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# IRCTC Mobile Ticketing Adoption in an Indian Context

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## Abstract

This study - is an investigation on the contributory roles of the innovation attributes borrowed from the *Technology Acceptance Model* in influencing the behavioural intention and actual adoption of the *IRCTC mobile ticketing application* in the Indian context. The TAM model was empirically tested against the data gathered from the respondents for this study. The SPSS tool was used to test the data reliability, and also linear and logistic regressions were run to test the model performance. Whilst relative advantage, perceived ease of use, cost, and riskiness shared a significant and positive relationship with behavioural intention, perceived ease of use positively influenced the relative advantage, and behavioural intention and cost significantly impacted the adoption of this mobile ticketing application by IRCTC. Alongside discussing the findings from this study, the potential limitations were also identified, followed by research implications and future research suggestions being made. There is no attempt previously made to examine adoption of mobile ticketing application in Indian context. Hence, the findings from this study are original and will offer value for the mobile service providers, Indian railway, and any other organisations that may be interested in implementing mobile based organisations.

**Keywords:** *Adoption, Innovation, IRCTC, Mobile ticketing, TAM.*

## 1. Introduction

Indian railway is one of the most popular services in use amongst the Indian citizens. It coming with the benefits of having access to the interiors of Indian villages and towns, and being very affordable at the same time makes it the most used transportation system in India (Patel and Grover, 2010). Adding to its credit is another enhancement – the introduction of a mobile application making railway bookings possible on a mobile phone. The IRCTC mobile ticketing application is a secure mobile ticketing solution that has been recently launched by the *Indian Railway Catering and Tourism Corporation Limited* for the convenience of the citizens in allowing them to book railway tickets using their mobile phones. To use this mobile application, the users are required to register

with IRCTC using their mobile phone number, followed by a download and installation of the IRCTC mobile application on their Java enabled, GPRS activated mobile phones. There are three different providers of this application – Paymate, ngpay, and Atom.

It is important to note that the application has undergone some recent upgrades allowing it to be usable on CDMA phones. Also, many mobile companies are partnering with IRCTC to play active providers of this application. However, the time at which our study began (in the June of year 2012) there were only three active providers - Paymate, ngpay and Atom (IRCTC, 2013), which is much obviously why our questionnaires only contain these three providers. The official IRCTC website also provides evidences on them partnering with banks such as ICICI to provide this service. Despite considerable researching, it is not very clearly available as to which, and how many of these providers of this application are currently actively functioning. Since this application is still in its initial stages, undergoing considerable upgrades and changes, our study chooses to address the only three service providers that were in use at the time our survey was being run.

The booking procedure is simple and similar to the internet way of booking railway tickets. According to IRCTC, the payment system in using this ticketing application is fully secure. The transmitted data and the stored data on the mobile phone are apparently completely encrypted. They assure that this application satisfies the privacy, authentication, and security requirements. They claim that there is no charge on making railway bookings using this application, as such. However, as this application consumes data to access the internet from the 3G/4G network providers, these providers may charge the customers differently depending upon their data costs (IRCTC, 2013). A feature that is most attractive about getting to use different services on a mobile phone is the ability to have access to these services from anywhere, ubiquitously (Liang et al., 2007). The same can be linked with using the IRCTC mobile ticketing application which makes the facility of booking railway tickets at any time of the day and week, available to its customers. This in return turns out to be both, time and cost effective.

Upon searching the literature, it was found that many m-commerce adoption (Siau and Shen, 2003) and m-payment adoption (Wu and Wang, 2005) studies were present, but there were no studies at all on the adoption of the IRCTC mobile ticketing application. However, there were few studies found very briefly discussing or only mentioning this application as an example of m-commerce, which have been identified in the literature review section of this chapter. This mobile ticketing application is still new in the Indian context which can be seen as the possible reason why no studies on the adoption of this technology have made their way yet into the existing literature. The IRCTC mobile ticketing application is an evolving technology in India which unfortunately, does not hold any official statistics or reports that can account for the factors that influence its adoption. Therefore, it is important to run an empirical examination to attain useful information on the factors that act as the influencers and barriers to its adoption in the Indian context. Hence, the sole aim of our study is to undertake an empirical investigation of the roles of the innovation attributes in extending an impact on the acceptance of this mobile ticketing application. The revelations from our study could succeed in providing the stakeholders of this application with information that may assist them in developing competitive strategies to promote this technology on a larger scale, enabling its increased acceptance by the targeted population.

Having introduced the technology of our interest, the next section of this paper reviews the literature specific to the adoption of mobile commerce and mobile ticketing applications. Next, the attention will be concentrated on providing the study's theoretical basis, whilst extending the hypotheses proposed in accordance with the proposed model of study. A section in paper will then focus on detailing on the method of research that was followed for carrying out this study, by addressing the instrument of survey, conducted pilot study and the process of gathering the necessary data. The collected data is then subjected to various tests using the SPSS analysis tool, the direct results of which are illustrated in the findings section. The statistics from the SPSS tests are

then discussed against the proposed hypotheses and tested for their validity against the proposed model for this study. Finally, key conclusions from the discussion are highlighted, shortcomings in terms of limitations of this study are identified, and suitable future research directions are suggested.

## **2. Literature Review**

The innovation of focus in our study is the recently introduced mobile ticketing application by IRCTC which provides the registered users with the privilege of booking railway tickets using their mobile phones and paying for their tickets over a secure mode. In a broader sense, the IRCTC mobile ticketing application uses the 3G/4G mobile data from its phone network providers to connect to the internet for making the railway bookings and finally, availing the tickets by confirming payment for the tickets over the mobile application. Therefore, this application can be regarded as an integration of the mobile payment and the mobile ticketing services. There are numerous publications on mobile payments in the literature – In a study on mobile payments acceptance by consumers, Chen (2008) used two models, TAM and the innovation diffusion theory and found that perceived use, perceived ease of use, perceived risk, and compatibility had a significant impact on the adoption of mobile payments. Another study on mobile payments by Mallat (2007) where focus group sessions were used to study the consumers' behaviour, it was found that relative advantage and compatibility significantly influenced their adoption decisions. A study on mobile banking services in Germany by Koenig-Lewis et al. (2010) showed that perceived usefulness, compatibility and risk behaved as the significant determinants of adoption. Schierz et al. (2010) in their study on the adoption of mobile payment services found for compatibility, subjective norm and individual mobility to be the most important predictors of its adoption.

In our search for studies on adoption of mobile ticketing, in particular, we found that not many publications were available in the existing literature. Out of the few available, results from some of the studies have been briefly presented here – a study on the adoption of mobile ticketing services for public transportation brought together the TAM attributes and the attributes from Rogers' diffusion of innovations theory to conclude that while compatibility had the strongest effect on consumers' adoption intention, perceived usefulness and ease of use strongly impacted its actual adoption (Mallat et al., 2008). In another study on the acceptance of mobile ticketing services by Mallat et al. (2009) ease of use and compatibility were found to be the important predictors of adoption intention, and on the other hand, relative advantage showed an insignificant effect on intention. As mentioned in the introduction section earlier, there weren't many studies on the IRCTC mobile ticketing application, either. Very few studies discussing or merely mentioning the presence of this mobile ticketing application were found - Srivastava et al. (2007) in their study on modernization of the passenger reservation system at Indian railways, happen to only vaguely mention that reservation services would be made available on mobile phones by the Indian railways. Singh and Yammiyar (2008) in their work on developing a user centred approach for evaluating the Indian market for m-commerce mention mobile ticketing and propose to design a macro commerce application for the informational needs of the travellers across the country. Patel and Grover (2010) in their study concentrate on a map-based source and destination input mechanism for the IRCTC mobile ticketing application. Out of these very few studies on mobile ticketing, a master thesis also showed up in our online search, wherein, Sreekumar (2010) in his thesis on biometric authentication on mobile payments only introduces the IRCTC mobile application and its basic use.

These aforementioned exemplifications are a proof that although there are many studies available on the adoption of mobile commerce and mobile payments, very few studying the adoption of the mobile ticketing services have made their presence. Most importantly, there is no study particularly studying the factors that promote the adoption of the IRCTC mobile ticketing application in an Indian context. It becomes important to reiterate that the IRCTC ticketing application is a recent

technology which is still very slowly diffusing amongst the Indian consumers, in a way justifying the absence of any publications on its adoption. With our study, we aim to acquire an understanding of the adoption factors of this application and present the first insights into the behaviour of a chosen set of innovation attributes on the use intention and the actual adoption of this mobile ticketing application by IRCTC.

### **3. Theoretical Basis and Development of the Conceptual Model**

This mobile ticketing application suffers a low adoption rate which is identified, confirmed, addressed and discussed in the later part of this paper; but the points of concern are - how can the poor adoption rate of this application be justified? Do consumer backgrounds or some kinds of societal influences play a role in making such an adoption decision, or is it simply because of the consumer unawareness of this technology? Also, Rogers (2003) points out that one of the most common issues requiring attention during the diffusion of any innovation is – what should the managers and implementers of such technologies do to speed its rate of diffusion? In providing answers to all these questions from the IRCTC mobile ticketing application perspective, the stakeholders will need clarity and information on the few critically important factors that will facilitate the use of this ticketing application.

