EMPLOYEE BEHAVIOUR TOWARDS USING ICT DEVICES IN URBAN PUBLIC TRANSPORTATION: AN EMPIRICAL STUDY

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ABSTRACT

Information and Communication Technology (ICT) could play a key role in providing solutions to the problems faced in urban public transportation. Little literature is available on the factors that influence the employee adoption of innovation, especially in the context of a public transport organization. This study focuses on the adoption of electronic Ticket Issuing Machines (TIMS) by city bus conductors. This study investigates the role of individual attitude and risk perception in the adoption of innovation. The study reveals that Information and Communication Technologies (ICT's) can be successfully deployed to address the urbanization challenges. ICT based innovations have tremendous potential for addressing the challenges related to mass urbanization.

This paper aims at two objectives: The first objective pertains to validation of the basic Technology Acceptance Model (TAM). The second objective pertains to determining the role of perceived risk in shaping the user attitude towards the behavioral intentions/ actual usage of the ICT enabled device.

Keywords: Information and Communication Technology (ICT), Public Transportation, Adoption of Innovation, Technology Acceptance Model (TAM), Electronic Ticket Issuing Machines (TIMS).

INTRODUCTION

According to World Bank report (2019) India along with United States, China, Nigeria and Indonesia will lead the world's urban population rush by 2050. As per the census of 2012 India has around 468 cities with population of more-than 1, 00,000 inhabitants (Census of India 2011). Many Indian cities have lower vehicle ownership rates compared to many developing economies. Most of the city dwellers rely on public transportation systems for their daily commuting needs Arnold et al. (2005).

According to information and communication technology (ICT) has enormous economic significance, in addition to its ubiquitous presence Arunachalam, (2005). The global information technology industry is expected to reach a value of \$5.2 trillion this year, according to IDC research 2020. The United States is the world's largest technology market, accounting for 32 percent of the total, or roughly \$1.7 trillion in 2020. There has also been a great debate whether ICTs will have a substitution effect (replacing the traditional travel) or a complementarily effect on the travel industry Bagdare, & Jain (2013). Present paper will examine the role of ICTs in their complementarity role. While many of the previous works studied aspects like teleworking, providing real- time traveler information etc., small amount of research is available on the issues related to adoption of ICTs from the perspective of service providers, especially in public transportation. The undertaking study specifically addresses the factors that affecting the

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behavioral intentions of employees (bus conductors) in the usage of ICT enabled devices Bagozzi & Yi (1988).

City buses offer an economic and convenient way of transportation across various sections of urban society. City buses in India are typically owned and run by the state government through Transport Corporations. Many policy initiatives have recommended on the transport supply solutions to address the challenges of urban growth. An important recommendation of these policies was the need to provide on efficient public transportation systems in cities. As per the policy recommendation the central government of India, the ministry of urban development has made investments in urban development through a program known as Jawaharlal Nehru National Urban Renewal Mission (JNNURM), between 2007 and 2014. In spite, of the funding of augmentation and introduction of bus fleets, development of bus rapid transit system, only 61 cities in India have formal city bus systems.

ICT in Road Transportation

Information and Communication Technologies (ICTs) could play a major role in providing solutions to the problems faced in urban transportation. ICT could be used in locating vehicles in real time, identifying the traffic problems like congestion, etc., matching demand with supply. Information related to weather, traffic, passengers, departure and arrival schedules of other modes of transportation like trains and flights could be aggregated and analyzed to arrive at solution in urban transportation Barras, (1990).

The common forms of ICT enabled system for transportation include parking assistance systems, traffic management system, electronic payment system, transport coordination system etc., Bitner, et al. (2000) One of the interesting applications of ICT in public transport organization is the introduction of ticket issuing machines by various state road transport organizations Bitner, et al. (2002). A Ticket Issuing Machine (TIM) typically carried by the bus conductors are a handheld device that makes it easy for the city bus conductors to issue the ticket Bitner, (1992).

