Figure 3.
E-taxi service map in the study area

Source: Authors (2018)

conditions of a roadway based on travel time, speed, delay and safety. LOS is designated with a letter, A to F, where "A" represents the best-operating conditions and "F" represents the worst (Kadiyali, 2013). Table III illustrates the worst operating condition (F) of a roadway at traffic more and Nimtola more intersection. Inappropriate channelization of vehicles in this narrow roadway intersection is considering as the main influential factors for this worst traffic condition. The operating condition of other road intersections is not also satisfactory and the main reason for this worst operating condition is the illegal use of footpath, lack of traffic police at the intersection, on-street parking on a narrow road, no traffic sign and signal and inappropriate channelization of vehicles.

Figure 4 shows the temporal variation of traffic flow at major road intersection (Terminal, Traffic more, Judge Court, Maril Bypass, Nimtola more and Edward College). The traffic desperate was observed from 7 a.m. to 1 p.m. and 2 to 5 p.m.. Traffic was a greater between 12 to 1 p.m. and 4 to 5 p.m. than at other timings, and from 7 to 8 a.m., the traffic was found to be low. This could be because a lot of people go to the Central Business

Intersection name	Route name	Vehicle number (PCU) (V)	Capacity (C)	Peak hour (V/C)	Level of service (LOS)	Width of carriage way (meter)
Terminal	Terminal to town	4,595	5,928	0.77	D	7
	Terminal to Maril bypass	3,298	5,928	0.55	C	8.5
Traffic more	Town to Maril bypass	4,523	4,155	1.08	F	6.5
	Town to Edward college	2,040	3,025	0.68	C	6.8
In front of Judge court	Town to Ananto	2,720	3,600	0.75	D	8
	Town to Library bazar	1,728	3,600	0.48	B	8
Maril Bypass	Maril to Town	2,895	3,989	0.72	D	7
	Gaspara to terminal	1,748	3,575	0.48	B	9
Nimtola more	Town to terminal	4,176	3,601	1.16	F	6.5
In front of Edward college	Town to Gaspara	3,634	3,878	0.93	E	7

Table III.
Impact of illegal E-taxi on roadway level of service

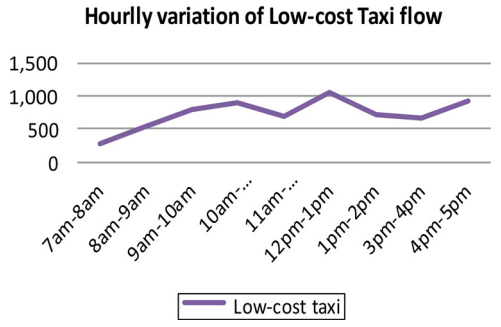

Figure 4.
Average number of per day E-taxi trips

District (CBD) area for shopping and recreation (especially, between 4 and 5 p.m.), and during the morning hours (from 7 to 8 a.m.), people get themselves ready for work, and for this reason, the traffic flow was low at that time. Severe traffic congestion was also observed during the peak hours at Traffic more, Nimtola more and in front of Edward College. Lack of traffic management, lack of traffic signal, illegal use of footpath and traffic rules' violations by unlicensed E-taxis were observed.

Figure 5 shows the average number of unlicensed E-taxi trips for each day of the week. It was found that the greatest number of trips were made on Thursday (6,977) and Sunday (6,279) and the smallest on Friday (4,053). This could be because Friday and Saturday are weekends, and Thursday and Sunday are the days before and after the weekends. It was also noted that almost all government officials, businesses and hospitals were closed on Friday. Therefore, there were fewer taxi passengers during the daytime. Figure 6 shows the E-taxi trips characteristics of the study area. An OD survey was applied to collect the origin and destination data of the commuters. As the commuters do not know the exact (latitude and longitude) drop-off and pick-up location, the OD survey data were processed by using

