Is Electric Street Car a Sustainable Public Transport System in India? A Demand Side Analysis[♣]

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Abstract

Electric Street Car (ESC) is well acknowledged as a public transport system in urban space which offers better safety, minimum pollution, conservation of fossil fuel and hence establishing as an ideal one for urban agglomeration. Yet, India embarked on an ambitious plan for going all-electric by 2030 by procuring E-buses rather than ESCs (i.e., tramways). The crucial question is, when the government is trying to implement electric public transport system with a drive towards a low carbon emission technology then why not upgrade the existing ESC as a part of that initiative considering that the E-buses need a profound infrastructure development in India? This paper identifies the factors under which the stated preferences of the commuters to avail the ESC service are more than e-buses. Our study is based on the primary survey from randomly selected 1028 daily public transport commuters' responses from the city of Kolkata, as in the Indian sub-continent it is the only city having ESCs in operation till date. Using random utility choice model the study estimates the impact of specific performance improvements on the intention to avail the ESC services compared to the E-buses. The study helps to understand how perceptions of the individuals about ESC are aligned when the commuters are frequent or infrequent travellers of ESC. It is identified that higher frequency in availability of ESC service and technological upgradation are two important factors which contributes towards the switching intention of the commuters towards ESC. By promoting the ESC services over E-buses, Indian government could save substantial amount of public investment and can reach a low carbon pathway cost effectively. The findings have crucial implication both from managerial and policy perspective in transportation sector, energy sector, urban development, climate change and in public policy.

Keywords: Sustainability, Urban Development, Electric Vehicle, ESC

JEL Classification: R58, R49, Q56, Q40

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1. Introduction

Urban areas are significant contributors to climate change and their response towards climate change mitigation is crucially linked to how the city operates (UNDP, 2011). Thirteen out of twenty cities in the world with highest air pollution are in India (WHO, 2014). To achieve emission cut target as stringently as possible, India has embarked on an ambitious plan for going all-electric by 2030. The International Energy Agency, 2017 (IEA) has estimated that the ambitious target would mean selling 10 million EVs, a figure equivalent to more than five times the number of EVs globally today. In this connection Government of India has also unveiled National Electric Mobility Mission Plan (NEMMP) 2020 to accelerate the growth of the electric and hybrid components of the automotive sector. The push was evident from the move by the Department of Heavy Industries (DHI) when FAME (Faster Adaptation and Manufacturing of (Hybrid) & Electric Vehicles) was launched in April 2015 to promote manufacturing of electric and hybrid vehicles in India with a corpus of about ₹ 8 billion (US$ 111 million) to invested within September 2018. Additionally, in the second phase of FAME[1], the approximate budget estimate is about ₹ 55 billion (US$ 763 million), though it is expected to create demand incentives for fleet vehicles only rather than for private owners but, the e-buses are the only action point identified by the NITI Aayog in terms of fleet vehicles. The idea is to create public awareness and to ensure shared and connected mobility is achieved along with mass EV penetration (Gosh, 2018). However, a globally popular clean and safe electric transport system, the Electric Street Cars (ESC, the tramways), finds no mention in any of the policy parameters. When the master plans for most cities in India target 60-80 per cent clean public transport ridership by 2025-2030, reason for under-studying the potential on tramways is difficult to comprehend. In this paper, we study the potential market demand for ESC and underline the important factors which might lead to probable increase in ridership of trams.

Rashid et al. (2006) identifies safety, environment, energy and land conservation as important four factors that urban planner needs to keep in mind while structuring urban transport system. Electric Street Cars (ESC) is the only transport system which satisfies all the four features and offers the best safety, minimum pollution, conservation of fossil fuel and minimum land requirement (Xie and Levinson, 2009). Ricket (2010) provide a comparison between buses and ESC to identify that ESC can generally provide a high quality ride in the presence of designated tracks and regularity in service. Additionally the buses lose out in

[1] FAME II is expected to come out anytime in the September 2018.

terms of capacity, life-cycle cost and level of pollution. However, the preparatory time for ESC is relatively long and initial financial investment is voluminous. On the other hand, bus services require much less initial funds and can be introduced quite quickly. This is one of the primary reasons explaining why buses play a major role in city transport even in the presence of ESC in popular urban cities. Though Electric Buses can perform better in terms of level of pollution emission but it again pushes up the cost of operations as the initial investment cost is way higher for e-buses (almost 40% more than conventional buses). The Government of India realizes it is necessary for a holistic initiative to bring about a change not only by focusing on demand incentives for EVs but also through required EV infrastructure development (Gosh, 2018). The government think-tank NITI Aayog has suggested the state government to go for electrification of public transport force to reduce the carbon footprint contributed by each states. It has been well realized by the experts that market forces work well when it comes to individual choices and hence pushing for private EVs via incentive offers may not be efficient. This is one among the primary reasons for the centre to potentially advise state government to drive for electric buses. Given this objective and the expected allocated budget for popularity of electric transport systems we identify, ESC can be a model example of electric public transport and it generates the motivation for exploration for its operational feasibility in the cities of India.

