Investigating Effective Factors and Presenting a Practical Guideline to Adoption of Mobile Ticketing

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Abstract

Methods of doing business have seen changes during the recent years (Ngai & Gunasekaran, 2007). Use of internet, wireless technology, mobile networks and devices has brought new opportunities for different businesses to offer a variety of products and services. This way of doing business via mobile networks by the use of mobile devices is so-called as mobile commerce (m-commerce) (Tsangatidou & Pitoura, 2001). It also can be regarded as a subset of e-commerce (Coursaris & Hassanein, 2002). One of the reasons for this growth in the popularity of wireless services is their convenience (Rao & Minakakis, 2003). Phones and personal digital assistants increase the availability, frequency and speed of communication (Scharl et al., 2005).

Lots of theories have been developed to explain the adoption of technology by the users but little research has been done for the adoption and customer intention to use mobile ticketing. The objective of this research is to study mobile ticketing in Tehran metro transportation system as one of the applications of mobile commerce. This study will answer three important questions about the important factors effective in customer use intention and adoption of mobile ticketing, the most important factors involved in the adoption and practical guidelines which the implementers should take into consideration before the launch of this system.

The conceptual framework is based on a study by Mallat et al. (2008) is mainly based on two models, Technology Acceptance Model (TAM) developed by Davis (1989) and Innovation Diffusion Theory (IDT) by Rogers (1983). The research approach is mainly quantitative. To design the research a library research has been done to find the best models, besides interviews with 6 experts to approve the conceptual research framework so this section is involved with exploration. Then a questionnaire was designed and distributed to 600 metro passengers. 138 questionnaires were eliminated and 462 questionnaires were accepted so the response rate equals to 77%.

The data collected from the distributed questionnaires were analyzed using the SEM (Structural Equation Modeling) method. The results of the analysis show that first; all the factors are reliable and valid for the analysis by testing them with Kaiser-Meyer-Olkin
(KMO) and Bartlett’s tests and the communalities table. Second; their causality relationships were tested to answer the research hypotheses. The results show that prior experience is the most effective factor, and mobility, ease of use, risk, perceived usefulness, trust and use context are also important factors in the use intention at a lower level. These results also show that effect of compatibility, cost, social influence and attitude on customer use intention of mobile ticketing is really low.

Based on the results of the analysis, customers should be offered the service before complete adoption and use intention of the service. Also, mobile networks of the mobile operators should be strengthened in a way that ensures the anytime, anyplace purchase will be achieved by the customer which can be considered as the mobility issue. The interface should be user-friendly and easy to work with because the ease of use is an important factor for the customers. As well, mobile wireless networks infrastructure, mobile middleware and wireless user infrastructure, all should support the system use in order to satisfy the customers and result in their frequent use of the system.

Theoretically, a wide range of literature review of mobile commerce, applications use intention and adoption is given in this study which will be helpful for academic applications. From the business point of view, this study suggests guidelines which are helpful in the successful implementation and launch of the mobile ticketing system.

Key words: wireless technology, mobile networks, mobile commerce, mobile ticketing, transportation system, adoption, effective factors, use intention, prior experience, mobility, ease of use, risk, perceived usefulness, trust, use context, compatibility, cost, social influence ,attitude, Technology Acceptance Model , Innovation Diffusion Theory, Tehran metro passengers, Structural Equation Modeling, guidelines
Acknowledgements

Moving each step forward, I achieved the understanding as to the sweetness of endeavor to gain knowledge. I appreciate God to have bestowed such a chance to enjoy the beauty of search for knowledge and exploration of mysteries.

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Finally, I want to thank my family for their non-stop supports in every single moment of my life, especially my kind parents,” THANKS.”
List of Abbreviations

CHTML : Compact Hypertext Markup Language
GPRS : General Packet Radio Services
GSM : Global System for Mobile Communications
IDT : Innovation Diffusion Theory
M-commerce : Mobile Commerce
M-banking : Mobile Banking
PC : Personal Computer
RFID : Radio Frequency Identification
SMS : Short Message Service
SEM : Structural Equation Modeling
TRA : Theory of Reasoned Action
TPB : Theory of Planned Behavior
TAM : Technology Acceptance Model
UTAUT : Unified Theory of Acceptance and Use of Technology
WAP : Wireless Application Protocol
WML : Wireless Markup Language
WLAN : wireless local area network
XML : e-Xtensible Markup Language
1 G : 1st Generation
2 G : 2nd Generation