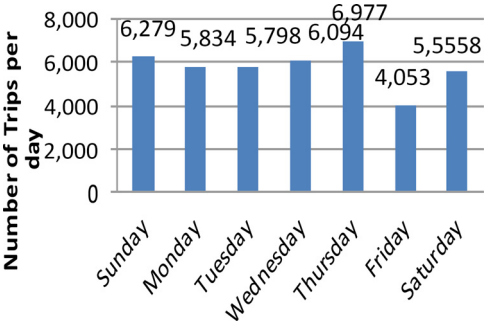

Figure 5.
Average number of E-taxi trips for each day of the week

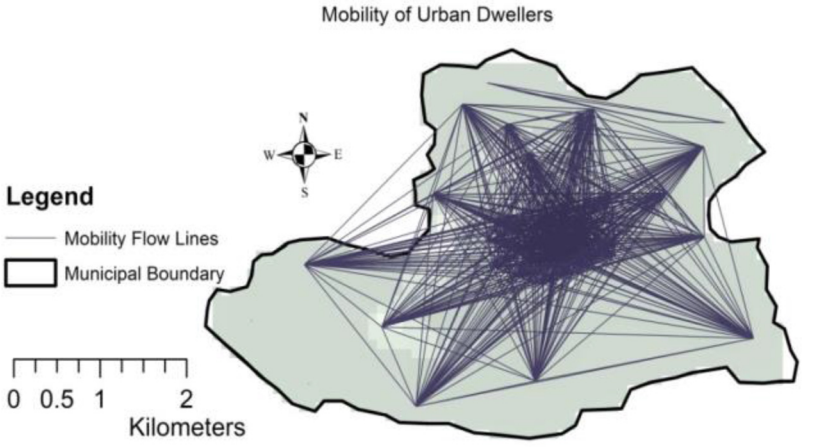

Figure 6.
E-taxi trips characteristics in the study area

Source: Authors (2018)

google earth and ArcGIS 10.3 software. First, shapefiles were created for each facility in the study area. Second, pick-up and drop-off location was indicated with the aid of google map, and finally, the model ran with the network analysis tools in GIS environment. It was found that most of the trips were originated out of the CBD area and concentrated into the CBD area. OD survey revealed that about 15 per cent trips were made for schools and college; 4 per cent for recreation; 9 per cent for shopping; 3 per cent for others and personal work purpose trips; and the rest 69 per cent trips were made either home or to work/office (Figure 7).

4.2 Motivational factors of commuter to use an unlicensed electric taxi

4.2.1 Socio-economic and demographic conditions of the commuter. To understand how the socio-demographic, socio-economic and socio-cultural profiles of the commuters motivate using an illegal E-taxi, authors conduct a direct interview with dwellers.

From the survey, it was found that the main economic source for the urban dwellers is small business (30 per cent) (Figure 8), which includes retail, hotel and restaurant, cottage industry, and another important source is private sector (23 per cent). Different types of nongovernment organizations (NGO) like BRAC, Grameen Bank and ASA provide employment opportunity for the unemployed. But highly educated people mostly get a job in these NGOs, and on the other hand, the people who engaged in the illegal E-taxi operation are uneducated and somehow have completed primary education level. Very few people were engaged with government service sectors (6.6 per cent). Students (23.3 per cent) are another major part of the population s of the municipality who use an unlicensed E-taxi for their daily transportation from home to different educational institutions. The main reason

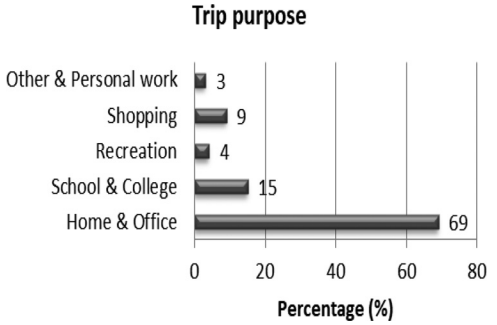

Figure 7.
Purpose of trips

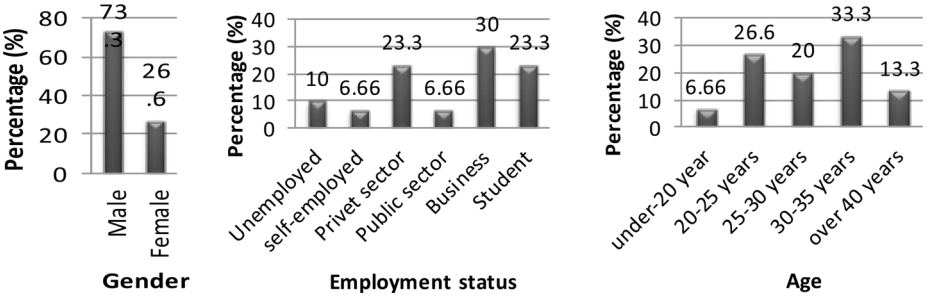

Figure 8.
Demographic characteristics of commuters

for this is the location of "Pabna University of Science and Technology" and "Medical College" in the municipality. Majority of students reside off-campus and travel to and from the institutions at various times of the day by using their institutional buses and informal E-taxis. Some university student said that they do a part-time job (e.g. tuition) to support themselves and reduce pressure on their families. The illegal E-taxis are the only option for them.