Stead and Pojani (2015) record that till 2013, modern ESC has been adopted in 436 cities across the world and it is identified as the most successful medium capacity mode, with over 100 years of development behind it, yet incorporating the latest technology for the future. A modal choice survey by UITP (1997) has shown that on the average 11% car drivers were taking trams in 93% of the European cities. Also, unanimously the commuters from all the EU cities studied in the survey rated trams being more accessible than buses and 73% believed that LRT are even more reliable than the buses. There are evidences showing that modern tram system not only attracts passengers to itself but also exhibits a spill over effect by providing a good integration between modes of transport system and hence, increasing ridership of the public transport system as a whole[2] (Brown et al.,2012, Barter et al., 2000, Clercq 2003). Hence modern LRT even though not yet used in India (old trams operate in Kolkata) deserves serious consideration for use as a mode of medium capacity mass rapid transport. To understand the intentions of the daily commuters to avail tram service over

[2] In Strasbourg ,Germany, total public transport ridership had increased by 45% between 1990 to 1997, since the opening of the LRT and use of private cars in the city center had reduced by 17% (see http://www.lightrailnow.org/facts/fa_lrt_nation-germany.htm)

electric buses we have selected the study area in a way such that the subjects are aware about the viability and existence of tramways. Though, in India, we had trams in many cities[3] but it is discontinued in all the cities due to various reasons. Kolkata (formerly Calcutta) is the only city in the Indian subcontinent having trams in operation till date amidst lot of hurdles, barriers and setbacks[4]. Thus, Kolkata provides the premise to study the commuters' demand for tram service even in the presence of modern, faster transport system like e-buses. We have conducted a primary survey for 1028 randomly selected individual responses to estimate the impact of specific performance improvements, in the tram system, on the intentions of the commuters to avail ESC services over e-buses. By using survey data and probabilistic choice model the study identifies improvement in frequency and technology are the two important factors to determine the service type availed by the commuters. Although these are crude estimates of stated preferences, it gives an idea about the actual potential of ESC in urban areas. By promoting the ESC services over e-buses, Indian government could save substantial amount of public investment amount and can reach a low carbon pathway cost effectively. The findings have crucial implication both from managerial and policy perspective in transportation sector, energy sector, urban development, climate change and in public policy.

The rest of the paper is organized as follows. The methodology and the data are described in section 2 and 3. Section 4 lays down the findings from our model. The final section provides some concluding remarks and throws some light on intended future works.

2. Identifying the preference for ESC- The Methodology

To assess consumers' intention to avail the ESC and identify the components that might influence the demand for ESC services we need to understand the possible wedge between consumers' ex-ante stated intention and ex-post realized activity (Bagozzi and Dholakia, 1999; Gollwitzer, 1999). Literature shows that there could be negative correlation between the stated intention and real activity (Balasubramanian and Kamakura, 1989; Kahneman and

[3] Trams had been operational in Indian cities like Bhavnagar, Patna, Chalakaudy, Kanpur, Chennai, Delhi, Nashik and Mumbai but it is discontinued either for urban congestion (like in Delhi), or emergence of other forms of efficient transport like train systems (in the case of Mumbai), or low ridership (case of Patna), or bankruptcy (as in Chennai), so on so forth (Bhattacharya, 1995).

[4] Increasingly, the tram is considered too slow for the city's streets and hence has been identified as the cause of traffic disruption (Dasgupta et al., 2012). This led to the suspension of trams during the rush hours, when demand for transport would be generally high, denying the opportunity for ridership capture and increase in revenues. Also, construction of Metro rail, flyovers, concretization of the tram tracks and other development projects in the city has led to suspension of several tram routes.

Snell, 1992) as the consumers tend to over-report the desired behaviour (Gecere et al., 2018; Bagozzi, 1994; Bagozzi, Yi, and Nassen, 1999) and this leads to overestimation of their demand (Klein et al., 1997). Also, the variables influencing the intentions to avail tram services may not be time invariant, which might contribute by aggravating the gap between is stated intention and actual activity (Infosino, 1986; Morwitzetal., 2007; Sun and Morwitz, 2010). Furthermore, the relationship between intentions to avail tram service may usually be affected by various other demographic and socio-cultural factors (Morwitz and Schmittlein, 1992).

Stated intention could be asked as a direct question (for example: "Do you intend to avail ESC service?") or in probabilistic terms (for example: "How likely are you to avail the ESC service?") using a different intentions scale (Infosino, 1986; Morwitz and Schmittlein, 1992; Armstrong et al., 2000). Assessing intentions with purchase probabilities partially solves the problem of overstatement of service availing intentions and allows us to better describe situations where people may not have planned to avail the service, but realize that they may do so in the near future (Armstrong et al., 2000; Carson and Groves, 2007). MacRae, (2007) shows that in the case of capturing intentions to purchase a new product, purchase probability scales performed better than purchase intention scales.

The analysis of the paper is structured using a random utility model, which can be classified under the discrete choice model. Discrete Choice model had been widely used in transportation modelling form the last 25 years. The theoretical basis of DCEs is vividly explained by Lancaster's (1996) in the theory of consumer behaviour and welfare theory. McFadden (1976) developed strong theoretical justification behind complex analysis of transportation demand. The model aims to identify the utility that individuals derive from attributes conforming an environmental good or service under valuation. DCE seems to be ideally suitable to inform the choice and design of multidimensional policies compared to any other choice models (for example: Contingent valuation methods) (Hanley et al; 2001). Another advantage of the model is that it reduces the potential biases from cognitive choices by capturing more information from respondent and by testing for internal consistency (Alpizar et al, 2001). DCE also helps to provide a deeper understanding of trade-offs between different attributes of a service (Adamowicz et al; 1998; Jin et al, 2006). Further, when valuing multi attribute programs DCE can be significantly easier to implement as only one questionnaire can be used in that case. These models consider that demand is the result of several decisions of each individual in the population under consideration. The decisions consist of a choice made among a finite set of alternatives and the associated facilities (in the

context of this paper, these are comfortable seats in trams, frequency of availability of trams, etc.). The model actually provides a better understanding of complex systems by predicting future states of the considered system, controlling or influencing its behaviour and optimizing its performances (Shogren, 2006; Adamowicz and Deshazo, 2006). The DCE approach to preference elicitation is similar to the choice based approach to consumer theory because it is explicitly assumed that respondents observed choice in the experiment reveal the preferences of the individuals.