Constructs Abbreviations List

PU : Perceived usefulness
EOU : Ease of use
ATT : Attitude
CP : Compatibility
PEX : Prior experience
SOI : Social influence
COS : Cost
TR : Trust
RIS : Risk
MOB : Mobility
USC : Use context
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1. Chapter One

Introduction and Preliminaries

1.1. Introduction and Preliminaries

In this chapter the topic of the research introduced. Then the background of the study as well as the differences between mobile commerce and e-commerce are presented successively. At last the research problems, research objectives, research method, research contribution and disposition of the research are introduced.

1.2. Introduction

From the 1990s onwards, we have been witnessing a great shift in methods of doing business with the emergence of the electronic commerce (Ngai and Gunasekaran, 2007).

There is no doubt that the use of wireless and mobile networks and devices is growing. Advances in wireless network technology and the continuously increasing number of users of hand held terminals make the later a new channel for offering
personalized services to mobile users and give pace to the rapid development of e-commerce conducted with portable devices (Tsalgatidou and Pitoura, 2001) nowadays called mobile commerce. The fast growth of the mobile telephone population, with the development of wireless technologies, makes m-commerce become increasingly important to many businesses nowadays (Hung et. al, 2003).

Mobile commerce can be viewed as a subset of e-commerce (Coursaris and Hassanein, 2002) and refers to any transaction with monetary value that is conducted via a mobile network (Clarke, 2001). The term also refers to commercial transactions conducted through a variety of mobile equipment over a wireless telecommunication network in a wireless environment (Coursaris and Hassanein, 2002; Gunasaekaran and Ngai, 2003).

As noted by Leon mobile commerce has the potential of serving customers in wireless environments for both business and pleasure (Leon, 2004). Technical advances have provided users with powerful and affordable computing and communications devices such as Personal Digital Assistants (PDAs) and cellular phones.

Mobile media transcend traditional communication and support one-to-one, many-to-many and mass communication (Hoffman and Novak, 1996).

Rao and Minakakis state that the convenience of the wireless devices is the biggest reason for the growing popularity of wireless services (Rao and Minakakis, 2003). The ‘mobile’ Internet is growing at an astonishing rate, and is expected to surpass the desktop-based Internet in a few years (Lee and Benbazat, 2003). One reason which is mentioned by Scharl et al. is that phones and personal digital assistants increase the availability, frequency and speed of communication. Yet the technology associated with these devices, which let marketers personally communicate with consumers, continues to evolve. (Scharl et al, 2005)

Sadeh states that a technological frontier m-commerce has novelty, rapid growth, and potential applications (Sadeh, 2002).

Considering the potentials of m-commerce applications, many organizations have been allocating remarkable resources on these technologies to deliver value added, interactive, and/or location-based mobile services such as banking, content download, emergency/ roadside assistance, etc to customers (Lin and Wang, 2006).
Current e-commerce providers, engaged through mobile devices, will find advantage in developing unique m-commerce value propositions founded upon the specific dimensions of ‘always on,’ location-centric, convenience, customization, and identifiability (Wen and Mahatanankoon, 2004).

1.3. Research Problem and Questions

There has been little research regarding adoption of wireless or mobile devices, but there is a solid foundation of theories and previous studies on technology adoption (Kleijnen et al., 2003).

As noted by Keen and Mackintosh, the demand side of m-commerce is a search for value and hence there is a need to build an understanding of the elements and special features of wireless electronic channels that are value-adding from the consumer’s point of view (Keen and Mackintosh, 2001).

Every company entering the mobile space has the same goal—leveraging this channel to create customer value. Customers are thus asking for proofs that the adoption of mobile services will add value to their lives and/or businesses and respectively, to their consumers. (Kleijnen et al., 2003).

According to Taga and Karlsson m-parking solutions have gained interest, and other small payments like m-ticketing for public transportation will continue to make up the vast majority of sales via mobile phones (Taga and Karlsson, 2005).

Yang explored potential impacts of various individual characteristics (such as age, gender, innovativeness, and past adoption behavior) on perceived usefulness and ease of use (Yang, 2005) which are effective on the total use intention and adoption of the mobile service. Wu and Wang considered perceived risks, cost, and compatibility within m-commerce and found compatibility to be the most important determinant of intention to use the technology (Wu and Wang, 2005).