People from the age group of 30 to 35 years used illegal E-taxis more (33.3 per cent); this was observed from the analysis, and the main reasons are ease of getting in and out of a taxi (which is suitable for old people), comfortable seats and smooth ride. People of other age groups also use E-taxis as shown in Figure 8. From the field survey, it was experiential that a man is the money-earner in the family; he has to go out to earn the daily bread, and this was the main reason for the increase in the number of male commuters (73 per cent) with an illegal E-taxi than that of female commuters (26.6 per cent). UGIIP report said that about 80 per cent commuters use an E-taxi for internal transport in the municipality, and their traveling patterns were attributed to traveling from residence to work/business place and academic institutions, including going to markets for shopping and offices for getting different orders, completing business deals, dealing cases in the court, medical centers and for social visits. UGIIP also said that about 50.48 per cent dwellers of total population were sufficient to meet minimum requirements of their family expenditures, and the rest 49.52 per cent met their family needs in hardship, that is, by taking loan from their friends/relatives, moneylenders and illegal E-taxi driving, which gives a comprehensive picture of how individual commuters are involved with illegal E-taxi business to meet their minimum family requirements.

4.2.2 Commuter satisfaction level. Table IV shows the frequency of commuter satisfaction level on the E-taxi service quality. Table V indicates the correlation matrixes of six service quality variables, i.e. continuous service, comfort, safety, reliability, affordability and driver behavior with customer satisfaction. All the variables instead of the driver

Table IV.
Frequency of commuter satisfaction levels

Question	Variables	Respondent	Frequency (%)
Commuters perception on E-taxi service quality			
Safety	Low probability of accident	15	50
	Low probability of fallen	6	20
	Low probability of assault	9	30
Comfort	Comfortable seat	16	53.3
	Smooth ride	14	46.6
	Sheltered waiting area	–	–
Continuous service	Service on weekends	6	20
	Service on weekdays	7	23.3
	Service on public holiday	6	20
	Door-to-door service	4	13.3
	Service in evening	7	23.3
Affordability	Cheap fares	17	56.66
	No tickets required	13	43.3
Driver behavior		30	100
Reliability	Arriving on time	15	50
	Waiting away from home	9	30
	Delay on route	6	20

	Safety	Comfort	Continuous service	Affordability	Driver behavior	Reliability
Safety						
Pearson correlation	1	0.858**	0.918**	0.820**	−0.553**	0.940**
Sig. (two-tailed)		0.000	0.000	0.000	0.002	0.000
Comfort						
Pearson correlation	0.858**	1	0.855**	0.802**	−0.645**	0.838**
Sig. (two-tailed)	0.000		0.000	0.000	0.000	0.000
Continuous service						
Pearson correlation	0.918**	0.855**	1	0.894**	−0.715**	0.904**
Sig. (two-tailed)	0.000	0.000		0.000	0.000	0.000
Affordability						
Pearson correlation	0.820**	0.802**	0.894**	1	−0.739**	0.786**
Sig. (two-tailed)	0.000	0.000	0.000		0.000	0.000
Driver behavior						
Pearson correlation	−0.553**	−0.645**	−0.715**	−0.739**	1	−0.540**
Sig. (two-tailed)	0.002	0.000	0.000	0.000		0.002
Reliability						
Pearson correlation	0.940**	0.838**	0.904**	0.786**	−0.540**	1
Sig. (two-tailed)	0.000	0.000	0.000	0.000	0.002	

Notes: Adjusted $R^2 = 0.76$; **correlation is significant at the 0.01 level (two-tailed)

Table V.
Correlation matrix of E-taxi service quality

variable have a positive and a significant relationship with customer satisfaction with the adjusted R^2 value of 0.76.

The correlation results said that:

- "Safety" had a positive value and was statistically significant; commuters usually felt safe in using the low-cost taxi because these rides were smooth, and drivers drove carefully.
- "Comfort" had a positive value with a high significant level; the commuter gained satisfaction when the taxi service provided comfortable seats and when the taxis had enough air circulation.
- "Continuous service" had a statistically significant positive values; commuter was very satisfied with the continuous service of E-taxi for the door to door regular bases service.
- "Affordability" had a positive value and was statistically significant; the commuter used an E-taxi because the travel fee of an E-taxi is economical (i.e. only TK20 for 1.5 km).
- "Driver behavior" had negative values but was statistically significant that means the driver's behavior does not have an effect on the commuter satisfaction level.
- "Reliability" implied ready availability of an E-taxi at the station; timely arrival at the destination is the main reason for increase in the use of E-taxi in the study area which is positively and significantly related to customer satisfaction.