It is important to address here that this mobile ticketing application is not the only railway booking system. It is merely an added option to the already existing and well established railway booking options such as the over the counter booking at IRCTC and internet booking. In studying for factors that would increase the adoption of this mobile application, we need to question, why the consumers would want to use mobile ticketing over the already existing systems. The answer to this question can only be obtained by understanding what in this mobile application, do the consumers find relatively better than the physical or e-booking options? As specified earlier, this application offers to its consumers, the feature of mobility, where the users can make railway booking on the move, from anywhere, at their convenience. Is it this convenience of ubiquitous use attracting consumers to opt this mobile application over the other systems? These two very basic questions can be answered by focussing our attention on two important and most used innovation attributes, *relative advantage* and *perceived ease of use*.

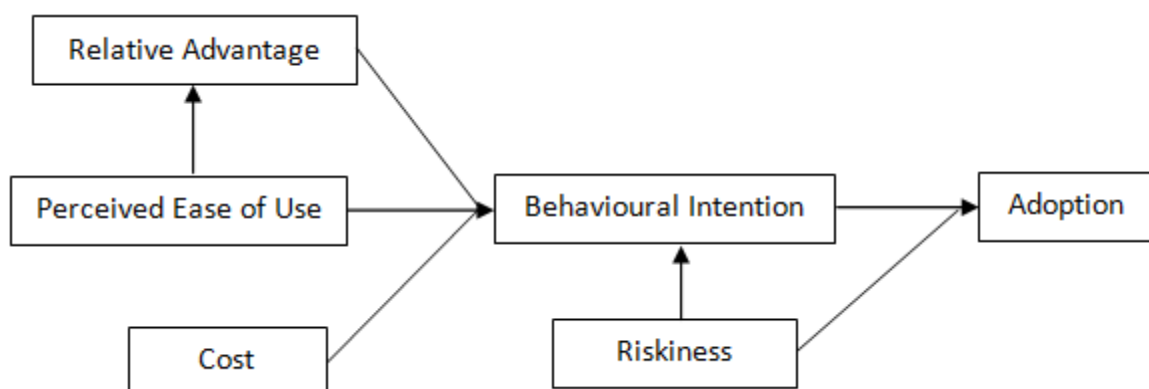
The literature in the field of innovations is very rich with models that help in predicting the use intentions and actual adoption of different innovations. Some of the most used innovation models are the diffusion of innovations theory (DOI), the technology acceptance model (TAM), the theory of reasoned action (TRA), the theory of planned behaviour (TPB), and the unified theory of acceptance and use of technology (UTAUT). Our study aimed to borrow one of the above mentioned models. While briefly reviewing these models it was found that the DOI theory had already been used and its attributes been studied by many works in the past (Tornatzky and Klein, 1982; Moore and Benbasat, 1991; Greenhalgh et al., 2004; Kim et al., 2008; Legare et al., 2008). Therefore, our study decided to use a model other than the DOI theory. Further review of the models revealed that these remaining models – TAM, TRA, TBP, and UTAUT studied the similar innovation attributes. Interestingly, there were evidences of publication that regarded the theory of acceptance model to be superior in comparison to the other above mentioned models. Some of such studies were – a study by Gentry and Calantone (2002) on predicting the behavioural intentions of the buyers in the shop-bot context found that the TAM was superior in performance in comparison the TRA and TPB models; another study by Chau and Hu (2002) on adoption of telemedicine by the physicians also concluded for the theory of acceptance model to be superior that the TPB model.

As justified in the early part of this section the two innovation attributes of our interest are relative advantage and ease of use. What's interesting here is that the TAM model comprises of only two predictors of behavioural intention, which are perceived usefulness and perceived ease of use. Relative advantage was primarily defined in Rogers (2003) diffusion of innovations theory as the attribute which measures the degree to which an innovation is perceived to be better than the ides(s)

it is superseding. Then, there was Davis (1986) who in their technology acceptance model defined perceived usefulness to be the degree to which the use of a given innovation will be perceived as a factor that enhances the job performance of its adopters. It was Moore and Benbasat in 1982, who pointed at the similarities between these two attributes, *relative advantage* and *perceived usefulness*. They argued that these two attributes were basically similar in nature and were only being addressed using different names, belonging to two different models, which were typically same by measure. As already illustrated, our study intends to measure the relative advantage of the IRCTC mobile ticketing application from the other railway booking alternatives. Therefore, the term relative advantage was concluded more appropriate from the study's perspective. This also means that the technology acceptance model was deemed most appropriate and hence used as the proposed model for our study, the only change being, relative advantage and perceived ease of use were now being proposed as the predictors of behavioural intention. Thus, our study borrows attributes from TAM for undertaking empirical investigation on the adoption of the IRCTC mobile ticketing application in the Indian context.

Owing to the fact that we are investigating a recent mobile application, two other attributes, *riskiness* and *cost* were given some curious consideration. The IRCTC ticketing application requires its users making a railway booking to pay for the booking on their mobile devices, hence the element of *cost*, and the existence of consumers' apprehensions associated to entering their account/card details while transacting on their mobile phones, makes the element of *riskiness* evident. Some research into the past publications led us to find that many studies on mobile payment focussed much of their attention on the aspect of cost. The results from past studies have shown that any form of additional cost – hidden cost, premium pricing, high transaction fee, and so on, tend to have a negative influence on the use intentions of the potential users, which in turn acts as a barrier to the adoption of these mobile commerce applications (Hung et al., 2004; Wu and Wang, 2005; Dahlberg et al., 2007; Mallat, 2007). Hence, studying the influence of cost on the adoption of the IRCTC ticketing application was considered important. Moving on to riskiness, past studies on mobile banking and mobile ticketing have considered various aspects of risks that could be associated to any mobile commerce application, for instance, the risks of weak mobile network connectivity, the risks of a mobile device breakdown in the middle of a transaction, the risks of loss or theft of mobile phones which may contain the financial information and credentials stored within the mobile application, risk of a failed transaction and many more which are seen to behave as potential barriers of m-commerce adoption (Lee et al., 2003; Mallat et al., 2008). Therefore, studying the element of risk was also considered very important from our study's perspective.

Borrowing all attributes from TAM, two more attributes were thereby added to propose a new integrated conceptual model for this study, whereby the influences of four innovation attributes, relative advantage, perceived ease of use, riskiness, and cost will be studied on the *behavioural intention*, and the effect of one attribute, perceived ease of use will be studied on the *relative advantage*, and lastly the effect of two attributes, behavioural intention and riskiness will be studied on the *adoption* of the IRCTC mobile ticketing application in an Indian context.



**Fig. 1.** Conceptual Model

The innovation attributes shortlisted to be used in our study have been depicted in figure1, above, which represents the proposed research model for this study. This model proposes that relative advantage, perceived ease of use, cost and riskiness will have significant impacts on the intentions of the consumers to use this mobile ticketing application by IRCTC. The model also extends that the perceived ease of using this application will significantly impact its relative advantage, and also that the positive intentions of use and low risks will significantly influence the adoption of this mobile application in the Indian context. Following part of this section details on the aforementioned innovation attributes, individually, and also proposes relevant hypotheses for each.

### *Relative Advantage*

This innovation attribute is used to measure the degree to which the users of an innovation perceive it to be relatively advantageous over the existing systems that it is superseding (Rogers, 2003). This attribute is widely studied across different innovations, for instance, distributed work arrangements (Sia et al., 2004), online portal (Shih, 2008) and so on. It also finds presence in the mobile commerce studies - studies on the adoption of mobile internet (Hsu et al., 2007) and mobile banking services (Koenig-Lewis et al., 2010) have found for this attribute to significantly influence, and positively impact the use intentions of the consumers. Being proposed to the target consumers as an enhancement over the counter and internet type of railway bookings, the IRCTC mobile ticketing application can be considered to be superseding these existing systems with a mobility feature which allows the users to make railway bookings with a few simple taps on their mobile phone application, at any time, from anywhere. Hence the relevance of this attribute to our study, and thus its inclusion. This innovation attribute is therefore posited as,

**H1:** *Relative advantage will have a significant influence on the behavioural intentions of the potential users.*

### *Perceived Ease of Use*

Perceived ease of use was defined by Davis (1986) as the degree to which the use of an innovation under consideration is perceived to be free of physical and mental effort. Therefore, the easier the use of an innovation, higher is the probability of it being quickly and easily accepted. This innovation attribute has also made its presence across different technologies, for instance, e-government (Sang et al., 2009), IT (Lee and Kozar, 2008) and others. Many mobile commerce services have also studied the influence of this attribute - mobile multimedia services (Pagani, 2004), mobile data services (Lu et al., 2008), mobile payment (Chen, 2008; Schierz et al., 2010) and all these studies found that this attribute succeeded in positively influencing the use intentions of the potential consumers. The hypothesis can thus be formulated as,