Information Technology Application in Issuing Tickets

The conventional practice of manually issuing tickets to the passengers by the bus conductors is typically tedious Curran & Meuter, (2005). The bus conductors generally carry a bulky ticket tray with preprinted tickets of multiple denominations. A picture of the conventional ticket tray is shown in figure 1. The process starts with the conductor making an entry of the starting serial number of various ticket denominations on a document known as "Statistical Ticket Accountable and Record" (STAR) document. Once the journey starts, the conductor starts issuing tickets to the passengers by calculating the fare based on the origin and destination of the travel plan of individual passengers Curran et al. (2003). This is quite cumbersome as the conductor has to select the tickets of different denominations to arrive at the final combination of tickets to match the fare and then punch holes on the tickets (indicating the stage of boarding of the passenger) and finally hand over the tickets to the passenger I abholkar, (1996). The bus conductor collects the money and issues the balance amount to the passenger if the passenger gives the higher denomination currency against the travel fare.

The process doesn't end there for the conductor as he/she is should update the STAR document periodically along with the progress of the journey Dabholkar & Bagozzi, (2002). This involves the conductor entering the serial numbers of tickets of all denominations multiple times

during the progress of the journey. For example if a conductor is carrying ten denominations of the tickets and if there are 10 points /stops in the journey (where the passenger can either alight or board), the bus conductor must make at least 200 entries in the STAR documents he or she has done all this in moving bus, while issuing tickets, collecting fare from the passengers and returning the money due to the passenger Garg et al. (2014).

In this context, the transport organization has introduced ticket issuing machines (TIMS) to the conductors Garg et al. (2012). A picture of the Ticket Issuing Machine is shown in figure 1. The machine comes with pre-loaded information of various routes, distances and the fares for various destinations and a paper roll would be present in the machine on which the ticket would be printed once the conductor enters the origin and destination of passenger. A single ticket can be issued to a group of passengers who are travelling as a group with same origin and destination Harris et al. (2006). The bus conductors need not make entries in the STAR document as the details would be displayed on the machine screen just by pushing a button. The advantages of using TIM that the conductors are spared with all the above burdensome duties. The TIM automatically prints the time, date, boarding and destination stages. With the use of TIM there is no possibility of re-issue of tickets Kaushik & Rahman, (2015).

The TIM also helps issue of a single ticket for a group of six passengers and the stagewise data will help the authorities analyse operations and plan accordingly Khan et al. (2016). Despite the advantages of the machine, there are quite a few challenges in the execution. The conductor needs to be trained on the new machine, issues like safety, reliability, maintenance etc., need to be addressed.



FIGURE 1 CONVENTIONAL TICKET TRAY OF CITY BUS CONDUCTORS



FIGURE 2 BUS TICKET ISSUING MACHINE (TIM)

According to Ladhari et al. (2017) people by their very inherent nature will try to resist change unless they are convinced that they can directly benefit from the change. Any innovation should face the challenge of securing the end user acceptance and continuation of the usage of innovation even though the organization has decided to adopt the ticket issuing machines. As per Lee et al. (2012) the acceptance and usage of the innovation is critical for the successful deployment of the innovation Figure 2.

Gap of the Study

Many studies focused on the use of perceived usefulness and perceived ease of use of the innovation from the perspective of customers (e.g. internet banking) rather than the service providers Lemon & Verhoef, (2016).

Small numbers of studies are available on the factors that influence the employee adoption of innovation, especially in the context of a public transport organization. This study investigates the impact of individual attitude and risk perception in the adoption of innovation.

Study Background and Formulation of Hypothesis

(TAM) Technology acceptance Model Lin & Hsieh, (2006) is one of the most popular models used to investigate the adoption of technology. Theory of planned behavior (TPB) is considered as an extension of theory of reasoned action Meuter et al. (2003). These two models were considered as incomplete by some of the researchers. The inclusion of perceived risk should be considered to understand the behavioral intention with regards to the use of technologies Michelle Bobbitt & Dabholkar, (2001). felt that more systematic research is needed for the antecedents of the adoption of electronic services. Researchers like Montoya et al. (2003) noted that perceived risk and trust associated with the technology based transactions likely influence the behavioral intentions of the users. The technology acceptance model (TAM) given by Sarel & Marmorstein (1998) has explained the following important presumptions/ postulations.