Table VI shows the results of a multiple regression analysis on the commuter satisfaction level. The result shows positive β coefficient score for safety, comfort, driver behavior and reliability are $b = 0.613$, $p = 0.04$; $b = 0.141$, $p = 0.048$; $b = 0.27$, $p = 0.091$ and $b = 0.109$,

$p = 0.70$, respectively. Continuous service and affordability, however, score negative β coefficient. The overall regression model was statistically significant with the F (6, 23) = 16.62, $p < 0.001$ and $R^2 = 0.76$. They predict the commuter satisfaction significantly that means the commuter satisfaction is the main influential factor for the increase of unlicensed low-cost taxi in the study area.

4.3 Motivational factors of drivers to operate an illegal electric taxi

4.3.1 Socio-economic and demographic conditions of the drivers. Figure 9 shows the socio-economic and demographic conditions of the illegal E-taxi operators in the study area. The figure illustrated that the largest group of informal taxi operators belonged to the 30-35 years of age group who were about 33.3 per cent. Other groups were 26.6, 20 and 13.3 per cent under the age group of 20-25, 25-30 and 40+ years, respectively. Under 20 years of age group (6.6 per cent) is not yet fully involved in this slightly risky business. From the figure, it is clear that the peak period for the informal taxi business was the 20-35 year group (79.9

Model	Unstandardized coefficients B	Unstandardized coefficients Std. error	Standardized coefficients β	t	Sig.
(Constant)	1.575	0.323		4.878	0.000
Safety	0.262	0.137	0.613	1.908	0.049
Comfort	0.105	0.146	0.141	0.718	0.048
Continuous service	−0.065	0.087	−0.253	−0.746	0.463
Affordability	−0.540	0.111	−1.054	−4.854	0.000
Driver Behavior	0.228	0.129	0.270	1.763	0.091
Reliability	0.052	0.136	0.109	0.381	0.707

Notes: Dependent variable: customer satisfaction; and adjusted R^2: 0.76

Table VI.
Result of regression analysis of E-taxi service quality

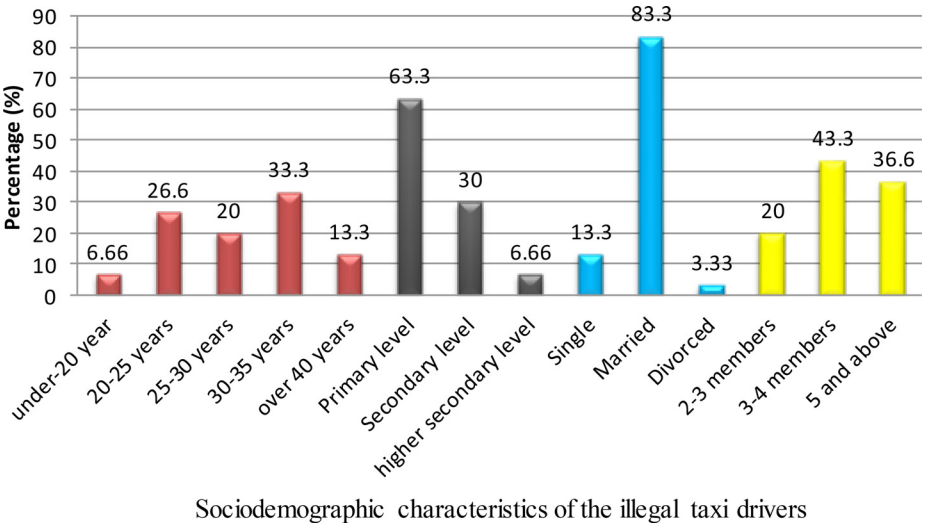

Figure 9.
Socio-demographic characteristics of the illegal E-taxi drivers

per cent) because the 20-35 years range people were married person (83.3 per cent) and they need a job to support their family. Married people who had to support three to four members were 43.3 per cent or more than five members were 36.6 per cent. On the other hand, for those with low education (primary level) (63.3 per cent) did not get a stable job in different NGOs and government department; eventually, to support their families, they started the illegal taxi operation as it was the only means of their living. However, the over 40 groups are the most experienced and knowledgeable operators who were actively thinking about to quitting the job or expand into different exercises like - small shop.

Pearson correlation analysis was conducted to show how the socio-economic and demographic conditions of the drivers' influenced to operate an informal taxi (Table VII). The degree of correlation, however, differs among the variables with age of respondent having the highest correlation of 1 followed by education level (0.4), marital status (0.2), family member support (−0.13) and monthly salary (−0.15). The correlation result said that age of respondent and education levels have a positive correlation with the illegal taxi operation. On the other hand, family member support and monthly salary have a negative correlation. It means family member support and monthly salary of the drivers does not affect to operate the illegal taxi operation, whereas education level and age of drivers influence to operate an illegal taxi. Different age groups of people (from under 20 to over 40 years) and the different education levels of people (from primary to higher secondary level) both are positively involved in an illegal taxi operation in the study area, and the reason is lack of employment opportunity. Thus, illegal taxi operations ensure a stable job to support their families.