In traditional empirical model, random utility approach, a consumer avail a service when the utility deriving from the service is higher than a given threshold corresponding to the utility of not availing the service (i.e. of availing an outside option). The utility is defined as a function of x, a set of product characteristics and consumers' characteristics, and a random term-

$$y_i^* = x'\beta + u \text{ with } E(u) = 0$$

In usual empirical setting, the researcher does not observe the utility y_i^*, but the actual purchase y_i. y_i is assumed to be a random dichotomous variable for the individual i, which takes value 1, when the utility evaluation of the consumers exceeds the threshold τ and the individual therefore purchases, and 0 otherwise:

$$y_i = \begin{cases} 1 & y_i^* > \tau \\ 0 & y_i^* \leq \tau \end{cases}$$

While the researcher cannot measure the utility y_i^*, she observes the realization of y_i and the set of covariates X. It is therefore possible to estimate the impact of the covariates on the probability to avail the service. In the random utility model, τ is often assumed to be zero (by (Cameron and Trivedi, 2005).

The simple estimation of Eq. (1) runs the serious risk of finding spurious relationships, since it is highly likely that consumers' unobserved characteristics, such as the existence of a latent bias for green products, correlate with both their characteristics and their stated intention to avail service. Therefore, as an additional point of departure from the standard literature, we exploit the full information of the dataset and manage to bypass this endogeneity issue (Train, 2003). In the survey respondents first declared their intention to buy y_{it}^*, then chose three different improvements they are willing to pay for, in order to improve the characteristics of the vehicle, and then they stated again their intention to buy, y_{it+1}^*. We can interpret the variation in the intention to buy after the chosen improvements as an increase in the utility

only due to change in the product characteristics. In this way, we have a controlled experiment, in which the endogeneity problem is much milder. We still cannot rule out that some unobserved heterogeneity correlates both with the intensity of change in the utility and with the choice of the improvement.

In order to detect the impact of the choice of improvements on the likelihood of crossing a specific threshold τ as the result of these choices, we estimate the following regression model.

$$\Pr\left(q_{i,t+1} > \tau \middle| q_{i,t} \leq \tau\right) = F(x) \text{ with } F(x) = \frac{1}{1+e^{-(x'\beta)}} \text{ and } \forall\, \tau$$

where X is a set of covariates which describe all the possible improvements and individual socio-demographic characteristics. Concerning the improvements, we include three categorical variables that indicate, for each consumer, what was the choice on the first, the second and the third improvement among the five possible choices at each step. To control unobserved heterogeneity gap between intention to avail the service and actual actions, the regression include a set of socio-demographic variables – gender, education, age, income and an individual controls that capture the attitude towards the public transport, the monthly expenditure towards public transport, average time to travel destination, the knowledge about alternative mode of ESC (e.g. E-buses) etc.

3. Data Collection and Descriptive Statistics

We conducted a primary survey in 2018 for capturing a probabilistic intention of the commuters towards ridership of trams from an Indian metropolitan city, Kolkata, where the ESC service is operational as a public transport system till date. On the outset, it is important to mention that the tramways of Kolkata did not undergo any technological upgradation since its inception (which goes way back around 1900 when electrification of trams happened from horse-drawn one) and also with the development of modern faster modes of transport (like Metro rail, Radio cabs, Auto rickshaws) it has lost its popularity.[5] However, it important to understand that trams are an age old green transport system and having a capacity of about four times of a bus. In spite of these facts the central as well as the state government identifies e-buses to be the only immediate action point to achieve low emission target. Kolkata being a metropolitan city as well as the capital city of the state Bengal (West Bengal), the state transport department is also running behind the carbon emission target limit

[5] Some survey identifies that the trams are still operational in the city due to its heritage value only.

set up by the NITI Aayog. Under FAME II policy, the Government of West Bengal has already placed requisition for e-buses, which is expected to hit the roads of the city anytime. Given, this new development in the public transport sphere of the Kolkata, it stands out as a pertaining question as to why cannot the authority upgrade the existing ESC as a part of low carbon emission initiative when operation of e-buses need a profound infrastructure development in the city? Thus, to understand this situation, we analyse the demand side of the market for ESC in Kolkata by enquiring about the probable intentions of purchasing tram service from 1223 commuters who choose public buses for their daily commute even in the presence on ESC service as alternative mode of transportation. After data sorting, cleaning and cross checking the rationality of their choice making we have built up our final data analysis out of 1028 number of observations.

The data was collected through systematic random sampling method from individuals who regularly (>3 days a week) travel through public transport in the city. At the first twelve operational public bus and tram depots of the city (which 50 percentage of the all bus and tram depots) were randomly selected. Then, every fifth passenger/traveler from the each public bus depot was selected for the survey. If the fifth individual refused to voluntarily participate in the survey, the next individual was asked and accordingly the next fifth individual was selected. They were given an option to opt out any time point of the survey, so that biased and erroneous responses can be minimised.

The survey was carried out with a designed and detailed questionnaire[6]. Six separate sections of the questionnaire dealt with the identification of the sample individuals, personal details (including their educational status, income status, gender, age, current occupation), their attitude towards availing public transport through bus and railway, attitudes towards availing e-bus compared to conventional bus, perception about the ESC services, followed by a section to understand attitudes towards availing ESC compared to e-buses and the last section gives a picture of the factors influencing intention to avail ESC. To lay the design of the questionnaire explicitly, the first part of the questionnaire deals with the personal details of the respondent for evaluating the socio-economic status of the individual. In the second section, the travelling details like monthly expenditure for travel, time of travel, mode of travel, etc. were collected to control for the individual behaviour. Since, the study hypothesised that the ESC could be an economic alternative for E-buses, in the next section we provide a comparative information between e- bus and conventional bus after which