- 1. Perceived ease of use understood as the degree to which a user should find a particular technology to be free from effort on their part.
- 2. Perceived usefulness understood as that using the technology would improve the way a user could complete a given task Shamdasani et al. (2008).
- 3. Perceived risk understood as the probability of certain outcomes given a behavior, and the danger and severity of negative consequences from engaging in those behaviors (Cunninggham).
- 4. Attitudes understood as a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor (Eagly and Chaiken, 1993, p. 1)

The current study proposes that in addition to the perceived risk of using the innovation from the perspective of the user is also an important factor that will play a key role in deciding the behavioral intentions. It is therefore postulated that Perceived Risk is negatively associated with the attitude of the user and thereby influences the user's behavioral intention to use the technology Sun, (2002).

In order to gain a deeper understanding of the process by which conductors decide whether to use TIM, the model shown in figure 3 was developed Thai Hoang et al. (2006). We propose three

antecedent beliefs as predictors of attitude towards a TIM. Ease of use and usefulness has been explored in the TAM literature, however perceived risk have not been extensively explored. This new antecedent belief is expected to extend the research based on the technology acceptance model. In addition, attitude towards a TIM is proposed to impact the overall behavioral intentions to use the TIM Verhoef et al. (2009). These relationships are shown in Figure 3. And specific hypotheses based on the model and descriptions of the constructs are discussed in the following paragraphs.



FIGURE 3 THEORETICAL MODEL

Antecedent Beliefs

Above model includes three antecedent predictors of attitude towards the Ticket Issuing Machines (TIMs). These three predictors are Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Perceived Risk (PR). Each of these four factors has been described below Walter, et al. (2010).

Perceived ease of use has been defined as the degree to which a user would find the use of a technology to be free from effort on their part. According to this construct is central to the technology acceptance model and has been used in many studies since. Therefore, it is hypothesized as follows:

 H_1 : The perceived ease of use of the Ticket Issuing Machine (TIM) is positively related to attitude toward the Ticket Issuing Machine (TIM).

As per Davis et al., Perceived usefulness is the degree to which a person believes that using a particular system would enhance his or her job performance". It means whether or not someone perceives that technology to be useful for what they want to do. It has received a great deal of attention in adoption literature. In this study the perceived usefulness is related to whether the TIM will enhance the employee's (his or her) job performance. Therefore, it is hypothesized as follows:

 H_2 : The perceivedusefulness of the Ticket Issuing Machine (TIM) is positively related to the attitude towards the Ticket Issuing Machine (TIM).

Discussed Perceived Risk (PR) in terms of the probability of certain outcomes given a behavior, and the danger and severity of negative consequences from engaging in those behaviors. This concept has been discussed in the technology framework under the terms of reliability, accuracy and recovery. Therefore, it is hypothesized:

H3: The perceived risk of using the Ticket Issuing Machine (TIM) is negatively related to attitude towards the TIM.

According to attitude is a psychological tendency that is expressed by evaluating an entity with some degree of favor or disfavor. The notion that attitude influences behavioral intentions has been researched extensively over the past few years and this relationship has been well established in the literature regarding the adoption of technology.

H₄: Employee (service provider) attitude towards Ticket Issuing Machine (TIM) is positively related to his/her behavioral intentions to use the TIM.

Construct Definitions

The following (Table 1) provides the operational definitions of the constructs used in this study.

Table 1 OPERATIONAL DEFINITION OF THE CONSTRUCTS				
Constructs	Operational Definitions			
Perceived Ease of Use (PEOU)	The strength of one's belief that interacting with TIM would be free of			
Perceived Usefulness (PU)	The strength of one's belief that using TIM will enhance his or her service.			
Perceived Risk (PR)	The strength of one's belief about the possibility of the product malfunctioning and not performing thereby failing to deliver the desired benefits.			
Conductor's Attitude	It is one's psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor (Eaggly and Chaiken, 1993)			
Behavioral Intention to Use (BIU)	The strength of one's willingness to use TIM as a service.			