The multiple regression result shows (Table VIII) the β and p values for four independent variables age, education level, marital status and family member support are $b = -0.009$, $p = 0.949$; $b = 0.402$, $p = 0.008$; $b = -0.011$, $p = 0.934$; and $b = -0.263$, $p = 0.057$, respectively. The regression result said that age, marital status and family member support had negative values and not statistically significant that means age, marital status and family member support of the illegal taxi driver does not influence to engage them into the

	Age of the respondent	Educational qualification	Marital status	Family member support	Monthly salary (in TK)
Age of the respondent					
Pearson correlation	1	0.404**	0.236	−0.136	−0.155
Sig. (two-tailed)		0.004	0.099	0.347	0.282
Educational qualification					
Pearson correlation	0.404**	1	−0.053	−0.189	−0.110
Sig. (two-tailed)	0.004		0.716	0.189	0.445
Marital status					
Pearson correlation	0.236	−0.053	1	−0.245	−0.108
Sig. (two-tailed)	0.099	0.716		0.086	0.457
Family member support					
Pearson correlation	−0.136	−0.189	−0.245	1	0.260
Sig. (two-tailed)	0.347	0.189	0.086		0.068
Monthly salary(in TK)					
Pearson correlation	−0.155	−0.110	−0.108	0.260	1
Sig. (two-tailed)	0.282	0.445	0.457	0.068	

Notes: Adjusted $R^2 = 0.21$: and **correlation is significant at the 0.01 level (two-tailed)

Table VII. Correlation matrix of the E-taxi drivers' socio-economic and demographic conditions

illegal taxi operation. On the other hand, educational qualifications of the drivers were found to be statistically significant to influence them into the illegal taxi operation. It represents that the primary educated and illiterate people of the study area are largely involved in this illegal business.

The aforementioned results lead to the acceptance of three (3) hypotheses and rejection of seven (7) hypotheses. The outcome of the hypotheses test is summarized in Table IX.

4.3.2 Satisfaction level of drivers to driving an illegal electric taxi. Figure 10 shows the satisfaction level of drivers with the income they earned from an illegal E-taxi operation. The drivers said that their monthly income range from the illegal taxi operation was TK12,000-14,000 for the employed taxi drivers and TK16,000-18,000 for owners. Majority of taxi drivers (71.3 per cent) observed the level of wages they earned as satisfactory for the time and effort they put in. Around 15.5 per cent drivers said the revenue they earned from the illegal taxi driving ranged from good to very good. Very few drivers (13.2 per cent) said

Table VIII.
Result of regression analysis for the E-taxi driver's socio-economic and demographic conditions

Model	Unstandardized coefficients B	Unstandardized coefficients Std. Error	Standardized coefficients β	t	Sig.
(Constant)	2.410	0.518		4.650	0.000
Age of the respondent	−0.005	0.071	−0.009	−0.064	0.949
Educational qualification	0.272	0.098	0.402	2.787	0.008
Marital status	−0.014	0.173	−0.011	−0.083	0.934
Family member support	−0.175	0.089	−0.263	−1.953	0.057

Notes: Dependent variable: causes of driving illegal E-taxi; and adjusted $R^2 = 0.21$

Table IX.
Results of hypotheses test

	Statement	B	p value	Accepted/ rejected
H1.	Age of the respondent has an influence to operate an unlicensed taxi	−0.009	0.949	Rejected
H2.	Educational level of the respondent has a positive and a significant influence to operate an unlicensed taxi	0.402	0.008	Accepted
H3.	Marital status of the respondent has an influence to operate an unlicensed taxi	−0.011	0.934	Rejected
H4.	Family member support of the respondent has an influence to operate an unlicensed taxi	−0.263	0.057	Rejected
H5.	Safety as observed by commuters has a positive and a significant influence on increasing the number of unlicensed taxis	0.613	0.049	Accepted
H6.	Continuous service as provided by unlicensed taxi has a significant influence on increasing the number of unlicensed taxis	−0.253	0.46	Rejected
H7.	Comfort as observed by commuters has a positive and a significant influence on increasing the number of unlicensed taxis	0.141	0.048	Accepted
H8.	Affordability of service as provided by an unlicensed taxi has a significant influence on increasing the number of unlicensed taxis	−1.054	0.001	Rejected
H9.	Reliability of service as observed by commuters has a positive and a significant influence on increasing the number of unlicensed taxis	0.109	0.70	Rejected
H10.	Good driver behavior observed by commuters has a significant influence on increasing the number unlicensed taxis	0.270	0.09	Rejected