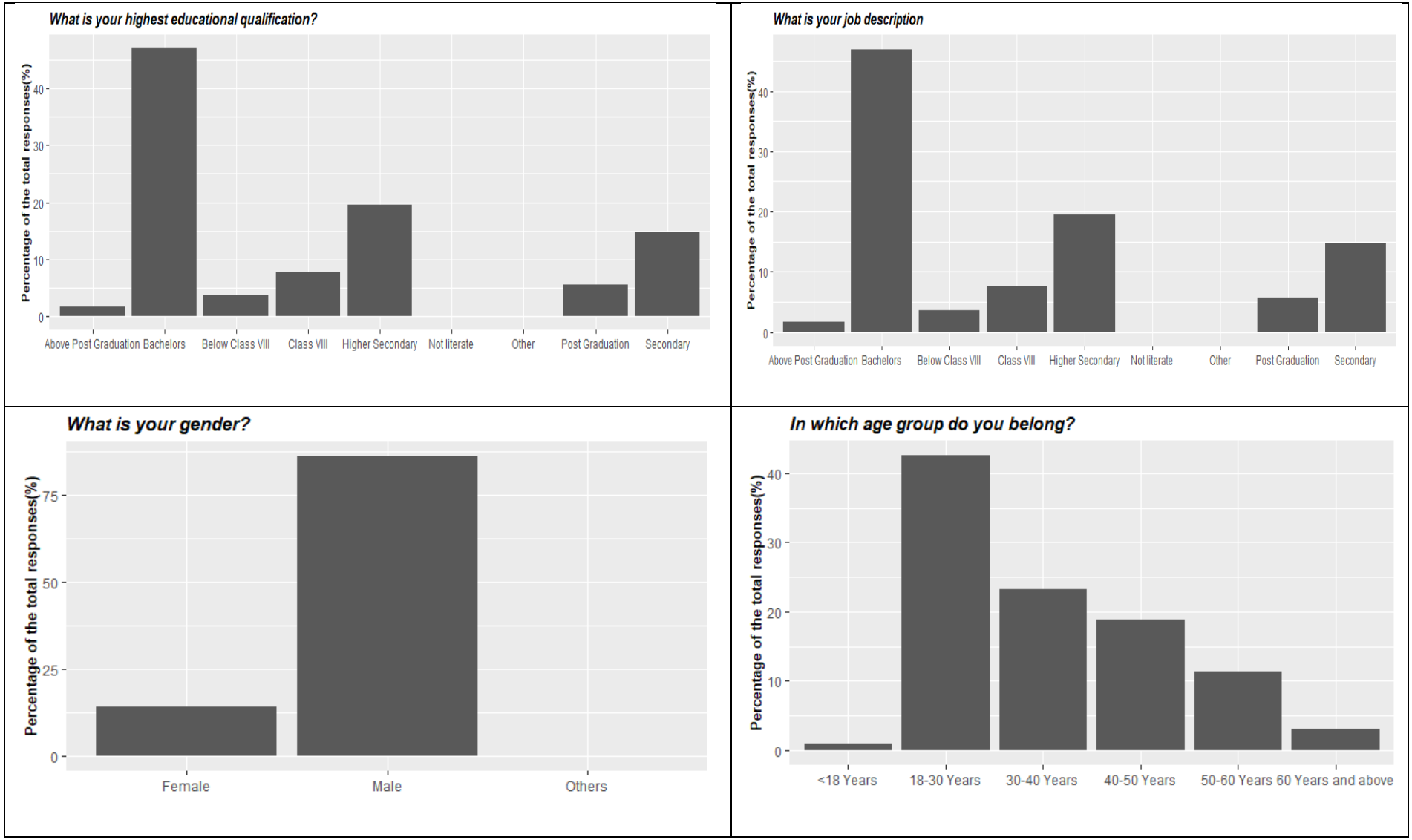
[6] Questionnaire can be shared upon request.