RESEARCH METHODOLOGY

The quantitative research is a social research that employs empirical methods and empirical statements, stated that quantitative research as a type of research that is "*explaining phenomena by collecting numerical data that are analyzed using mathematical based methods (Statistics)*."

In order to capture the determinants of intended usage of Ticket Issuing Machines (TIMs), a survey approach was adopted targeting bus conductors of the Telangana State Road Transportation Corporation (TSRTC). This corporation was selected because of its deployment of technology (TIMs) in service delivery. The present study was designed based on the definition given. The research is descriptive in nature and involved the collection of primary data from the

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respondents (city bus conductors) using a structured questionnaire. The structured questionnaire was developed using the constructs mentioned in TAM model. The questionnaire consisted of 23 Likert type statements with 5-point Likert types statements with five points from strongly disagree to strongly agree.

The information from the respondents was collected by directly interviewing the bus conductors. Hyderabad city the capital of Telangana State in India was chosen for the study. The state transport corporation runs a city bus fleet of around 4000 buses travelling different routes of the city making approximately 40000 trips a day and carrying around 36 hundred thousand commuters. During the course of data collection for the study the bus conductors were met during the lunch break at various bus depots and the interviews were carried out by the researchers Tables 2 & 3.

Table 2							
STUDY DEMOGRAPHICS							
Number Percentage							
Gender							
Male	264	88.0					
Female	36	12.0					
Age							
Under 35	124	41.3					
35 to 50	101	33.6					
Above 50	75	25					
Income							
Under 25, 000	92	30.6					
25,000 – 49,999	198	66.0					
Above 50, 000	10	3.3					
Education							
Intemediate	8	2.6					
Bachelor degree	199	66.3					
Master degree	93	31.0					

RESULTS AND DISCUSSION

Note 1: constructs are measured using 5 point Likert scale.

Note 2: AVE means average variance extracted, CR means composite reliability.

Table 3 TOTAL VARIANCE EXPLAINED										
Comp onent	Initial Eigen values	al Extraction Sums of Rotation es Squared Loadings Sums of Loadings Loadings								
	Total	% of Vari ance	Cum ulativ e %	Total	% of Varian ce	Cum ulativ e %	Total		% of Variance	Cum ulativ e %
1	7.232	31.4 44	31.44 4	7.232	31.444	31.44 4	7.177		31.203	31.20 3
2	4.363	18.9	50.41	4.363	18.97	50.41	4.284		18.627	49.83

		7	4			4			
3	3.314	14.4	64.82	3.314	14.407	64.82	3.144	13.667	63.49 8
4	1.977	8.59	73.41	1.977	8.597	73.41	1.987	8.638	72.13
		7	8			8			6
5	1.469	6.38	79.80	1.469	6.387	79.80	1.764	7.669	79.80
		7	5			5			5

All the reliabilities are above 0.7 which is the threshold limit suggested in literature for the scale development. A 23 item with five factors is derived from the EFA from the study. KMO and Bartlett's test measure of sampling adequacy is 0.838. Total variance explained by five factors 79.805 Figure 4.



SCREE PLOT OF SCALE ITEMS IN TIMS ADOPTION

Confirmatory Factor Analysis

Confirmatory factor anlysis was carried out using AMOS 20.0 for the three independent constructs PU, PEU, and PR. Two item under PEU and one item under PR had to be dropped due to validity issues. The various model fit statistics of the measurement model is given in Table 4.