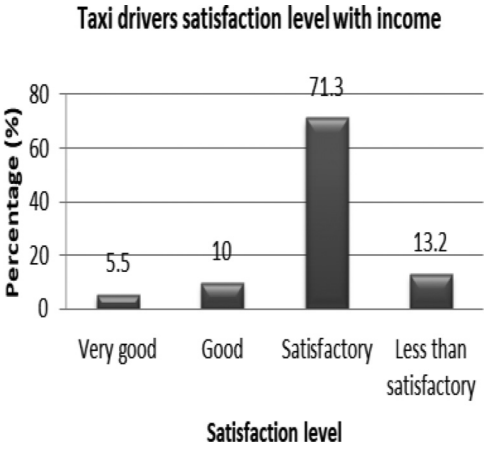

Figure 10.
Driver satisfaction level

the income they earned was less than satisfactory. Most of the drivers said that the amount they earned from the illegal taxi operation allowed them a reasonably good standard of living.

4.4 Positive aspects of driving an illegal electric taxi

Besides, every action plan must have some positive aspect, and from the illegal taxi operation, researcher found out three major positive aspects. Figure 11 summarizes these positive aspects. First, provision of a steady employment opportunity (75.5 per cent) for the taxi drivers; second, reduced taxi waiting time (23.44 per cent); and finally, management opportunity (5.25 per cent) than the licensed taxi. The majority of the drivers appreciated the fact that the informal taxi business provided them a steady job, enabling them to support their families. A sizeable number of drivers said that dealing with a smaller number of passengers was easier to manage than in the licensed taxi business.

4.5 Negative aspects of driving an illegal electric taxi

Figure 12 summarizes major negative aspect of the illegal taxi business that was observed from the direct conversation with the drivers. The most responsive negative aspect of the

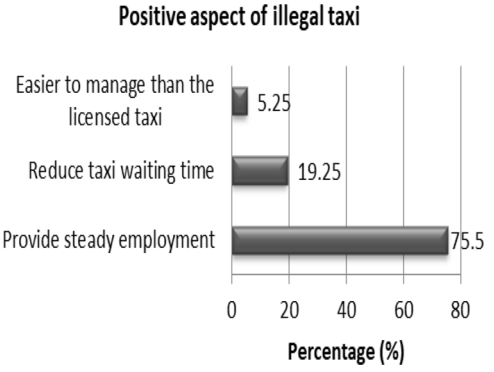

Figure 11.
Positive aspects

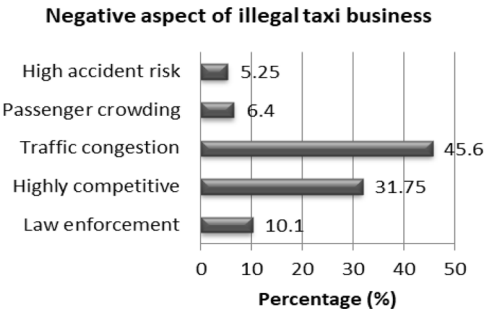

Figure 12.
Negative aspect

informal taxi operation is traffic congestion (45.6 per cent) in the CBD area. It is quite difficult to move 5,000 unlicensed taxis on only 187.50 km road from where 18.80 km streets are unpaved.

The second negative aspect of the informal taxi operation was the highly competitive (31.75 per cent) nature of the business. As the business is not controlled, it is common for new drivers to quickly perform on the scene and add to the number of taxis on specific routes. The impact of such an improvement is to reduce the number of travelers accessible to individual operators and, consequently, reduce the trips of the drivers. This regularly causes pressure among the operators; however, as they are on the whole working unlawfully, they can scarcely keep the inclusion of any new players. Such strains are managed following a concurred procedure. The trips are normally planned on a first come, first served premise, and by understanding, no driver is permitted to hop the line – everybody must anticipate their turn.

Law enforcement (10.1 per cent) is another major challenge. As the illegal taxis were operated without a license, the drivers run their taxis anywhere and at whatever time they wish. Sometimes, they were stopped and fined by the traffic police. The traffic police were frustrated at their helplessness to manage and to force the illegal taxi to stop.

The negative parts of the illegal taxi operation specified by the drivers were crowding of the passengers (6.4 per cent) and high accident risk (5.25 per cent). The insight of a high accident risk is related to the run-ins with the law enforcement agents. Despite that, the drivers realize that they need to take after the street rules expected of each driver, they regularly go for broke to abstain from having their vehicles seized. Some drivers (6.4 per cent) said they were to some degree humiliated at squeezing four or five travelers into their small size vehicles. Be that as it may, they said they needed to do this to accomplish their objectives of every day takings.