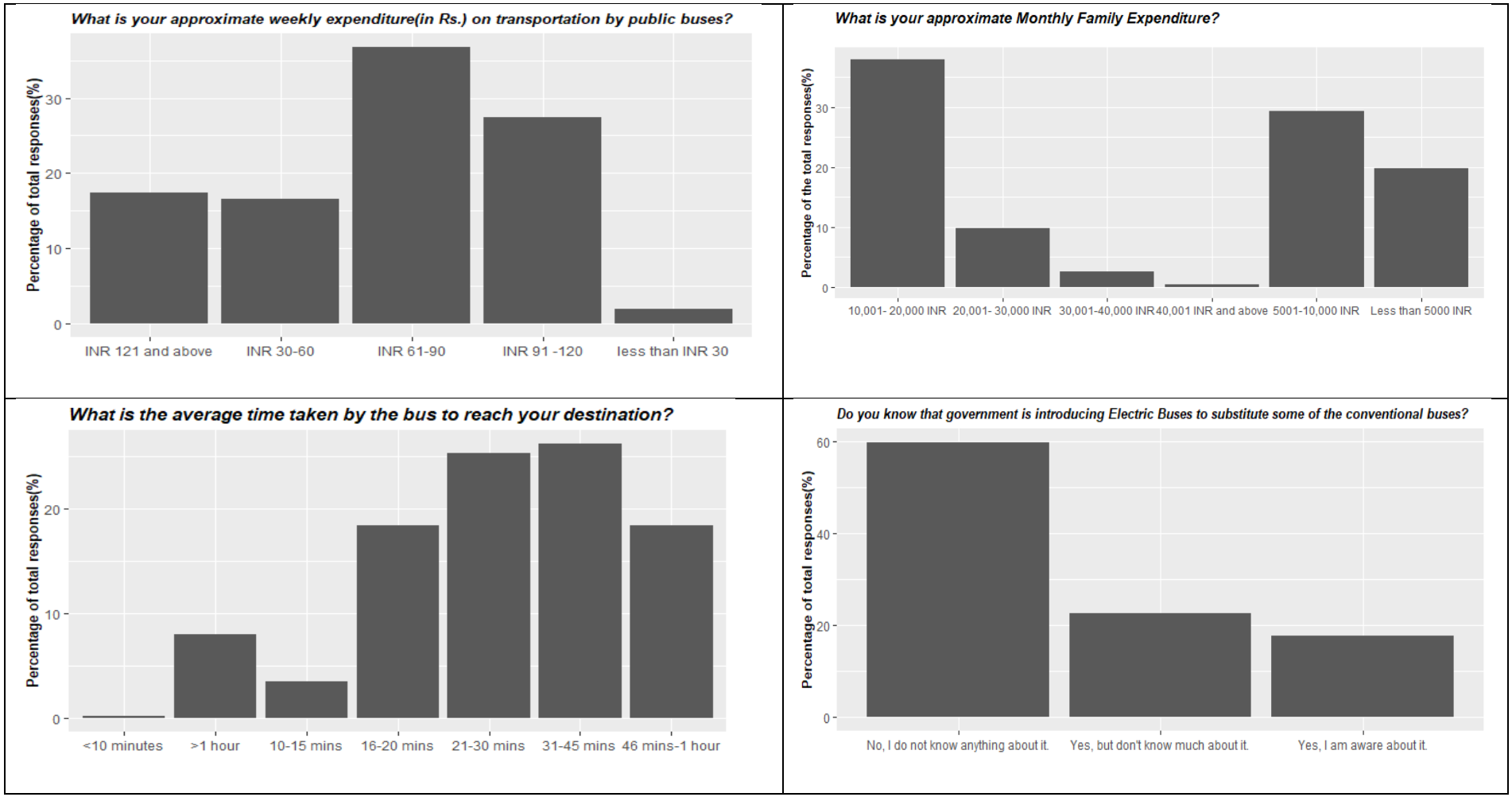
questions on their intention to avail the E-bus services where asked. The comparison between a generic conventional bus and a generic electric bus was proposed in terms of: minimum fare, maximum speed, frequency of availability, emission potential, fuel cost and passenger caring capacity (see Table A1). The respondents had to state their intention to avail the electric bus in terms of probability (i.e. through a continuous variable ranging from 0 to 1) on the basis of the provided information. The comparative information was essential to provide as general public were unaware of the benefits and cost of e-buses over conventional buses. Also, the purpose of this section is to check the rationality of the individual behaviour towards ESC service over EV services. In section five, a list of statements about ESC services was presented and the individuals were asked to indicate their level of agreement with each statement (1="Strongly disagree"; 5="Strongly agree"). The last part of the survey is most important for the scope of the present article, which is aimed at understanding how relevant some features of ESCs were for the respondents and at measuring their propensity to consider ESC as a realistic alternative for EV. First, a comparison between a generic electric street car and a generic electric bus was proposed in terms of the categories, same as for the previous case: minimum fare, maximum speed, frequency of availability, emission potential, fuel cost and passenger caring capacity. Based on this, respondents were again asked to state their intention to avail the ESC in terms of probability (i.e. through a continuous variable ranging from 0 to 1). The respondents were also asked to select the reasons behind their choice. The final part of the survey was devoted to understand how the purchase probability varied after the improvement of selected features like comfort, frequency, technology, traffic management and convenient payment mode. The preferences of respondents for these factors were evaluated in order to understand the scope of improvement of ESC services. With this stated objective, respondents were told to assume that given there will be no change in the fare then how would they indicate their intention to avail the service (a) if the most preferred factor was improved. This exercise was repeated two more times (three times in total): each time the respondent was asked to indicate their intention to avail the service as before (b) if there is improvement in the first three most preferred factors and (c) if there is an improvement in all the listed factors.

To understand the basic structure of the sample households, socio-economic structure, age-wise distribution, household types depending on the principal activity of the households, transport expenditure, income, etc. of the households were appended. In the survey, the respondents are mostly male educated, working class population of the city aged from 18-50 years belongs to low to middle income groups (Figure I). The reported occupations by

majority of the sample are service in private-sector, business and students. All these factors are controlled in the following regression analysis.

Figure 1: Demographic and Socio-economic characteristics of sample respondents





Source: Primary data survey

4. Findings

Based on the primary sample survey a data analysis has been done using of R-statistical software. In our data, 47% of the respondents are daily commuters i.e. who travelled more than 5 days a week. 30 % of the respondents travelled 4-5 days a week. Weekly expenditure for public transport is around 60-90 INR (37%) and 91-120 INR (27%). 50 % of commuters travelled for 21-45 minutes per trip. Almost every one commute by conventional bus as it is inexpensive and faster mode of transport to reach their destination. A crucial information which came out from the data was that, 60 % of the respondent are completely unaware of the fact that the government is introducing Electric Buses to substitute some of the conventional buses. Only 18% are aware about the fact and 22% heard about the fact but don't know details of the policy (figure 1). On an average there was 62% chance to avail the electric bus service over conventional bus service, whereas 52% chance that an average individual will avail ESC service over the E-bus. The reasons and factors responsible of this preference pattern is depicted in the following sections more critically with the help of sophisticated econometric tools.

4.1. Preference for ESC

From the survey response it can be easily deciphered that even though citizens of Kolkata expressed their views on ESC as a noisy public transport leading to havoc traffic congestions, yet they want expansion of the ESC network within the city as it is identified as eco-friendly, safe & comfortable, cheap and good for short distance travels. They believe that the existing ESC service is not a good alternative of E-buses but the service could be improved and expanded by technological upgradation, infrastructure development and government initiatives.