Table 4 MODEL FIT STATISTICS OF THE MEASUREMENT MODEL FOR INDERENDENT CONSTRUCTS								
Measure Actual value Threshold Source								
Cmin/df	2.103	<3.0	Hair et al., (2006)					
CFI	0.986	>0.95 great						
GFI	0.913	>0.9 good						
AGFI	0.898	>0.80 good						
IFI	0.970	>0.9 good						
RMR	0.044	<0.09 good						
RMSEA	0.036	<0.05 good						
Pclose	0.821	>0.05 good						

Structural Equation Modeling (SEM)

SEM is used to evaluate the model and the significance of relationship between the constructs. The basic model of TAM is evaluated in the context of the road transport corporation

employees with regards to ticket issuing machine (TIM) usage. The various model fit statistics and the threshold values are given in the above table. The model fit statistics clearly indicate that the TAM model is validated as a useful model to study the usage or adoption of Ticket Issuing Machines (TIMs) by the employees (ticket conductors) in India Figure 5.



FIGURE 5 STRUCTURAL MODEL

Table 5							
REGRESSION WEIGHTS AND THE SIGNIFICANCE OF RELATIONSHIP BETWEEN CONSTRUCTS							
			Estimates	S.E.	C.R.	Р	
ATT	÷	PEU	0.511	0.081	6.847	***	
ATT	÷	PU	0.691	0.108	7.964	***	
ATT	÷	PR	0.085	0.091	4.761	0.003	
BI	\leftarrow	ATT	0.688	0.069	10.541	***	

Note: PEU means perceived ease of use, PU means perceived usefulness, PR Means perceived risk, ATT means Attitude, BI means behavioural intention to use Tables 5 & 6.

Reliability and Validity of the Scale

The composite reliability of the constructs is above 0.7: average variance extracted (AVE) is above 0.5 convergent validity of the items in the construct: and maximum shared variance (MSV) along with the square root of AVE greater than the correlation among the constructs indicating discriminat validity of the constructs.

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Table 6							
MODEL FIT STATISTICS FOR TECHNOLOGY ISSUING MACHINES (TIMS)							
Measure	Actual value	Threshold	Source				
Cmin/df	1.544	<3.0	Hair et al., (2006)				
CFI	0.963	>0.95 great					
GFI	0.888	>0.9 good					
AGFI	0.850	>0.80 good					
IFI	0.961	>0.9 good					
RMR	0.039	<0.09 good					
RMSEA	0.046	<0.05 good					
Pclose	0.578	>0.05 good					

Findings

- The basic model of TAM is evaluated in the context of the road transport corporation employees with regards to ticket issuing machine (TIM) usage and respondents (ticket conductors) are much comfortable with the TIM machine over manual ticketing process.
- > The bus conductors were convinced with the perceived usefulness of TIMs, as it eliminates many of the problems of the conventional mode of issuing tickets.
- Perceived ease of use also played a significant role in the adoption, as with adequate among the conductors could operate the electronic machines.
- Interestly, from the ticket conductors perspective ease of use of TIM machine also contributing for the convenience and usefulness during onboard travelling.
- > The ticket conductors did not perceive much risk while using the TIM machine.
- Overall, ticket conductors are seeking out most comfort, much usefulness and maximum ease while delivering service to the passengers.

Thoeretical Contribution

The present study validated the technology acceptance model with regards to employee (conductors) behaviour towards usage of information and communication technological devices i.e. ticket issuing machine in the context of urban public trasportation corporation.

Implication of the Study for Policy Suggestion

The current study provide profound insights for managers of road and transportation corporation limited companies across India to emphasis on problems of manual ticketing and encourage the employees usage of TIMs without any inhibitions on job safety.

The present study findings also highlight, and extremely helpful for the managers at the time of resource (budget) allocation.

CONCLUSION

Public transportation system plays a crucial role in the development of modern cities. With rapid urbanization countries like India face major challenges in the adoption of ICT in the context of delivering public services, which is also true in the case of public transportation in urban areas. The basic TAM model has been improved by including the construct perceived risk in addition to perceived usefulness and perceived ease of use, constructs. The study reveals that Information and communication technologies (ICT's) can be successfully deployed to address

the urbanization challenges. ICT based innovations have tremendous potential for addressing the challenges related to mass urbanization.

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