5. Conclusions

This study aims to find out the actual causes of increasing unlicensed taxi and its extent in the Pabna municipal city. To do that, this study used a qualitative method to acquire more depth about the topics, where the researcher gave concern to both commuter and operators' socio-economic, demographic and cultural profiles to understand how their socio-economic, demographic conditions motivate them to conduct illegal taxi business. It was found that:

- The routes of Pabna municipality were patronized by the illegal taxis very actively. All classes of urban dwellers use this mode for their daily transportation.
- The economic conditions and the lack of employment opportunity are the main causes to engage the commuters with this informal job.

- It ensures a stable job for both educated and uneducated people, which allows them to accommodate their families. But increasing number of taxis might be reducing the trips of the drivers.
- Most of the illegal taxi operators were uneducated, unskilled and, otherwise, unemployed.
- Commuters were very satisfied with the door-to-door service system of these informal taxis.
- The surplus illegal taxis create pressure on traffic management system by introducing road accident, traffic congestion and traffic rules' violations.

After the analysis of socio-economic condition of commuters and drivers, the researcher developed a statistical model, where ten predicted hypotheses (age, education level, marital status and family member support of illegal drivers and the variable of commuter satisfaction, e.g. safety, comfort, continuous service, affordability of service, reliability of service and driver behavior) were tested. The model was analyzed through the multiple regression analysis technique, and the analysis' result proved that education level of illegal taxi drivers and the commuter satisfaction variable (safety and comfort) had a positive and significant effect on increasing number illegal taxi in the study area, and the other variable had no significant effect in case of increasing illegal taxis. This is the special mention of this paper. However, to find out the possible way, the socio-economic condition of the drivers should be considered, ensuring the development of local public transport system in the study area and in Bangladesh.

References

Baoxing, Q.I.U. (2006), "Improving the regulations, orderliness and services of the taxi market. Urban transport of China, 5, 000", available at: http://en.cnki.com.cn/Article_en/CJFDTOTAL-CSJT200605000.htm

Bari, M. and Efroymson, D. (2015), *Improving Dhaka's Traffic Situation: Lessons from Mirpur Road*, Health Bridge and Work for a Better Bangladesh Trust, Dhaka, 2005.

Begum, R. and Momotaz, S.N. (2014), "Determinants of passengers' satisfaction with CNG-run auto rickshaw services in Bangladesh: an empirical study on Dhaka city. D.u", *Journal of Marketing*, Vol. 15 June 2012 (Published in November, 2014).

Çetin, T. and Eryigit, K.Y. (2011), "Estimating the effects of entry regulation in the Istanbul taxicab market", *Transportation Research Part A: Policy and Practice*, Vol. 45 No. 6, pp. 476-484, available at: https://doi.org/10.1016/j.tra.2011.03.002

Chakma, M. (2018), "Analyze the effect of drivers behaviors and socioeconomic condition on traffic flow: a case study of Pabna municipality, Bangladesh", *Proceeding in the 4th International Conference on Civil Engineering for Sustainable Development (ICCESD 2018), KUET, Khulna, Bangladesh*, ISBN: 978-984-34-3502-9(Printed copy), pp. 261-262. ISBN: 978-984-34-3502-6 (online).

El Mahrsi, M.K., Come, E., Baro, J. and Oukhellou, L. (2014), *Urb Comp 14*, New York, NY.

Fukumoto, M., Matsuo, K. and Matsumoto, Y. (2017), "A study into the factors affecting the number of taxi trips in Toyohashi, Japan", *Journal of the Eastern Asia Society for Transportation Studies*, Vol. 12, pp. 1434-1447, available at: https://doi.org/10.11175/easts.12.1434

Government of Bangladesh (1985), *Third Five-Year Plan: 1985-1990*, Dhaka, Bangladesh.

Horsu, E.N. and Yeboah, S.T. (2015), "Influence of service quality on customer satisfaction: a study of minicab taxi services in cape Coast, Ghana", *International Journal of Economics, Commerce and Management*, Vol. III No. 5, May 2015, ISSN 2348 0386.

Jun-zhong, W.Q.Q.T. (2011), *Nature, Role and Management Mode of the Taxi Industry, Urban Problems*, 11, p. 016.

Kadiyali, L.R. (2013), *Traffic Engineering and Transport Planning*, Khanna publishers. New Delhi, 3013.

Mala, S. (2016), "Lack of taxi services cause of illegal operations, says Tuinaceva", Fijisun. 04 April 2016, available at: http://fijisun.com.fj/2016/04/04/lack-of-taxi-services-cause-of-illegal-operations-says-tuinaceva/

Mamun, A.H. (2015), "Electric three wheelers and municipal transportation in Bangladesh", *International Journal of Innovative and Applied Research*, Vol. 3 No. 2, pp. 12-16.