**H2:** *Ease of Use will have a positive influence on the behavioural intentions of the potential users.*

Another relationship that is most often explored in the context of this attribute is the effect of perceived ease of use on the perceived usefulness of a given innovation (or the relative advantage). The evidences of this relationship can be found in many studies from the past - a study on the prediction of intentions of online shoppers concluded that ease of use significantly influences perceived usefulness (Lin, 2007). Mobile commerce studies, such as studies on the adoption of the mobile payments services (Venkatesh et al., 2003; Schierz et al., 2010) also established a significant positive impact of the perceived ease of use on usefulness. The hypothesis formulated in this regard, therefore is,

**H3:** *Ease of Use will have a positive influence on the relative advantage of the IRCTC mobile ticketing application.*

## *Cost*

High costs associated to an innovation are observed to have a strong negative impact on the adoption of that innovation (Tornatzky and Klein, 1982). Effectively, low costs associated to an innovation lead to it being readily accepted by its prospective users. A study on mobile virtual network by Shin (2010) saw costs to negatively impact the use intentions of the potential consumers. More references from past publication for this attribute have already been made in the earlier part of this section. As also previously mentioned these railway bookings may impose a charge on the consumers depending upon the booking policies of their mobile data network providers. Therefore, the attribute, cost can be posited as,

**H4:** *Reduced costs will have a positive influence on the behavioural intentions of the potential users.*

## *Riskiness*

Riskiness, alike cost, has also been discussed in the early part of this section. To elaborate on the different aspect of this attribute, Rijdsdijk and Hultnik, (2003) addressed it to be a multidimensional component that comprised of multiple aspects of time loss, financial, social, psychological, physical, and performance types of risks. Some studies on mobile ticketing and marketing (Mallat et al., 2008; Tanakinjal et al., 2010) confirm for security and privacy risks to have a very significant impact on the consumers' use intentions, which directly affects the use of an innovation under consideration. Therefore, risk is always posited to exert a negative impact the adoption decision of an innovation. To explore the riskiness factor in the IRCTC mobile ticketing context on both, the use intention and its true adoption, the following hypotheses were made.

**H5:** *Riskiness will have a significant influence on the behavioural intentions of the potential users.*

**H6:** *Riskiness will have a significant influence on the adoption of the IRCTC mobile ticketing application.*

## *Behavioural Intention*

This attribute is one of the most frequently used attributes in the innovation studies. Behavioural intention was defined by Ajzen and Fishbein (1980) as the measure of the likelihood that a person will be involved in a given behaviour. Past studies such as Ajzen, (1991) and Ajjan and Hartshorne (2008) consider behavioural intention to be the important most predictor of the consumers' adoption decisions. Gumussoy and Calisir (2009) regard this innovation attribute to be an immediate predictor of the actual use of that innovation. Being studied as an attribute predicting adoption across various technologies, such as, online consumers for web shopping (Chen et al., 2002), web technologies (Ajjan and Hartshorne), e-reverse auction (Gumussoy and Calisir, 2009) and many more, the sole conclusion always arrived at is that this attribute positively impacts the use of a given innovation. Therefore it can be stated as - higher the intention to use a particular technology, stronger will the probability of the adoption of that technology. The hypothesis thus posited is,

**H7:** *Behavioural Intention will have a positive influence on the adoption of IRCTC mobile ticketing application.*

## **4. Research Method**

This section will introduce the instrument of survey used for this study, and detail on the questionnaire design, its validation, and the outcomes of the undertaken pilot study. The survey questionnaire was physically circulated as both, hard copies and was also made available as web links for those who preferred filling it online. These questionnaires were designed in accordance



with the shortlisted attributes to gather the relevant information from the targeted respondents to arrive at the factors that govern the diffusion of this IRCTC mobile ticketing application.

#### **4.1. Survey Instrument**

Our instrument of survey was a short questionnaire consisting of 28 questions altogether. Being circulated, both as physical copies and online, it was found that a higher majority of the respondents preferred filling the physical copies. Eight out of the total 28 questions were designed to be multiple choice demographic natured questions. While the first four of these eight questions were focussed on attaining each respondent's personal information on their age, gender, education and occupation, the remaining four multiple choice questions were targeted to extract the information pertaining to their use of the IRCTC mobile ticketing application, more specifically, on them being adopters or non-adopters, the provider of this mobile application they have chosen to use, the duration since they have been using this application, and the frequency of their usage.

The other twenty questions in the questionnaire were in the form of statements available with a range of responses to be rated on a seven point likert scale by the respondents, which in effect would be indicative of their attitude towards the posed statement (Jamieson, 2004). These 20 questions effectively covered the five shortlisted attributes of this study, inclusive of behavioural intention. Every attribute had four questions (items) each to their account that were aimed at attaining information essential for testing the proposed hypotheses, and in turn, for testing the performance of the proposed research model for this study. The respondents had to read the likert scale across seven points, where 1 was to extremely disagree, 2 to quite disagree, 3 to slightly disagree, 4 to neutral, 5 to slightly agree, 6 to quite agree, and lastly, 7 to extremely agree. The source(s) for all items utilised to measure the five attributes have been specified in table 1.

**Table 1**  
**Attributes and Items Mapping**

<b>Constructs</b>	<b>Source(s)</b>
<b>Relative Advantage</b>	Moore and Benbasat (1991)
<b>Ease of Use</b>	Moore and Benbasat (1991)
<b>Behavioural Intention</b>	Karahanna et al. (1999); Teo and Pok (2003); Shih and Fang (2004)
<b>Cost</b>	Mallat et al. (2008); Koenig-Lewis et al. (2010)
<b>Riskiness</b>	Tan and Teo (2000); Mallat et al. (2008)

#### **4.2. Pilot Study**

After completion of the survey instrument design, the questionnaire was required to undergo a pilot test to identify and improvise on any flaws that would prevent the respondents from comfortably filling the questionnaire. The sample size of the pilot study was set at 30 respondents. It was important to test the questionnaire for this study against a small population before releasing it to the larger target population. It was taken care that the members of the pilot study belonged to different age groups in order to confirm for the ease of understanding and completion of the questionnaire by all. The respondents were asked to give any specific or general comments on the effort involved in filling these questionnaires. The feedback revealed that the questionnaire was short, quick to complete, clear in terms of what was being asked, making it very easy to follow. A few other minor suggestions made by the respondents were addressed and incorporated in the questionnaire for its overall betterment.

#### **4.3. Data Collection**

Being set out with an aim of collecting the all India data, it was decided to target different cities in India. From a practical perspective it was concluded that one city each from the north, east, west and south regions of India will be used as our target location. Four target cities which were then focussed on were - Delhi city from the north, Kolkata city from the east, Mumbai city from the west, and lastly, Bangalore city from the south of India. The data from these four target cities was

expected to guide us through the factors that act as the influencers of the adoption of the IRCTC mobile ticketing application in India.

Respondents' wise, to arrive at a realistic estimate, a target number of 80 respondents from each city was set and eventually achieved. A total of 389 respondents filled these questionnaires. In the process of sorting these filled questionnaires, it was found that almost fourteen of them were incomplete. In the interest of data reliability, these fourteen part filled questionnaires were rejected, and the remaining 375 questionnaires were rendered valid to be subjected to further analysis to compute the final results from the findings from this study. In doing this, the SPSS data analysis tool was used to analyse and interpret the gathered data, the findings from which have been made available in section 5, below. The findings section contains results from the various tests that were carried out – a frequency test was run for all of the eight demographic items, followed by the reliability test for measuring the internal consistency of the twenty items for the five innovation attributes. A descriptive test yielding the means and standard deviations for all these five attributes was also run, followed by the regression analyses. Statistics from both, the linear and the logistic regression runs was then used to test the posited hypotheses. Lastly, a multicollinearity test was also undertaken to ensure that the five independent attributes of this study were free of the multicollinearity problem, not suffering from high correlation.

## 5. FINDINGS

### 5.1. Frequency Tests

Frequency tests for the demographic characteristics were run for the age, gender, and education aspects of the respondents for this study, the results of which have been populated in the table 2, below. The statistics showed that a greater number of our respondents (38.7%) belonged to the 18-24 age group, followed closely by 36% of the respondents who were aged anywhere between 25 and 34 years. Gender wise, it was observed that the female respondents (53.6%) were more in number in comparison to the male respondents (46.1%). Lastly, most respondents were found to be graduates (48.8%) by their educational qualification.