A part of the survey was designed to capture the perception of the passengers about trams. As mentioned earlier the individuals who were interviewed were the daily commuters via public transport. However out of the 1028 individuals surveyed we found that only 56 % were regular commuters of tram ways, others have never taken trams for their daily commute. We found that the perceptions differ among the people who commute via ESC and those who does not. Their perception was captured by using likert scale, where they were given a series of fifteen assertive statements on which they could express their either agreement or disagreement or neutral views. The likert scale analysis shows that the statement 'Trams are

as good as e-bus' majority of the sample group shared neutral views, which means they neither agreed nor disagreed with the statement. But, if we segregate the data into frequent commuters of ESC and commuters who have never travelled in ESC, we find that majority of the frequent travellers (who takes tram> 3 times in a week) agree with the statement whereas most of the non-users of trams (who never takes trams) have revealed a disagreement with the statement. Another interesting insight about perception of the individuals about trams in accounted from the statement 'Infrastructural Development will improve the quality of Tram services'. We find that the most of the respondents agree with the statement but also out of them the frequent travellers were the ones who agreed to the statement in general. Among the commuters who never travelled by trams majorly disagree with the statement. A critical study of the table A2 (appendix) helps us to compare and propose that in general there exists a similarity in the pattern of responses for all the twelve statements within the frequent travellers as well as for the infrequent (never travelled) travellers.

4.2. Stated Intention to Avail ESC-Regression Analysis

The stated intentions to avail the ESC services in the presence of improved factors in the service, like frequent availability of trams, technological improvement, comfortable ride (in terms of better seats, Air-condition[7], etc.), traffic management and convenient payment mode has been studied. The econometric approach of this study allow us to assess how the perceived behaviour can control or alter the individual perception as well as preference towards ESC. Out of the factors which has been identified as the relevant ones for influencing the intentions of the commuters to purchase ESC services have been comfortable rides (labelled as factor 1), frequency of the availability of trams (labelled as factor 2), technological improvement (labelled as factor 3) and other facilities (labelled as factor 4; considered as base outcome in the regression analysis) .The table A3 (appendix) shows the impact of three improved identified factors on the probability of switching intention to avail ESC, given that there is no change in fare. The table reflects that the 'frequency of the availability of trams' is the most pivotal factor, affecting the probability to switch to the intention to avail the service. The second and the third important factors affecting the probability of switching intention to avail the ESC service are 'increased speed through technological improvement' and 'improved riding comfort' respectively.

Increased frequency in availability of ESC being the most important factor contributing towards the decision of switching intentions, it exhibits a predicted probability 48%. To

[7] At the present stage the tram seats in Kolkata are not cushioned and most of the trams are non-AC.

interpret in further, if an individual has decided to switch and intend to purchase ESC services, then there exists a probability of 48% for the reason being 'increased frequency of tram availability'. However, an increase of maximum speed through technological improvement is the second important factor with predicted probabilities 40%, to switch from the non-intention to the intention to avail the ESC service. This is a crucial finding for our empirical analysis. The decision makers usually try to improve the amenities and comfort level of the ESC service by introducing air-conditioner in the coach, cushioned seats, free wifi, etc. but the consumers emphasize more on 'increase in service availability' and 'technological upgradation of the service'. Many consumers choose improvements in traffic management system in the area of ESC service and convenient ESC fare payment system like smart card system (especially in the second and third steps of their decision process) and, as a consequence, their stated utility for the enhanced ESC service increases.

Measures have been taken to ensure that the individuals in the study are well aware about the service of ESC and the utility generated out of it. The awareness about the government initiative of electric vehicle and the frequent travel by ESC are two statistically significant case-specific regressor of the study re-enforcing the fact that the commuters' of ESC has a clear perspective on the service of ESC. Hence, their opinion on the improvement in the service as per the identified factors and related increased intentions in purchasing ESC service appears a crucial dimension from the policy perspective.

The marginal effects of the probability for the improvement in the availability of the ESC service is significantly captured by the change in age, occupation, education and frequency of travel via ESC of the respondent. On the other hand the probability of technological upgradation, especially to increase the speed is clearly captured by the change in all the regressors specified in the model. The marginal effects imply that the change in conditional mean value of the dependent variable due to change in regressor evaluated at mean values of the regressors.

To our knowledge, our empirical analysis is the first in its kind to investigate the determinants of the intention to avail an ESC in the presence of e-buses. So it provides a base-line understanding of the situation when ESC would be preferred over e-buses, also the paper provides a micro-understanding of the factors which influences the intention of purchase of the tram services positively.

5. Conclusion:

In this paper we intended to analyse the intention of the commuters to buy ESC services through the random utility model using the primary data collected from daily public transport users of Kolkata, India. Kolkata being the only city having an operational tramways (ESC), the city provide the perfect premise to study the perception of the commuters about ESC as a public transport system and their intentions to purchase ESC services. The study helps to understand how the perception of the individuals can be generalized into two categories of frequent ESC travellers (> 3 times in a week) and infrequent ESC travellers (zero times in a week). It is evident that majority of the people belonging to either of the groups exhibits similar perception regarding future of the ESCs. However, the frequent commuter of tram service expected that the ESC service could be as good as E-buses with technological upgradation from the existing system in contrast to the view of the commuters who never travelled by tram in the city.

The paper also identifies that the frequency in availability of ESC services is the primary factor behind switching intentions to purchase ESC services over e-buses. The second most important factor has been technological improvement followed by increased ride comfort. Precisely, the results predict that even though the urban planners thinks about improvement of services through improved amenities but essentially commuters of Kolkata are more concerned about higher frequency in availability and technological upgradation. These two factors play pivotal role in understanding why individuals would switch intentions to avail ESCs. With the governmental target on cutting down of carbon- footprints such that India can match with the global standards, the state governments are working towards launching e-buses as a public transport. Furthermore, the central government of India is proposing of providing financial incentive through FAME-II to the state government for moving towards green fleet vehicles. In this wider spectrum it has been missed out that the reviving an existent ESC system might be an ideally meaningful and cost –effective exercise. For that purpose, this paper provides the underlying factors explaining the demand side of the ESC market.