Mannan, S.M. and Karim, M.M. (2001), "Current state of the mobility of the urban dwellers in greater Dhaka", *94th Annual Conference and Exhibition of Air and Waste Management Association*, June 24-28, 2001, *Orlando, FL*.

Merriam, S.B. (2009), *Qualitative Research: A Guide to Design and Implementation*, Jossey-Bass, San Francisco, CA, ISBN-13: 978-0470283547.

Ming-yi, C.H.E.N. (2007), "Entry regulation, fares control and the divagation of unlicensed taxis–analysis on the taxi markets in Beijing and shanghai", *Journal of Shanxi Finance and Economics University*, Vol. 11, p. 010.

Minott, A. (2016), "Companies admit to dispatching illegal taxis to collect passengers", The Gleaner, December 6, 2016, available at: http://jamaica-gleaner.com/article/lead-stories/20161206/companies-admit-dispatching-illegal-taxis-collect-passengers

Oliver, R.L. (1997), "Satisfaction: a behavioral perspective on the consumer", *Irwin/McGraw Hill*, New York, NY, p. 13.

Peterson, R.A. (1994), "A Meta-Analysis of Cronbach's coefficient alpha", *Journal of Consumer Research*, Vol. 21 No. 2, pp. 381-391, available at: www.jstor.org/stable/2489828

Rahim, M.A., Joardder, M.U.H., Hoque, S.M.N., Rahman, M.M. and Sumon, N.H. (2012), "Socio-economic and environmental impacts of battery driven auto rickshaw at Rajshahi city in Bangladesh", *International Conference on Mechanical, Industrial and Energy Engineering 2012 01-02 February, 2013, Khulna, Bangladesh*.

Rahman, M.M., Okura, I. and Nakamura, F. (2004), "Effects OF rickshaws and auto-rickshaws on the capacity OF urban signalized intersections", *IATSS Research*, Vol. 28 No. 1.

Rana, S., Hossain, F., Roy, S.S. and Mitra, S.K. (2013), "The role of battery operated Auto-Rickshaw in the transportation system of a city", *Journal of Asian Electric Vehicles*, Vol. 11, No. 1, June 2013.

Rosen, J. (2016), "The Bangladeshi traffic jam that never ends", The New York Time Style Magazine, available at: www.nytimes.com/2016/09/23/t-magazine/travel/dhaka-bangladesh-traffic.html

Saha, A.K., Haque, M.R., Nahar, T.T. and Rahman, M.M. (2013), "Application of traffic management plan a sustainable solution of traffic congestion in Pabna city, Bangladesh", *International Journal of Recent Development in Engineering and Technology*, Vol. 1 No. 3, pp. 11-15.

Seemela, M. (2017), "Illegal taxi ranks in fourways cause concern", Fourway Review, February 17, 2017, available at: https://fourwaysreview.co.za/254851/illegal-taxi-ranks-in-fourways-cause-concern/

Shamsher, R. and Abdullah, M.N. (2013), "Traffic congestion in Bangladesh-Causes and solutions: a study of Chittagong metropolitan city", *Asian Business Review*, Vol. 2 No. 1, (Issue 3) ISSN 2304-2613 (Print); ISSN 2305-8730 (Online).

Tichagwa, C.G. (2016), "Unlicensed taxis in Zimbabwe's urban areas: the case for Legalising an informal urban transportation system", *Development Southern Africa*, Vol. 33 No. 1, pp. 81-98, available at: https://doi.org/10.1080/0376835X.2015.1113125

Tribune, D. (2018), "Study: Dhaka traffic wastes 5 million work hours, costs Tk37,000 crore", Tuesday, available at: www.dhakatribune.com/bangladesh/dhaka/2018/05/20/study-dhaka-traffic-wastes-5-million-work-hours-costs-tk37-000-crore (accessed 22 May 2018).

Uddin, M.F. and Sano, K. (2011), "Transportation problem urban city of the developing country Bangladesh", Proceedings of the Eastern Asia Society for Transportation Studies, Vol. 8.

UGIIP (2007), *Urban Governance and Infrastructure Improvement Project (UGIIP) for Pabna Pourashava*, Local Government and Engineering Department of Bangladesh, Dhaka.

Yanshen, C.H.E.N. (2009), *Analysis on Current Problems of Taxi Industry Stablizing and Developing*, *Urban Studies*, 2, p. 022.

Yuan, W., Deng, P., Taleb, T., Wan, J. and Bi, C. (2016), "An unlicensed taxi identification model based on big data analysis", *IEEE Transactions on Intelligent Transportation Systems*, Vol. 17 No. 6, pp. 1703-1713, doi: 10.1109/TITS.2015.2498180.

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