**Table 2**  
**Frequency Test I**

Variable	Group	Frequency	Percentage
Age	18-24	145	38.7
	25-34	135	36.0
	35-44	47	12.5
	45-54	35	9.3
	55-64	12	3.2
	65-74	0	0
	Above 75	1	0.3
	<b>Total</b>	<b>375</b>	<b>100.0</b>
Gender	Male	173	46.1
	Female	201	53.6
	<b>Total</b>	<b>375</b>	<b>100.0</b>
Education	Secondary School	11	2.9
	Higher Secondary	58	15.5
	Diploma	24	6.4
	Graduate	183	48.8
	Postgraduate – Taught	68	18.1
	Postgraduate – Research	20	5.3
	Other	11	2.9
	<b>Total</b>	<b>375</b>	<b>100.0</b>

The frequency test was then run on the demographics aspects directly related to the respondents' use of the IRCTC mobile ticketing application, the results from which have been presented in table 3, below. The statistics are representative of a very poor rate of adoption for this mobile ticketing

application. Only 83 of the total 375 respondents were found to have used this application, the remaining 292 respondents represented the non-adopter population for this technology. Out of the existing adopter population, most preferred Paymate (14.1%) as their network provider. Most of these adopters (10.4%) had been using this ticketing application only since a year, or even lesser than a year's span. When asked about the frequency of usage, many of the adopters (9.6%) responded that they used the application less often.

**Table 3**  
**Frequency Test II**

Variable	Group	Frequency	Percentage
Application Type	Paymate	53	14.1
	ngpay	15	4
	Atom	15	4
	Non Adopters	292	77.9
	<b>Total</b>	<b>375</b>	<b>100</b>
Usage Duration	<=12 Months	39	10.4
	12-24 Months	23	6.1
	25-36 Months	10	2.7
	>36 Months	8	2.1
	Other	3	0.5
	Non Adopters	292	77.9
	<b>Total</b>	<b>375</b>	<b>100</b>
Usage Frequency	Several times a day	5	1.3
	Once a day	16	4.3
	1-2 days a week	10	2.7
	3-5 days a week	5	1.3
	Once every few weeks	9	2.4
	Less often	36	9.6
	Other	2	0.5
	Non Adopters	292	77.9
	<b>Total</b>	<b>375</b>	<b>100</b>

## 5.2. Reliability Test

The SPSS tool was used to run a reliability test to check for the internal consistencies of the items for each of the shortlisted innovation attribute. The reliability test results have been populated in table 4, below. This test yielded a Cronbach's alpha value for each attribute which was used to conclude on the reliability for that attribute. Each innovation attribute was initially made up of four items each. However, in conducting the reliability test, three of our innovation attributes underwent the deletion of one item each in order to improvise their alpha values (which have been clearly indicated against the relevant attributes in table 4). Hinton et al. (2004) classified the different reliability types based on different sets of ranges in which these Cronbach's alpha values fell – alpha values greater than or equal to 0.90 were considered to represent excellent reliability, values in the range 0.70-0.90 were read as high reliability types, values between 0.50 and 0.70 were considered to be of moderate reliability, and finally any values below 0.50 were regarded to represent a low reliability type. From the statistics in table 4, it can be seen that out of the five innovation attributes for this study, two attributes showed excellent, two attributes showed high, and one attribute showed moderate reliability. A high Cronbach's alpha value is representative of higher internal consistency amongst the items making up an innovation attribute. Behavioural intention was the attribute with the excellent most reliability at .912, which was followed very closely by relative advantage at an alpha value of .903.

**Table 4**  
**Reliability Test**

Constructs	Sample Size	Number of Items	Cronbach's Alpha ( $\alpha$ )	Number of Items	Improvised Alpha ( $\alpha$ )	Reliability Type
Behavioural Intention	375	4	.912	4	.912	Excellent
Relative Advantage	375	4	.903	4	.903	Excellent
Ease of Use	375	4	.613	3	.665	Moderate

Riskiness	375	4	.668	3	.760	High
Cost	375	4	.738	3	.785	High

### 5.3. Descriptive Statistics

A descriptive test was also run, the results of which have been populated in a descending order of mean values along with the respective standard deviations in the table 5, below. Relative Advantage was clearly the attribute with the highest mean value out of all the five shortlisted attributes at 4.69.

**Table 5**  
Descriptive Statistics

Constructs	N	n	Mean	Std. Deviation
Relative Advantage	375	4	4.69	1.40
Ease of Use	375	3	4.43	1.19
Behaviuoral Intention	375	4	4.42	1.47
Cost	375	3	4.37	1.25
Riskiness	375	3	4.14	1.34

### 5.4. Regression analyses

Regression analysis, by definition, is a statistical technique which is used to predict the value of a dependent attribute using the values of one or more independent attributes (Allen, M.P., 2004). Both, linear and logistic regression runs were undertaken for all of the 375 cases, the outcomes of both of which have been detailed below.

#### 5.4.1. Linear Regression I

According to Worster et al. (2007), in linear regressions, a linear relationship between the independent and dependent attributes is assumed. In the linear regression run for our study, behavioral intention was considered as the dependent attribute, and the remaining four attributes, relative advantage, ease of use, riskiness and cost were considered as the independent attributes, the results of which have been made available in table 6, below. The model resulting from this run was found to very significantly predict the behavioral intention towards IRCTC mobile ticketing application: ( $F(4,375) = 74.675, p=0.000$ ). Overall, the model successfully explained 44.7% variance (adjusted  $R^2=0.447$ ). As evident from table 6, all independent attributes behaved as the significant predictor attributes of behavioral intention - relative advantage ( $\beta=0.293; p=0.000$ ), ease of use ( $\beta=0.162; p=0.09$ ), riskiness ( $\beta=-0.102; p=0.017$ ), and cost ( $\beta=0.338; p=0.000$ ).

**Table 6**  
Linear Regression I

Independent Variables	Standardized Coefficients (Beta)	t	Sig.	Collinearity Statistics		Hypotheses Support
				Tolerance	VIF	
(Constant)		3.214	.001			
Relative Advantage	.293	4.989	.000	.435	2.301	H1: Supported
Ease of Use	.162	2.618	.009	.393	2.547	H2: Supported
Cost	.338	6.061	.000	.480	2.084	H4: Supported
Riskiness	-.102	-2.401	.017	.825	1.212	H5: Supported
<b>Model Details</b>						
Adjusted R Square = 0.447; F = 74.675; Significance = 0.000						

#### 5.4.2. Linear Regression II

As we are testing attributes from TAM, there was a need to undertake another linear regression run where the relationship between relative advantage and ease of use would be focussed on. The

second linear regression was run with relative advantage being the dependent attribute, and ease of use being the independent attribute, the results from which have been populated in table 7, below.

**Table 7**  
**Linear Regression II**

Independent Variable	Standardized Coefficients (Beta)	t	Sig.	Collinearity Statistics		Hypothesis Support
				Tolerance	VIF	
(Constant)		4.762	.000			
Ease of Use	.724	20.286	.000	1.000	1.000	H3: Supported
<b>Model Details</b>						
Adjusted R Square = 0.523; F = 411.526; Significance = 0.000						

The model resulting from this run was also found to be very significant. This model successfully predicted the relative advantage of IRCTC mobile ticketing application over the already existing railway booking systems: ( $F(1, 375) = 411.526; p=0.000$ ). The model also succeeded in explaining about 52.3% of the variance (adjusted  $R^2=0.523$ ). It was thereby concluded that ease of use had both, a significant impact and successfully predicted the relative advantage of the mobile ticketing application under consideration ( $\beta=0.724; p=0.000$ ).

#### 5.4.3. Multicollinearity Test

Multicollinearity is a condition in which a high correlation is detected between two or more predictor attributes which disrupt analysing the contribution of the chosen independent attributes towards the performance of the model under consideration (Brace et al., 2006). Both linear regressions also produced the results from the multicollinearity test in terms of VIF values. These values are read to be good, if they fall below the maximum allowed value of 10 (Irani et al., 2009). The test results from the first linear regression (table 6) show the VIF values of the shortlisted attributes to be within the 1.2-2.5 range. Similarly, the second linear regression run (table 7) has a VIF value of 1 for ease of use. These VIF values across both regression runs are much below 10, rendering the predictor attributes of this study to be free from the multicollinearity problem. This also indicates that there exists a higher probability of the variance explanation given by the four predictor attributes to be very close to the real situation.

#### 5.4.4. Logistic Regression

According to (Worster et al., 2007) for logistic regression, the outcome variable has to be dichotomous having two possible outcomes. Brace et al., (2006) refers to this regression type as a computation of the probability that a given case will end up belonging to a particular category. For our study, the logistic regression run was undertaken for adoption as the dependent attribute, and both, behavioural intention and riskiness as the predictor attributes, the results of which are available in table 8, below. The model resulting from this study was also favourably found to significantly predict the consumers' decisions of adopting the IRCTC mobile ticketing application (omnibus chi-square =25.302,  $df=2, p=0.000$ ). At the same time, this model accounted for 6.5% to 10% of variance in the adoption decision, as depicted in table 9. Further, it was also revealed from table 10 that where 100% of non-adopters were successfully predicted, a mere 18.3% of the adopters were only predicted. Also, overall about 82.1% of the model's predictions were found to be accurate.