Considering the stated factors effective in the adoption of m-commerce, and based on the case of analysis which is mobile ticketing by metro users the research questions would be:

- What are the constructs effective on the customer adoption and intention to use mobile ticketing in public transportation?
What are the most important factors involved in the customer acceptance and intention to use a mobile ticketing service?

What measures should service providers take to handle the adoption of mobile ticketing by their customers?

1.4. Research Objectives

Based on the research questions, the main objectives of this research are introduced below:

- To identify the key elements in the mobile commerce applications adoption based on the literature
- To identify the effective factors in the adoption of mobile ticketing based on the literature
- To measure the effective factors involved in the adoption of mobile-ticketing services
- To provide a few practical guidelines and recommendations for effective and efficient application of mobile ticketing by the Iranian public transportation systems

1.5. Research Background

Many classify the 1990s as the decade of the Internet, and propose to label the first decade of the 21st century as the decade of mobile computing and mobile commerce (Mahatanankoon et.al, 2005). According to Tsalgatidou and Pitoura mobile electronic commerce becomes interesting with the huge increase in the web-based business-to-consumer e-commerce in Internet since 1995 and the simultaneous and huge growth of digital wireless telecom networks throughout the world (Tsalgatidou and Pitoura, 2001). As stated by de Haan mobile devices have been the fastest adopted consumer products of all time with more mobile phones shipped than automobiles and PCs combined (de Haan, 2000).

In the past, these mobile devices or technologies were regarded as a kind of luxury for individuals. However, this situation has changed. The market for mobile technologies has seen significant growth in the past few years (Kumar and Stokkeland, 2003).
Pagani, categorizes the history of mobile communication technologies into first generation (1G), second generation (2G), enhancement of second generation (2.5G), third generation (3G), three point five (3.5G), fourth generation (4G) (Pagani, 2005).

Considering the recent developments in the wireless technology and increasing capabilities of the technology, lots of opportunities have been created for e-commerce providers to expand beyond the traditional limitations of the personal computers. This is creating a new opportunity for the growth of m-commerce. The decision by a company to utilize cell-phones in its business is in essence a technology adoption issue. A number of theories have been developed to help explain the concept of technology adoption (Kleijnen et al., 2003).

According to Kleijnen et al. little research has been done regarding adoption of wireless (mobile) devices, but there is a solid foundation of theories and previous studies on technology adoption (Kleijnen et al., 2003).

In this research mobile ticketing as one of the applications of mobile commerce is chosen and going to be discussed in, Tehran metro, an Iranian transportation company.

1.6. Research Method

Because the nature of this research is both exploratory and explanatory, both a qualitative and quantitative approach has been assigned to do the research. The nature of this research is to evaluate the effective factors in the customer use intention and adoption of mobile ticketing service. To acquire a good insight about the research problem and question a library research has been done about mobile commerce and mobile ticketing literature as well as personnel interviews with Iranian experts to identify different models and shape a comprehensive and useful theoretical frame-work, so the research approach is exploratory. Then the chosen framework will be examined and relationships between variables will be discussed by an explanatory method. To achieve this structural equation modeling will be selected for the analysis by the use of SPSS software package. Overall 6 interviews have been conducted and 462 acceptable questionnaires have been collected.

1.7. Research Contribution

Contributions of this research can be categorized into three different areas:
Theoretically a wide literature review of mobile commerce and its applications is given also one of its major applications which are identified as mobile ticketing is introduced. Also, in the literature review two different models which have been applied in the adoption of mobile commerce applications are introduced and different factors involving the adoption of mobile commerce are investigated.

From the methodology point of view, it is both exploratory and explanatory. It is exploratory because all over this research it has been tried to identify different factors involving the adoption of mobile ticketing by customers. Also, it is explanatory because of the aim to analyze the effects of different factors on the adoption process by the users.

In the application this research is contributed to one of the most recent advantages of mobile commerce which is mostly applied in the public transportation system, so-called as mobile ticketing.

1.8. Disposition of the Thesis

The research is structured by five respective chapters as shown in Figure 1.1. The first chapter consists of introduction, background, research problem and research questions as well as research contribution. The second chapter consists of the literature review, theoretical framework and the research model. The third chapter indicates the research methodology applied in the current study. In chapter four the data analysis and the results will be presented and in the final chapter the discussion, conclusion and future research will be presented.