The findings of the paper provide important insights from policy perspective as well. The national citizens are not fully aware about the technology, working condition requirements and cost- efficiency of electric buses. Hence, to impose a higher price on commuters for a service which is already provided by conventional buses might not be smooth exercise. There

is a need for the Government to publicize about the long-term benefits of e-buses accounting from reduced emission and saved non-renewable resources. However, this is a costly affair which includes for the initial investment required for infrastructural development (like charging station, procuring e-buses, providing incentives to Indian manufacturer to come up with e-buses, etc.) as well as the cost to generate awareness among civilians (through advertisement, awareness camps, etc.) Since, ESC services had been in the city of Kolkata for more than a hundred years, diffusion is not an issue. The paper, therefore, creates a niche area, where the demand of ESC in India has been studied and the intriguing results generated out to the empirical model have implications in managerial and policy perspective in transportation sector, energy sector, urban development, climate change and in public policy. In future we intend to examine the supply side of the ESC services to develop a strong basis to understand the entire ESC market.

Appendix

Table A1**:** Comparative details of Electric Bus, Conventional Bus and Electric Street Car

Features	Electric Bus	Conventional Bus	Electric Street Car (TRAM)
Costs	2-3 Crores	88 Lakhs	1 crore
Capacity	80	50	270
Service life	8 Years	10-12 Years	60-70 years
Fare/ km	35/km	6/km	Rs. 6 (fixed)
Emission	Euro III	Zero Tail Pipe	Zero Tail Pipe
Fuel Efficiency	1.5 kWh/km	2.2 km/Lt	1.8 kWh/km
Fuel Cost	10/km	23/km	Rs. 2/ km
Speed (Max)	80km/h	**17.6 km/h** (with maximum speed of 46.4 km/h)	70 km/h (43 mph)
Frequency	Less Frequent	High	Less Frequent
Comfortability	Same	Same	Same

Source: Secondary data sources

Table A2: Modal perception about the ESC service among the daily commuters in the city

Statements	All respondents	Respondents who frequently travelled by ESC	Respondents who never travelled by ESC
Trams have heritage value.	Strongly Agree (64%)		
Trams are noisy.	Agree (56%)		
Trams creates traffic congestion.	Agree (40%)		
Trams are eco-friendly Public transport.	Agree (60%)		
Trams will be revived In the city.	Agree (46%)		
Technological upgradation Will improve The quality of tram Service.	Agree (55%)		
Infrastructural Development will Improve the quality of Tram services.	Agree (53%)		
Government initiative Will improve the tram Services.	Agree (34%)	Disagree (30%)	Agree (40%)
Tram rides are safe And comfortable.	Agree (54%)		
Tram's ticket fare Should be revised.	Agree (33%)	Disagree (30%)	Agree (38%)
Trams are as good as Electric bus.	Disagree (44%)		
Citizens prefer tram Service over other Public transportation.	Neither Agree nor Disagree (36%)	Disagree (38%)	Neither Agree nor Disagree (44%)
Trams are good for Short distance travel.	Agree (68%)		
Better tram services Can substitute autorickshaw Services.	Disagree (49%)		
Trams network should Be expanded within the City.	Agree (43%)		

Source: Primary data collected from the survey

Table A3 : Regression Analysis for first preferred Factor of improvement

	Multinomial Probit				**Multinomial Logit**		
No. of observation:1028							
Regressors	**Marginal effect**	**Standard Deviation**	**z Value**		**Marginal effect**	**Standard Deviation**	**z Value**
Factor-Comfort							
Gender *	.006501	.02846	0.23		.0022292	.0288	0.08
Age	-.0022397	.00901	-0.25		-.0007718	.00888	-0.09
Edu	.0097878	.00797	1.23		.0101272	.00802	1.26
Eev_know*	.0172331	.02874	0.60		.0176711	.02875	0.61
Occup	.0011518	.00548	0.21		.00543	.0011846	0.22
Tram_travel *	-.0531849	.02054	-2.59		-.055101	0.02069	-2.66
Time_travel	.0127052	.00899	1.41		0.0137812	0.00906	1.52
Exp_travel	-.0059653	.01137	-0.52		-.0073852	0.01139	-0.65
Factor-Frequency of the service							
Gender*	-.0539685	.04659	-1.16		-.0526971	.0472	-1.12
Age	.0117795	.01391	0.85		.0109631	.01408	0.78
Edu	-.0103508	.01232	-0.84		-.0115518	.01264	-0.91
Eev_know*	-.0811708	0.04386	-1.85		-0.0843975	.04483	-1.88
Occup	0.0111174	.00868	1.28		.0121148	.00884	1.37
Tram_travel *	.0485161	.03205	1.51		.0504246	.03248	1.55
Time_travel	-.0915329	.01485	-6.17		-.0948812	.01551	-6.12
Exp_travel	-.0153046	.01868	-0.82		-.0145496	0.01923	-0.76
Factor-Technological upgradation							
Gender *	.0191291	.04417	0.43		0.025311	0.04459	0.57
Age	-.014729	.01338	-1.10		-0.0150659	0.01345	-1.12
Edu	.0024408	.01204	0.20		0.0020087	0.012	0.17
Eev_know*	.0987291	.04392	2.25		0.1014929	0.04442	2.28
Occup	-.0143655	.00847	-1.70		-0.0150161	0.00862	-1.74
Tram_travel*	.0516805	.0307	1.68		0.0502578	0.03096	1.62
Time_travel	.0552251	.01424	3.88		0.0576134	0.01445	3.99
Exp_travel	.0392407	.01765	2.22		0.0391327	0.01795	2.18
NOTE I:Codes of statistical significance- 0.001 "**", 0.05'*'							
NOTE II:factor=0= 'other factors' is the base outcome							

Source: Primary data collected from the survey

References

Adamowicz, W., & Deshazo, J. (2006). Frontiers in Stated Preferences Methods: An Introduction. Environmental And Resource Economics, 34(1), 1-6. doi: 10.1007/s10640-005-4818-z33-66.