**Table 8**  
**Omnibus Tests of Model Coefficients**

		Chi-square	df	Sig.
Step 1	Step	25.302	2	.000
	Block	25.302	2	.000
	Model	25.302	2	.000

**Table 9**  
**Model Summary**

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	368.609	.065	.100

**Table 10**  
**Classification Table**

	Observed	Predicted			
		Installed or Not		Percentage	
		Yes	No	Correct	
Step 1	Installed or Not	Yes	15	67	18.3
		No	0	293	100.0
	Overall Percentage				82.1

In addition, the coefficients, Wald statistics, degrees of freedom, and probability values for both, behavioural intention and riskiness were also computed, as visible from table 11, below. The values in the table are a proof that both, behavioural intention and riskiness reliably predicted the adoption of the IRCTC mobile ticketing application. The coefficient values are indicative of the fact that a unit increase in the consumers' use intention will be in direct relation to a unit decrease in the odds of the consumers' actual adoption of this mobile ticketing application by a factor of 1.241 (95% CI 1.04 and 1.47). The same holds true in the case of riskiness, where an increase in low risk associated to this application will result in a unit decrease in the odds of consumers' application adoption decision by a factor of 1.428 (95% CI 1.18 and 1.72).

**Table 11**  
**Variables in the equation**

Independent Variable	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)		Hypothesis Support
							Lower	Upper	
Riskiness	.357	.097	13.429	1	.000	1.428	1.180	1.729	H6: Supported
Behavioural Intention	.216	.087	6.206	1	.013	1.241	1.047	1.470	H7: Supported
Constant	-1.062	.483	4.825	1	.028	.346			

## 6. DISCUSSION

### 6.1. Hypotheses testing and the validated research model

To test the intention and adoption of the mobile ticketing application under consideration, a total of seven hypotheses were formulated to be tested for examining the influence of the five innovation attributes shortlisted for our study. All the seven posited hypotheses were supported by findings from the data accumulated to test the diffusion of this application in the Indian context. The statistics from tables, 6, 7 and 11, above clearly show that while relative advantage, perceived ease of use, cost and riskiness significantly influenced the behavioural intentions of the users towards this application, perceived ease of use was successful in explaining the relative advantage of using the mobile ticketing application over the other railway booking options. Further revelations showed that both, riskiness and behavioural intention made significant impacts on the adoption of the IRCTC mobile ticketing application. The influence of these innovation attributes on the relative advantage, behavioural intention and adoption attributes has been discussed in further detail in the following paragraphs.

The hypotheses, H1, H2 and H3 were clearly supported by the empirical data, wherein, whilst relative advantage and ease of use were found to have a significant influence on the behavioural intentions of the consumers, perceived ease of use was found to exert a significant positive impact

on the relative advantage of the mobile ticketing application under consideration. In terms of making a railway booking, a prospective traveller has a choice of physically going to the IRCTC offices to make an over-the-counter booking, or choose to look up for the travel schedules online and make a web booking. With the mobile ticketing being introduced, now, this option of railway booking turns out to be relatively advantageous as it is much quicker than the other types of booking. It makes possible for the users to access the railways schedule and make bookings with a simple tap on a ticketing application on their mobile phones, without having open up a web browser to input the web link, and then be redirected to the IRCTC booking page followed by inputting the login credentials to pull up the schedules and then make a booking. It offers the flexibility of being able to make a booking at any time, alongside its much attractive mobility which lets the users make the bookings from anywhere, on the go, which much evidently surpasses the options of counter booking and e-ticketing. Also, in using this application, the consumers do not have to look for internet or Wi-Fi enabled access points for gaining web access as the mobile application can be very conveniently run by using the data from the mobile network providers who offer very reasonable data tariffs/plans these days. From the points highlighted in the discussion above and the supporting data results, it becomes evident that the consumers of this mobile ticketing application perceive it to be both, an easy to use mobile application, and the one which is relatively advantageous than the other existing railway booking options, with a fairly higher degree of usefulness.

In our search for past studies showing a similar significant behaviour of relative advantage and ease of use on behavioural intention, the following evidences providing a strong support in the field of mobile commerce, particularly, were found – Mallat et al. (2008) also undertook a study on the adoption of mobile ticketing services in public transportation using the TAM attributes alongside other innovation attributes to create an integrated model, which is a close case to our study, to also find that perceived usefulness and ease of use tend to have a statistically significant impact on the adoption intention. Another study on the adoption of mobile ticketing in Helsinki by Mallat et al. (2006), although showed a non significant effect of perceived usefulness on use intentions, it showed the same positive and significant effect of the perceived ease of use on the use intention. Pagani (2004) in their study found that perceived usefulness and ease of use were the most important determinants of consumers' adoption intentions. Gerpott (2011) conducted a study on the adoption of mobile internet by the mobile phone users in Germany, and they found that relative advantage significantly impacted the use intentions of both the actual users and the potential users of the service in question. Schierz et al. (2010) also studying the acceptance of mobile payment services found that perceived usefulness was a significant determinant of attitude of use which in turn positively influenced the use intention of the consumers towards mobile payment. In studying the acceptance of mobile internet, and specifically the multimedia message service (MMS), Hsu et al., (2007), in their test results found that perceived ease of use was found to have a significant impact on the use intentions in the case of early adopters of the MMS service. Tanakinjal et al. (2010) in studying the acceptance of mobile marketing from a Malaysian perspective showed that the users' perception of relative advantage of an innovation being used was an important determinant of users' intention of adopting mobile marketing. A study on adoption of multimedia messaging service in Iran showed a successful significant impact of relative advantage on the use intentions. Lu et al. (2003) did a study on the adoption of wireless internet via mobile technology in China, which was yet another evidence to support the strong influences of both, relative advantage and ease of use on the behavioural intentions of the consumers.

Mobile commerce studies supporting the similar behaviour of perceived ease of use on the perceived usefulness as in the case of our test results, were also found – in a study by Lu et al. (2008) on wireless mobile data services in the Chinese context, they compared their study results to most TAM related studies, and found that perceived ease of use had a significant impact on the perceived usefulness of the mobile data services. A study predicting young consumers' acceptance of mobile banking services by Koenig-Lewis (2010) combined the TAM and IDT attributes, where as well, the significant influence of perceived ease of use on the perceived usefulness was observed.

There have been several other studies on the adoption of various technologies, other than mobile commerce which extend a strong support to our hypotheses H1, H2 and H3; these studies also used the TAM attributes either exclusively, or in integration with attributes from other models to conclude on test results, in line with the empirical results from our study. Some examples are - e-government (Sang et al., 2009); groupware applications (Slyke et al., 2002); anti-spyware software (Lee and Kozar, 2008); WebQual instrument (Loiacono et al., 2007); IS (Yang and Choi, 2001); e-commerce (Crespo and Rodriguez, 2008); IT (Kim et al., 2008).

When it comes to the costs associated to using an innovation, the consumers tend to evaluate the costs against the benefits they receive in using that innovation. If consumers perceive the advantages of an innovation to be much higher than the costs that they may have to bear to use that innovation, they tend to regard the associated costs as affordable. Our hypothesis 6 was formulated to address this issue of cost, which was tested to be true. The consumers perceive the costs of using the IRCTC mobile application to be low and affordable. These low costs persuade the consumers' adoption intentions positively, which was confirmed by the test results for our study. Literature is often seen to regard costs, particularly high cost associations of an innovation as a barrier to its adoption (Tornatzky and Klein, 1982). Dahlberg et al. (2007) reviewed the past studies on mobile payment and highlighted that all these studies had paid specific attention to cost as an innovation attribute to study its influence on the consumers intentions to adopt these m-commerce innovations. Hence, the element of cost is an important factor in a mobile payment environment which significantly influences the consumers' intentions and adoption decisions.

The hypotheses, H6 and H7, which were postulated for the influences of the two predictor attributes, risk and behavioural intention on adoption, were both confirmed positive for this study. Riskiness, in our study was tested for its influence on both, use intention (hypothesis 5) and actual adoption. While it displayed significant influences on both the dependent attributes, it exerted a significant negative impact on the use intention. Similar observations regarding its impact on the adoption intentions have been made by some of the earlier mobile commerce studies - a study on the acceptance of mobile banking services found that riskiness had a significant negative impact on the adoption intention of the users (Koenig-Lewis et al., 2010). Chen (2008) in studying the consumer acceptance of mobile payment also specifically observed a significant negative impact of riskiness on the users' adoption intentions. Finally, hypothesis 7 for this study was also confirmed true from the test results for this study where behavioural intention was found to have significant influence on the adoption of the IRCTC mobile ticketing application. This attribute in particular receives strong support from the past publications, where the association between behavioural intention and the adoption behaviour of an innovation has always been concluded to be significant (Ajzen, 1991; Hartshorne and Ajjan, 2009). Some instances have been briefly exemplified here – in empirically investigating the adoption of an anti-spyware software, Lee and Kozar (2008) found a direct relationship between the use intention and the actual adoption of the software. Taylor and Todd (1997) in studying the consumer composing behaviour also observed a significant impact of the behavioural intention of the consumers on the actual behaviour. An m-commerce study on the policy implications of mobile virtual network by Shin (2010) also confirmed the positive and significant influence of behavioural intention on the actual behaviour.

The validated research model showing the impact of the shortlisted innovation attributes on the behavioural intention, relative advantage and adoption of the IRCTC mobile ticketing application, has been illustrated in the figure 2, below.