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**Figure 1.1: Research Structure**

<table>
<thead>
<tr>
<th>Introduction and Preliminaries</th>
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<tbody>
<tr>
<td>Theoretical Review</td>
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<tr>
<td>Research Methodology</td>
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<tr>
<td>Data Analysis and Results</td>
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<tr>
<td>Conclusion and Implementation</td>
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2. Chapter Two

Theoretical Review

2.1. Introduction

The previous chapter introduced the research objectives, research problem and questions, research method, contribution of the research and limitations confronting the research. The objective of this chapter are to provide an insight to the research area and to review relevant literature in the research based on the scope and main questions of the research. First we discuss concepts related with mobile commerce specifically definition of mobile commerce, then we discuss about the differences between mobile commerce and e-commerce to make the benefits of mobile commerce stand out. Second in this chapter mobile ticketing, as one of the applications of mobile commerce, will be discussed and different factors which have been discussed to be effective on customer use intention in mobile commerce will be reviewed. Finally the research frame which is based on the pilot
interviews with experts professional in customer adoption mobile services will be discussed.

2.2. Mobile Commerce

With the growth in the acceptance and adoption of mobile devices worldwide the applications related with these devices is also growing. As stated by de Haan, with more mobile phones shipped than automobiles and PCs combined, mobile devices have been the fastest adopted consumer products of all time (de Haan, 2000).

While m-commerce (mobile commerce) is not conveying the pledges that many experts had declared just a few years ago in terms of providing extraordinary commercial functionality to the masses (Malladi and Agrawal, 2002) it is yet assumed to be one of the main driving forces for next generation computing and a major revenue generating platform for many corporations.

Tsalgatidou and Pitoura define mobile commerce as any type of transaction of an economic value that is conducted through a mobile terminal that uses a wireless telecommunications network for communication with the e-commerce infrastructures. Also, they interpret it as e-commerce activities solely or partially relying on mobile e-commerce transactions (Tsalgatidou, Pitoura, 2001).

Jarvenpaa et al. give the definition of mobile commerce as “transaction via wireless device and data connection that results in a transfer of information, services, and/or goods” (Jarvenpaa et al., 2003).

Sadeh states that a technological frontier m-commerce has uniqueness, potential applications, and rapid growth (Sadeh, 2002). The arrival of location-based services enables m-commerce to be more leveraged so that the mobility aspect is taken advantage of rather than just repackaging old applications in a new format (Rao and Minakakis, 2003). Mobile media transcend traditional communication and support one-to-one, many-to-many and mass communication (Hoffman and Novak, 1996).

In the past, mobile devices or technologies were regarded as a kind of luxury for adopters and users. However, the situation has changed. The market for mobile technologies has seen significant growth in the past few years (Kumar and Stokkeland, 2003).
This will bring a proof to the statement of many experts who classify the 1980s as the decade of the PCs, the 1990s as the decade of the Internet, and propose to label the first decade of the 21st century as the decade of mobile computing and mobile commerce (Mahatanankoon et.al, 2005). Based on the researches and numbers this is becoming more real. The mobile penetration rate is growing rapidly worldwide. In Iran this trend has got the same growth. Table 2.1: indicates this trend in Iran.

2.2.1. Trends in Mobile Communication Technologies

Mobile phones were once considered a luxury, but are now taking the place of conventional telephones in residential use (Kumar and Zhan, 2003). One of the reasons for this worldwide trend is that, nowadays, with the volatile growth of the mobile telephone population, combined with the development of wireless technologies, m-commerce is becoming increasingly important to many individuals (Hung et. al, 2003). Also, wireless networks sets users free from the ties that have bound them to their desk, enabling them to live and work in more flexible and convenient ways (Kumar and Zhan, 2003). As stated by Kippenberger, the market for mobile technologies has seen significant growth in the past few years (Kippenberger, 2000).

Mobile networks and devices have been facing many developments during the last decades. These advances and maturities facilitate e-commerce conducted from a wired network to a wireless network (Ngai and Gunasekaran, 2007).

With the increasing developments in the wireless and mobile networks technologies more and more applications are offered to the customers (Table 2.2).