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. American Journal Of Agricultural Economics, 80(1), 64-75. doi: 10.2307/3180269

Bagozzi, R., & Dholakia, U. (1999). Goal Setting and Goal Striving in Consumer Behavior. Journal Of Marketing, 63, 19. doi: 10.2307/1252098

Balasubramanian, S., & Kamakura, W. (1989). Measuring Consumer Attitudes toward the Marketplace with Tailored Interviews. Journal Of Marketing Research, 26(3), 311. doi: 10.2307/3172903

Barter, P.A. (2000) Urban Transport in Asia: Problems and Prospects for High-Density Cities, Asia-Pacific Development Monitor, 2, 1,

Cameron, A., & Trivedi, P. (2005). Microeconometrics. Cambridge: Cambridge University Press.

Carson, R., & Groves, T. (2007). Incentive and informational properties of preference questions. Environmental And Resource Economics, 37(1), 181-210. doi: 10.1007/s10640-007-9124-5

Clercq, F., & Bertolini, L. (2003). Achieving Sustainable Accessibility: An Evaluation of Policy Measures in the Amsterdam Area. Built Environment, 29(1), 36-47. doi: 10.2148/benv.29.1.36.53949

Dutta, D. (2018). More Electric buses coming soon in India: NITI Aayog to set EV Target for states!. Retrieved from https://www.financialexpress.com/auto/car-news/more-electric-buses-coming-soon-in-india-niti-aayog-to-set-ev-target-for-states/1236890/

ERRAC Roadmaps, The FP7 project of ERRAC - The European Rail Research Advisory Council". (2009). Metro, light rail and tram systems in Europe [Ebook]. Retrieved from http://www.uitp.org/sites/default/files/cck-focus-papers-files/errac_metrolr_tramsystemsineurope.pdf

Fame , India. https://www.fame-india.gov.in/, Last accessed on 12th September, 2018.

Gollwitzer, P. (1999). Implementation intentions: Strong effects of simple plans. American Psychologist, 54(7), 493-503. doi: 10.1037//0003-066x.54.7.493

Hanley, N., Mourato, S., & Wright, R. (2002). Choice Modelling Approaches: A Superior Alternative for Environmental Valuation?. Journal Of Economic Surveys, 15(3), 435-462. doi: 10.1111/1467-6419.00145

Infosino, W. (1986). Forecasting New Product Sales from Likelihood of Purchase Ratings. Marketing Science, 5(4), 372-384. doi: 10.1287/mksc.5.4.372

International Energy Agency. https://www.iea.org/, Last accessed on 12th September, 2018.

Kahneman, D., & Snell, J. (1992). Predicting a changing taste: Do people know what they will like?. Journal Of Behavioral Decision Making, 5(3), 187-200. doi: 10.1002/bdm.3960050304

Kelvin J. Lancaster, 1996. "Trade, Markets and Welfare," Books, Edward Elgar Publishing, number 751.

LightRailNow - Germany - Rail Transit, Light Rail, Trams, Streetcars. Retrieved from https://www.lightrailnow.org/facts/fa_lrt_nation-germany.htm

Mackenzie, C. (2017). Bus vs. Light Rail: Which Is Cheaper to Operate?. Retrieved from https://www.thoughtco.com/bus-and-light-rail-costs-2798852

Ministry of Road Transport and Highways. http://morth.nic.in/, Last accessed on 12th September, 2018.

Ministry of Urban Development. http://mohua.gov.in/, Last accessed on 12th September, 2018.

Morwitz, V., & Schmittlein, D. (1992). Using Segmentation to Improve Sales Forecasts Based on Purchase Intent: Which "Intenders" Actually Buy?. Journal Of Marketing Research, 29(4), 391. doi: 10.2307/3172706

Morwitz, V., Steckel, J., & Gupta, A. (2006). When Do Purchase Intentions Predict Sales?. SSRN Electronic Journal. doi: 10.2139/ssrn.946194

National Institution for Transforming India, Government of India. http://niti.gov.in/, Last accessed on 12th September, 2018.

Petrin, A., & Train, K. (2003). Omitted Product Attributes in Discrete Choice Models. doi: 10.3386/w9452

Pojani, D., & Stead, D. (2015). Sustainable Urban Transport in the Developing World: Beyond Megacities. Sustainability, 7(6), 7784-7805. doi: 10.3390/su7067784

Sun, B., & Morwitz, V. (2010). Stated intentions and purchase behavior: A unified model. International Journal Of Research In Marketing, 27(4), 356-366. doi: 10.1016/j.ijresmar.2010.06.001

Tilmes, S., Richter, J., Kravitz, B., MacMartin, D., Mills, M., & Simpson, I. et al. (2018). CESM1(WACCM) Stratospheric Aerosol Geoengineering Large Ensemble (GLENS) Project. Bulletin Of The American Meteorological Society. doi: 10.1175/bams-d-17-0267.1

United Nations Development Program. (UNDP) http://www.undp.org/content/undp/en/home.html , Last accessed on 12th September, 2018.

WÄTZOLD, F., DRECHSLER, M., ARMSTRONG, C., BAUMGÄRTNER, S., GRIMM, V., & HUTH, A. et al. (2006). Ecological-Economic Modeling for Biodiversity Management: Potential, Pitfalls, and Prospects. Conservation Biology, 20(4), 1034-1041. doi: 10.1111/j.1523-1739.2006.00353.x

Wright, M., & MacRae, M. (2007). Bias and variability in purchase intention scales. Journal Of The Academy Of Marketing Science, 35(4), 617-624. doi: 10.1007/s11747-007-0049-x

Xie, F., & Levinson, D. (2007). Modeling the Growth of Transportation Networks: A Comprehensive Review. Networks And Spatial Economics, 9(3), 291-307. doi: 10.1007/s11067-007-9037-4

Zsambok, C., & Klein, G. (1997). Naturalistic decision making.