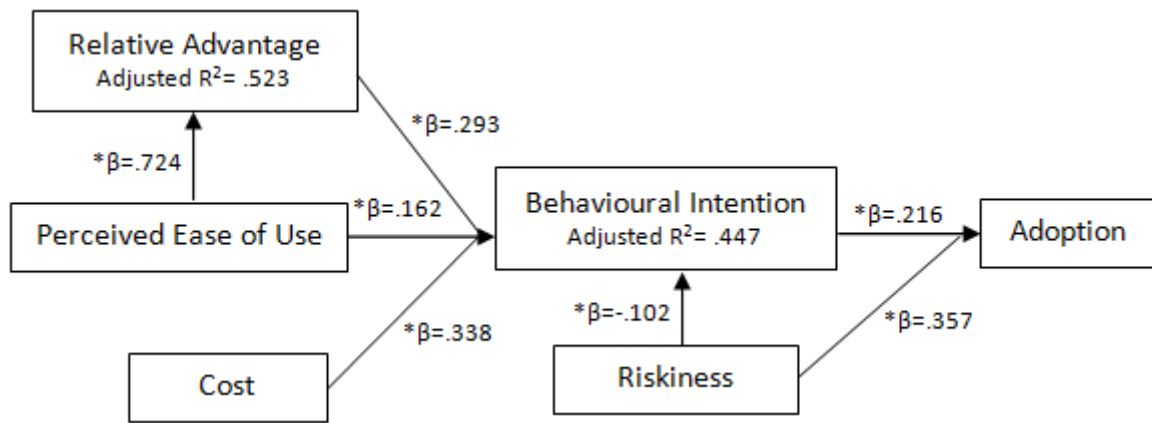


Fig. 2. Validated Research Model.

In accordance with the hypotheses proposed in section 2, the significant paths from the four predictor attributes on behavioural intention, the significant path from perceived ease of use to relative advantage, and from riskiness and intention to the actual adoption of this mobile application have been clearly shown in figure 2. The  $\beta$  values preceded by asterisk marks are indicative of significant effects of these predictor variables on the two dependent variables of this study.

In assessing the explanatory power of the research model proposed in this study,  $R^2$  values were derived out of the statistical computations for both, behavioural intention and adoption. Whilst relative advantage and behavioural intention were validated for adjusted  $R^2$  values, adoption was being validated for Cox and Snell, and Nagelkerke  $R^2$  values. Tables 6 and 7 give the adjusted  $R^2$  values for behavioural intention and relative advantage as 0.447 and 0.523 respectively. In understanding the drivers of consumers' composing behaviour, Taylor and Todd (1997), reported an  $R$  square value of 0.49 for behavioural intention. Ajjan and Hartshorne (2008) in their study on adoption of web technologies arrived at an adjusted  $R^2$  value of 0.754 for intention. Another study by Hartshorne and Ajjan (2009) found an adjusted  $R^2$  value of 0.63 which they used to regard their model as capable of explaining significant variance. Lin (2008) studied the users' intentions of shopping online using the TAM attributes and found an adjusted  $R^2$  value of 0.41 for use intentions. Considering the  $R^2$  value of 0.447 from our study for the use intentions was similar or close or slightly lesser in value to some of the past studies, it can be concluded that the variance of the use intentions was fairly significantly explained by the model proposed by our study. Similarly, in comparing the  $R^2$  values for relative advantage with the past publications, the following value range for this attribute were observed - Aubert and Hamel (2001) study the acceptance of smart cards in medical sector and in their study observe an adjusted  $R^2$  value of 0.69 for relative advantage. Kishore and McLean (2007) in studying IT adoptions use and validate three research models and report values ranging between 0.33 and 0.45 for the adjusted  $R^2$  value for relative advantage. Shih (2008) in studying the continued use of an online portal reported an adjusted  $R^2$  value of 0.484. These  $R^2$  values for relative advantage are either very close to, or lesser than the adjusted  $R^2$  value of 0.523 reported by our study. This indicates that the variance for relative advantage is significantly well explained by the validated model for our study.

Table 9 provides for the  $R^2$  values for adoption with the Cox and Snell  $R^2$  at 0.065 and Nagelkerke  $R^2$  at 0.100. In comparing these two  $R^2$  values with the earlier studies, it was found that the two  $R^2$  values for adoption in our study, were significantly lesser, for instance - Ungan (2004) in dwelling on the adoption of best practices in manufacturing, reported a Cox and Snell  $R^2$  of 0.479 and a Nagelkerke  $R^2$  of 0.648, on the basis of which they concluded for their model to have a very good fit; Gounaris and Koritos (2008) in investigating the drivers of internet banking adoption reported a Cox and Snell  $R^2$  of 0.417 and a Nagelkerke  $R^2$  of 0.581. Yu-Hui (2008) in empirically investigating the determinants of e-procurement adoption arrived at a Cox and Snell  $R^2$  of 0.379 and Nagelkerke  $R^2$  of 0.538. Ramamurthy et al. (2008) in investigating the data warehouse adoption

reported a Cox and Snell and a Nagelkerke  $R^2$  values in the range, 0.39 to 0.55 and stated that these values suggested that their model had a satisfactory explanation capability. Wang et al. (2010) in studying the determinants of RFID adoption found a Cox and Snell  $R^2$  of 0.51 and a Nagelkerke  $R^2$  of 0.69, the values of which they recognized as satisfactory. These two  $R^2$  values from Cox and Snell and Nagelkerke, for the adoption attribute, in all of these above mentioned past studies have been fairly higher than the values reported for our study. This in turn suggests that the variance for adoption is not well explained by our research model, and that the research model does not exhibit a very good fit with the data.

## **6.2. Research Contributions and Practical Implications**

This study contributes to the existing literature by extending the Technology Acceptance Model for testing and validating the attributes of this model in a whole new context, which is the diffusion of the *IRCTC mobile ticketing application in the Indian context*. As acknowledged at different points in this paper, no previous publications on the acceptance of this technology are available in the literature. Therefore, the findings from this study become significant in not only bringing to light the first insights into the extent of diffusion and adoption of this mobile ticketing application, but also offer a theoretical basis for the future researchers to dwell on. More specifically, from the theoretical perspective, some salient predictors of the basic beliefs in the acceptance of mobile ticketing have been confirmed by our study. The results from our study carry implications for both, the practitioners and researchers. From the practitioners' perspective, an understanding of the behaviour of the key drivers identified and proposed by our research model is necessary for the practitioners to enhance the design and services that the IRCTC mobile ticketing application has to offer to its consumers, in order to achieve a high adoption rate of this technology. Further, from the researchers' perspective, our study provides a basis for future refinement of the proposed model for studying the mobile ticketing acceptance by the potential consumers.

The findings in table 3 clearly show that only 22.1% of our respondent population were found to be adopters of this mobile application. Despite the statistics confirming positive effects of our shortlisted innovation attributes on the consumers' intention and adoption decision, a low adoption rate prevailed which could be viewed to be a resultant of the either of the following – The IRCTC mobile application offers similar services as the other existing systems, not having features appealing enough to act as incentives attracting customers to use it more than the other available options; or the consumers have not been well informed of the advantages that this application offers over its alternatives, meaning a simple lack of awareness of the positives of the IRCTC mobile application exists.

The results from this study typically show the behaviour of the TAM attributes in influencing both, the use intention and the adoption of the IRCTC mobile application. In today's commercial world, where the use of mobile wallet is encouraged, and the aspects of convenience and time value are appreciated, making the day to day services available on a ubiquitous platform is trending to be very popular. This increases the need for understanding the determinants of adoption of a technology such as the mobile ticketing application, to assist the managers and implementers in better steering the diffusion of such innovations. The findings illustrated that the advantages offered by this application were considered relatively superior to the other existing methods of railway booking. More importantly, the issue of low adoption rate of this application also surfaced from the findings. A reason behind this poor adoption rate could be, being well acquainted with the older established systems of railway booking such as e-booking and over-the-counter booking, the consumers are comfortable with the older systems and are evidently not immediately attracted to the new mobile system of making bookings. Therefore, it is very important that IRCTC and the co-implementers of this technology upgrade the mobile application with attractive and superior quality services which will draw more customers towards its use. What is more important is to make the

potential customers aware of the enhancement in the technology over the older systems to attract their attention towards its adoption.

The findings also revealed that lesser effort involved in making railway bookings on the mobile application, in other words, an easy to use railway booking application was attractive and important to both, the current and potential consumers. This extends suggestions that this mobile ticketing application must be carefully designed to allow for easy and straightforward options where the users can easily do a lookup for the rail schedules and making bookings of their choice along with easy and quick payment options and methods. The schedule, booking, payment and other passenger details screens must be easy to understand and to navigate through. The interface should be well structured with reduced number of steps involved for making a booking. Also, an interactive interface guiding the users with adequate feedback towards the completion of transaction with minimized confusion will greatly influence and attract consumers towards its use.