Table 2.1: Growth of mobile technology in Iran

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile users</td>
<td>9,200</td>
<td>60,000</td>
<td>3,500,000</td>
<td>20,000,000</td>
</tr>
<tr>
<td>SMS users</td>
<td>0</td>
<td>0</td>
<td>15,000</td>
<td>20,000,000</td>
</tr>
</tbody>
</table>

Source: (Shantiayi, 2008)

Table 2.2: Mobile Communication Technologies Eras
<table>
<thead>
<tr>
<th>No.</th>
<th>Generation</th>
<th>Decade</th>
<th>Features</th>
</tr>
</thead>
</table>
| 1   | 1<sup>st</sup> Generation | 80-Mid 90s | ● Simplest communication networks  
● Voice service only  
● Analog frequency  
● Inconsistent  
● Loss of signal  
● Limited customer base |
| 2   | 2<sup>nd</sup> Generation | Mid 90s-2000s | ● Digital frequency  
● High quality and secure mobile voice  
● Fax and messaging services  
● Worldwide roaming service |
| 3   | 2.5 Generation   | Early 2000s | ● Include GPRS & EDGE Services  
● Visual & multimedia messaging  
● Location based services  
● Colored internet browsing  
● High Speed Circuit Switched Date (28.8 kbps speed) |
| 4   | 3<sup>rd</sup> Generation | Early 2000s | ● Extortionate fees  
● Will be a stepping-stone towards global mobile convergence  
● Bases and IP-Core network infrastructure |
<p>| 5   | 3.5 Generation   | Expected around 2010 | ● Promises high rate data transfer (about 10 Mbps and higher) |</p>
<table>
<thead>
<tr>
<th>6</th>
<th>4th Generation</th>
<th>Expected 2010–2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voice data integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support for mobile and fixed networking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enhanced services through the use of simple networks with intelligent terminal devices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flexible method of payment for network connectivity</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mobile Satellite Networks</td>
<td>Launch is not mentioned yet</td>
</tr>
<tr>
<td></td>
<td>Ubiquitous access to voice and data services anywhere in the world</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accurate positioning information used to provide location sensitive information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Access to IP-based networks including internet and corporate data networks</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Olla, 2005)

The spread of wireless capability has brought an opportunity for e-commerce providers to expand beyond the traditional limitations of the PC. Provoked by such enabling technologies as 3G broadband capability, XML, CHTML, WML, WAP, GPRS and Internet ready mobile terminals, “The wireless world is a parallel universe almost as large as the Net, and the two are beginning a fascinating convergence,” (Rao, 2000).

This is creating a new opportunity for the growth of m-commerce. The decision by a company to utilize cell phones in its business processes is in essence a technology
adoption issue. A number of theories have been developed to help interpret the concept of technology adoption (Kleijnen et al., 2003).

Little research has been done regarding corporate adoption of wireless (mobile) devices, but there is a firm foundation of theories and previous studies on technology adoption (Kleijnen et al., 2003; Van Akkeren and Harker, 2003).

2.2.2. Differences between M-commerce and E-commerce

Many mobile devices today can access the internet allowing the user to participate in typical e-commerce activities, like Yahoo shopping (Webwereld, 2005). However, there are still characteristics separating e-commerce and m-commerce despite m-commerce “catching” up to ecommerce in terms of possibilities. According to Gordon and Gebauer mobile commerce applications not only cover the e-commerce provided applications but also include new ones such as, some tasks that are not feasible for electronic commerce, such as mobile inventory tracking and dispatching, are possible for mobile commerce (Gordon and Gebauer, 2001).

Table 2.3 shows the m-commerce and e-commerce capabilities of a standard GSM mobile phone, a smart phone, and a PC.

Anckar and D’Incau argue that the popularity of m-commerce cannot simply be measured by the popularity of mobile devices, just as the popularity of wired e-commerce cannot be calculated by the popularity of computers (Anckar and D’Incau, 2002).

Mobile electronic commerce has a number of businesses, technical and legal implications that are different from e-commerce in the fixed internet setting. Most notably, location based products and services are a completely new business, technical, and legal area that is typical only of mobile electronic commerce (Tsalgatidou and Pitoura, 2001).