For our study, riskiness was found to negatively affect the users' intention to adopt the mobile ticketing application and significantly affected their adoption decisions. Consumers take time to rely on a new unfamiliar technology in its initial stages. A negative impact on the intentions is more inclined to adversely affect the adoption of a given innovation. Therefore, it is important for the implementers to place priority on reducing the risks associated to the use of the mobile ticketing application. As discussed earlier, there are many facets to risk (environmental, technical, behavioural and so on) to which the providers of this mobile application need to pay exclusive attention. Lastly, it is critical to ensure that all of the advantages and enhancements that the mobile ticketing application comes with, be effectively communicated to the potential consumers of this application. One most sought method to do which is, advertising; the providers should focus on the unique advantages that come with this ticketing application such as ubiquity, personalization and localization aspects of such a service.

## **7. Conclusions, Limitations and Future Research Directions**

This study on the acceptance of the IRCTC mobile ticketing application verifies and confirms some of the well recognized notions associated to the acceptance of an innovation. Our research model was adapted from the Technology Acceptance Model, the attributes of which, alongside two other attributes, cost and riskiness were tested for their behavioural influence on the adoption intentions and actual adoption of the mobile ticketing application, recently introduced by IRCTC in India. The integrated research model for this study confirmed for all of the seven posited hypotheses to be true in this mobile ticketing context. The statistical results drawn from the SPSS tests were conclusive along the following key findings - relative advantage, ease of use, cost and riskiness significantly influenced the consumers' adoption intentions, where more particularly, cost and relative advantage were the strongest of the four predictors of the use intentions; perceived ease of using the ticketing application had a very strong and positive influence on the relative advantage of this mobile application; also, riskiness and behavioural intention, both were the significant, positive predictors of the actual adoption of this IRCTC mobile application. In addition, the proposed model explained 44.7% variance in the consumers' intention to adopt the mobile ticketing application, indicating a good model performance, overall.

Dahlberg et al. (2007) address in their study that payment culture is a specific part of the overall culture and lifestyle in a society, and that influential lifestyles and cultural factors are required to be considered in the mobile payment services context. The IRCTC mobile ticketing application, although is basically a mobile railway booking application, it involves payment over the mobile in terms of transaction fee and booking costs, therefore this application also needs to be explored for the societal lifestyle and cultural factors. The data utilized in our study was limited to just four states representing north, east, west, south regions of India, out of the total 28 existing states. To

account for the probable cultural aspects that act as the potential influencers and barriers to the acceptance of this mobile ticketing application, the future researchers may want to consider gathering data from these other states, and build specifically on the region or state-wise interpretations of adoption from a much larger dataset to highlight the possible cultural influences on the diffusion and acceptance of the mobile ticketing application by IRCTC.

The attributes shortlisted for our study were restricted to the TAM attributes and two other additional attributes, cost and riskiness. The field of innovations has been richly explored using many other innovation attributes which have been found to significantly influence an innovation's diffusion and adoption, like voluntariness, result demonstrability, image, social approval, trust, security and many more. In justifying the choice of innovation attributes for this study in the conceptual basis section of this paper, we chose to ignore the Rogers' five innovation attributes as they have been already been extensively used and explored in studying other innovations. However, it would still be interesting and value additive from the research perspective to investigate the influence of the attributes from the diffusion of innovations theory on the use intention and adoption of the IRCTC mobile ticketing application. In addition, Tornatzky and Klein (1982) also identified almost 25 other innovation attributes in their meta-analysis which were proposed to considerably impact an innovation's diffusion process, which can be studied in the future studies on this mobile ticketing application by IRCTC to expand the literature on the influence innovation attributes in the mobile ticketing context. Another significant contribution to the literature in terms of innovation attributes was from Moore and Benbasat's study in 1991 on developing an instrument that measured users' adoption perceptions. All these attributes, other than the TAM attributes which have already been validated in our study will be aimed at, as a part of our future research. To more meaningfully interpret the strongest influencers of adoption for the mobile ticketing application under consideration, the future researchers may also want to focus on these other innovation attributes in their studies.

Interestingly, although relative advantage, ease of use and costs associated to the use of the mobile ticketing application positively influenced the consumers' intentions, the overall adoption of this technology was found to be very less (22.1%). In order to obtain more detailed insights into this low rate of adoption, it may be a good idea to study the influence of the above mentioned three attributes on the adoption of the IRCTC mobile ticketing application, and not just on the behavioural intention, as is the case in our study. Our future work on this ticketing application will be to learn the influence of relative advantage, ease of use and cost on the adoption attribute.

As highlighted at multiple instances in this paper, riskiness is assumed to be made up of multiple components. Past studies emphasize on the presence of various types of risks associated to any innovation (Gupta and Xu, 2010). In our study, we studied riskiness as a whole, as one single component. However, breaking this innovation attribute into the different specific aspects of risk such as environmental, behavioural, performance, technology, social, security, product, financial, and the other types of potential risks should lead into a more in depth understanding of the behaviour of this attribute. Future researchers in this field may therefore want to consider risk as a multi-component attribute and probe into its possible different components, exclusively.

Section 6.1 interprets the logistic regression run and the weak variance explanation by our research model, where comparatively lower  $R^2$  values for Cox and Snell and Nagelkerke  $R^2$  for adoption were found. These values indicated that the explanation of total variance by our model was slightly less. The recommendation of including more number of innovation attributes to study the adoption of this application as made in the earlier part of this section can be repeated here in this regard. The future researchers in this area may want to strongly consider studying more innovation attributes that would help in better explaining the variance for adoption. Lastly, being a recent introduction in the Indian context, the diffusion of this application has evidently been slow and is still continuing. As Rogers (2003) suggests the diffusion of any innovation is communicated over time, therefore it

becomes imperative to conduct empirical investigations for such applications at different points in time.

## REFERENCES

Ajjan, H. and Hartshorne, R. (2008). Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests. *Internet and Higher Education*, 11, 71–80.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting behavior. Englewood Cliffs, NJ: Prentice Hall.

Allen, M.P. (2004), *Understanding Regression Analysis*. Springer.

Aubert, B.A. and Hamel, G. (2001). Adoption of smart cards in the medical sector: the Canadian experience. *Social Science and Medicine*, 53, 879-894.

Brace N, Kemp R and Snelgar R (2003). *SPSS for psychologists: a guide to data analysis using SPSS for windows*. Palgrave Macmillan, New York.

Chau, P.Y.K. and Hu, P.J.H. (2002). Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories. *Information and Management*, 39 (4), 297–311.

Chen, L-D., Gillenson, M.L., and Sherrell, D.L. (2002). Enticing Online Consumers: an extended technology acceptance perspective. *Information and Management*, xx, 705-719.

Chen, L-D. (2008). A model of consumer acceptance of mobile payment. *International Journal of Mobile Communications*, 6(1), 32-52.

Crespo, Á.H., and Rodríguez, I. A.R.D.B. (2008). Explaining B2C e-commerce acceptance: An integrative model based on the framework by Gatignon and Robertson. *Interacting with Computers*, 20(2), 212-224.

Dahlberg, T., Mallat, N., Ondrus, J. and Zmijewska, A. (2007). Past, present and future of mobile payments research: A literature review. *Electronic Commerce Research and Applications*, 7(2) 165-181.

Davis, F.D. (1986). A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results, Doctoral dissertation, *Sloan School of Management, Massachusetts Institute of Technology*.

Gentry, L. and Calantone, R. (2002). A comparison of three models to explain Shop-bot use on the web. *Psychology and Marketing*, 19(11), 945–956.

Gumussoy, C.A. and Calisir, F. (2009). Undersatnding factors affecting e-reverse auction use: An integrative approach. *Computers in Human Behavior*, 25, 975-968.

Gupta S and Xu H. (2010). Examining the Relative Influence of Risk and Control on Intention to Adopt Risky Technologies. *Journal of Technology Management and Innovation*, 5(4) 22-37.

- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., and Kyriakidou, O. (2004). Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *The Milbank Quarterly*, 82(4), 581-629.
- Grepott, T.J. (2011). Attribute perceptions as factors explaining Mobile Internet acceptance of cellular customers in Germany – An empirical study comparing actual and potential adopters with distinct categories of access appliances. *Expert Systems with Applications*, 38, pp. 2148–2162.
- Gounaris, S., and Koritos, C. (2008). Investigating the drivers of internet banking adoption decision: A comparison of three alternative frameworks. *International Journal of Bank Marketing*, 26(5), 282-304.
- Hartshorne, R. and Ajjan, H. (2009). Examining student decisions to adopt Web 2.0 technologies: theory and empirical tests. *Journal of Computer in Higher Education*, 21, 183–198.
- Hinton, P.R., Brownlow, C., McMurray, I., & Cozens, B. (2004). *SPSS explained*. Routledge Inc., East Sussex, England.
- Hsu, C-L., Lu, H-P., and Hsu, H-H. (2007). Adoption of the mobile Internet: An empirical study of multimedia message service (MMS), *Omega*, 35, 715-726.
- Hung, S. Y., Chang, S. I. and Lee, P. J. (2004). *Critical factors of ERP adoption for small-and medium-sized enterprises: an empirical study*. In Pacific Asia Conference on Information Systems.
- IRCTC. (2013). <https://www.irctc.co.in/mobilebooking.html>. Accessed: 2013[January 7].
- Irani, Z., Dwivedi, Y. K., & Williams, M. D. (2009). Understanding Consumer Adoption of Broadband: An Extension of Technology Acceptance Model, *Journal of Operational Research Society*, 60(10), 1322-1334.
- Jamieson, S. (2004). Likert scales: how to (ab)use them. *Medical Education*, 38, 1212-1218.
- Karahanna, E., Straub, D.W., and Chervany, N.L. (1999). Information technology Adoption Across Time: A Cross-Sectional Comparison of Pre-Adoption and Post-Adoption Beliefs. *MIS Quarterly*, 23(2) 183-213.
- Kim, H-J., Mannino, M. and Nieschwietz, R.J. (2008). Information technology acceptance in the internal audit profession: Impact of technology features and complexity. *International Journal of Accounting Information Systems*, 10, 214-228.
- Kishore, R. and McLean, E.R. (2007). Reconceptualising innovation compatibility as organizational alignment in the secondary IT adoption contexts: An investigation of software reuse infusion. *IEEE Transactions on Engineering Management*, 54(4), 756-775.
- Kleijnen, M., Ruyter, K., & Wetzels, M.G.M. (2003). Factors Influencing the Adoption of Mobile Gaming Services. In B.E. Mennecke & T.J. Strader (Eds.), *Mobile Commerce—Technology, Theory and Applications* (pp. 213–214). Hershey, PA: Idea Publishing Group.
- Koenig-Lewis, N., Palmer, A. and Moll, A. (2010). Predicting young consumers' take up of mobile banking services, *International Journal of Bank Marketing*, 28(5), 410-432.
- Lee, Y. and Kozar, K (2008). An empirical investigation of anti-spyware software adoption: A multitheoretical perspective, *Information & Management*, 45, xx-xx.

- Lee, M.S.Y., McGoldrick, P.J., Keeling, K.A. and Doherty, J. (2003). Using ZMET to explore barriers to the adoption of 3G mobile banking services. *International Journal of Retail & Distribution Management*, 31(6) 340–348.
- Le´gare´, F., Ratte´, S., Gravel, K., and Graham, I.D. (2008). Barriers and facilitators to implementing shared decision-making in clinical practice: Update of a systematic review of health professionals’ perceptions. *Patient Education and Counseling*, 73(1), 526–535.
- Liang, T-P., Huang, C-W., Yeh, Y-H., and Lin, B. (2007). Adoption of mobile technology in business: a fit-viability model. *Industrial Management and Data Systems*, 107(8), 1154-1169.
- Lin, H-F. (2008). Predicting consumer intentions to shop online: An empirical test of competing theories. *Electronic Commerce Research and Applications*, 6, 433-442.
- Loiacono, E.T., Watson, R.T. and Goodhue, D.L. (2007). WebQual: An instrument for consumer evaluation of websites. *International Journal of Electronic Commerce*, 11(3), 51-87.
- Lu, J., Liu, C., Yu, C. S., & Yao, J. E. (2003). Exploring factors associated with wireless internet via mobile technology acceptance in Mainland China. *Communications of the International Information Management Association*, 3(1), 101-120.
- Lu, J., Liu, C., Yu, C-S. and Wang, K. (2008). Determinants of accepting wireless mobile data services in China, *Information & Management*, 45, 52–64.
- Mallat, N. (2007). Exploring Consumer Adoption of Mobile Payments - A Qualitative Study, in *Proceedings of Helsinki Mobility Roundtable Sprouts: Working Papers on Information Systems*, 6(44).
- Mallat, N., Rossi, M., Tuunainen, V. K. and Öörni, A. (2008). An empirical investigation of mobile ticketing service adoption in public transportation. *Personal and Ubiquitous Computing*, 12(1) 57-65.
- Mallat, N., Rossi, M., Tuunainen, V. K. and Öörni, A. (2009). The impact of use context on mobile services acceptance: The case of mobile ticketing. *Information & Management*, 46(3), 190-195.
- Moore, G.C., and Benbasat, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research*, 2(3), 192-222.
- Pagani, M. (2004). Determinants of adoption of third generation mobile multimedia services. *Journal of Interactive Marketing*, 18(3), 46-59.
- Patel, A. and Grover, I. (2010). *Map-based interaction for inputting in mobile phones*. In Proceedings of the 2010 international conference on Interaction Design & International Development, British Computer Society, 60-64.
- Ramamurthy, K., Sen, A. and Sinha, A.P. (2008). An empirical investigation of the key determinants of data warehouse adoption. *Decision Support Systems*, 44, 817-841.
- Rijsdijk, S. A. and Hultink, E. J. (2003). “Honey, have you seen our hamster?” Consumer evaluations of autonomous domestic products. *Journal of Product Innovation Management*, 20(3), 204-216.

- Rogers, E.M. (2003). *Diffusion of Innovations*. New York: The Free Press. 5<sup>th</sup> edition.
- Sang, S., Lee, J-D., and Lee, J. (2009). E-government adoption in ASEAN: the case of Cambodia,” *Internet Research*, 19(5), 517-534.
- Schierz, P.G., Oliver Schilke, O., and Wirtz, B.W. (2010). Understanding consumer acceptance of mobile payment services: An empirical analysis. *Electronic Commerce Research and Applications*. 9, 209-216.
- Shih, Y-Y. and Fang, K. (2004). The use of a decomposed theory of planned behavior to study Internet banking in Taiwan. *Internet Research*, 14(3), 213-223.
- Shih, H-P. (2008). Continued use of a Chinese online portal: an empirical study. *Behaviour and Information Technology*, 27(3), 201-209.
- Shin, D-H. (2010). MVNO services: Policy implications for promoting MVNO diffusion. *Telecommunications Policy*, 34, 616–632.
- Siau, K and Shen, Z. (2003). Building customer trust in mobile commerce. *Communications of the ACM*, 46(4), 91-94.
- Sia, C-H., Teo, H-H., Tan, B.C.Y., and Wei, K-K. (2004). Effects of environmental uncertainty on organizational intention to adopt distributed work arrangements. *IEEE Transactions on Engineering Management*, 51(3), 253-267.
- Slyke, C.V., Lou, H., and Day, J. (2002). The impact of perceived innovation characteristics on intention to use groupware. *Information Resource Management Journal*, 15(1), 5–12.
- Singh, K. and Yammiyar, P. (2008). *Establishing a User Centered approach to evaluate Indian market for m-commerce*—CAUE.
- Sreekumar, S. (2007). Biometric Authentication in Mobile Payments. Masters Thesis. University of Koblenz-Landau.
- Srivastava, S. C., Mathur, S. S. and Teo, T. S. (2007). Modernization of passenger reservation system: Indian Railways' dilemma. *Journal of Information Technology*, 22(4) 432-439.
- Taylor, S. and Todd, P. (1995). Understanding information technology usage: a test of competing models. *Information Systems Research*, 6 (3), 144–176.
- Tanakinjal, G.H., Deans, K.R., and Gray, B.J. (2010). Third Screen Communication and the Adoption of Mobile Marketing: A Malaysia Perspective. *International Journal of Marketing Studies*, 2(1), 36-47.
- Tan M. and Teo T.S.H. (2000). Factors Influencing the Adoption of Internet Banking. *Journal of the Association for Information Systems*, 1(5) 1-42.
- Teo, T.S.H. and Pok, S.H. (2003). *Adoption of WAP-enabled mobile phones among Internet users*. *Omega*, 31, 483 – 498.



- Tornatzky, L.G., and Klein, K.J. (1982). Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings. *IEEE Transactions on Engineering Management*, 29(1), 28-43.
- Venkatesh, V., Morris, M.G., Davis, G.B., and Davis, F.D. (2003). User Acceptance of Information Technology: Toward a Unified View, *MIS Quarterly*, 27(3), 425-478.
- Ungan, M. (2004). Factors affecting the adoption of manufacturing best practices. *Benchmarking: An International Journal*, 11(5), 504-520.
- Wang, Y-M., Wang, Y-S., and Yang, Y-F. (2010). Understanding the determinants of RFID adoption in the manufacturing industry, *Technological Forecasting and Social Change*, 77 (5), pp. 808-815.
- Worster, A., Fan, J. and Ismaila, A. (2007). Understanding linear and logistic regression analyses, pedagogical tools and methods. *CJEM*, 9(2), 111-113.
- Wu, J-H and Wang, S-C (2005). What drives mobile commerce?: An empirical evaluation of the revised technology acceptance model. *Information and Management*, 42(5), 719-725.
- Yang, H-D. and Choi, I. (2001). Revisiting technology acceptance model with social influence factors, in *PACIS 2001 proceedings*. Paper 35.
- Yu-Hui, Li. (2008). An empirical investigation on the determinants of E-procurement adoption in Chinese manufacturing enterprises, in *international conference on management science and engineering (15th)*, 32-37.