Table 2.3: M-commerce and e-commerce capabilities table

<table>
<thead>
<tr>
<th>E-commerce Versus M-commerce</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>E-commerce Features and Characteristics</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Benefits of Mobile Commerce</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>- Done via accessing the internet</td>
</tr>
<tr>
<td>- Extends the benefits of the web</td>
</tr>
<tr>
<td>- Can be done while staying still</td>
</tr>
</tbody>
</table>

- Can access the internet allowing the user to participate in typical e-commerce activities, like Yahoo shopping (Webwereld, 2005).
- In wireless/mobile application design allow for a more usable and user-friendly environment for conducting m-commerce (Lee & Benbasat, 2003).
- Extends not only benefits of the web but also allows for unique services and additional benefits when compared to traditional ecommerce applications (Tsalgatidou & Pitoura, 2001).
- Can be achieved any-time, anywhere, and even on the move (Ngai & Gunasekaran, 2007).

### 2.2.3. Mobile Commerce Applications

M-commerce offers a wide range of new mobile applications to consumers, makes life more convenient and provides easy access to information from a mobile phone (Hussin et al., 2005). Yet, not much research has been conducted on the applications and strategies of m-commerce (Ngai and Gunasekaran, 2007).

These days many e-commerce transactions are conducted through mobile devices (e.g., cellular phones, hand-held or palm-sized computers, and even vehicle mounted interfaces) applying wireless telecommunications networks and other wired e-commerce technologies. They are referred to as mobile commerce. The possible potentials of these m-commerce applications have increased rapidly in the last little while, leading many organizations to make huge investments on these technologies (Wang and Liao, 2007).
Mobile devices that are of interest to mobile electronic commerce can be divided into four categories based on their processor, memory and battery capability, application capabilities (SMS, WAP, Web, I-mode), as well as physical size and weight. These categories are illustrated, from weakest to strongest, in Table 2.4.

Weaknesses and strengths of mobile sets’ capabilities affect directly the applications which can be applied by the mobile device user. According to Mennecke and Strader m-commerce applications require the support of technology from the foundation of wireless user infrastructure, mobile middleware, and wireless network infrastructure (Mennecke and Strader, 2003).

Table 2.4: Interested Mobile Devices

<table>
<thead>
<tr>
<th>No.</th>
<th>Type</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>usual voice handsets with SMS capability</td>
<td>Weak capabilities</td>
</tr>
<tr>
<td>2</td>
<td>WAP phones</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>communicators/PDA with wireless communication capability</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>laptops with wireless communication facilities</td>
<td>Strong capabilities</td>
</tr>
</tbody>
</table>

Source: (Tsagatidou and Pitoura, 2001).

According to Ngai and Gunasekaran, m-commerce applications have two major characteristics: mobility and broad reach. Mobility implies portability, e.g., users can conduct business real time via mobile devices. With m-commerce, people can be reached at any time via a mobile device (Ngai and Gunasekaran, 2007). In this study, m-commerce refers to the conduct of commerce via wireless devices.

According to Mahatanankoon et al. the portability of mobile devices offers new business applications different from the scope of fixed, desktop-based internet offerings (Mahatanankoon et al., 2005). They categorize m-commerce operations into two modes:
- content delivery (notification and reporting) mode
- transaction (purchasing and data entry) mode

Table 2.5 gives the definition and explains the characteristics of these two modes.

On the one hand, they found out that content delivery applications were generally accompanied by consumers’ sense of ‘always-on’ and convenience, and concluded that being constantly connected to the internet provides consumers with the most preferable value-added benefits.

**Table 2.5: M-commerce Operation Modes**

<table>
<thead>
<tr>
<th></th>
<th>Content Delivery Mode</th>
<th>Transaction Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition/Characteristics</strong></td>
<td>• This operation notifies and reports important content messages to consumers such as sports news and personalized financial news.</td>
<td>• This operation runs business transaction over the wireless Internet. Consumers can browse through the catalog and order products on mobile devices.</td>
</tr>
<tr>
<td><strong>Promotion Measures/Ways</strong></td>
<td>• Notifying customers when they have been outbid in an auction that is about to close; • Delivering sports news; financial news, and personalized information; • Offering ring-tones and other downloads to m-phone customers; and</td>
<td>• Using micro-payment technology in transactions involving vending machines, tickets, trains or taxi fares; • Automating ubiquitous online auction</td>
</tr>
</tbody>
</table>
Using the Web as a cost-effective way to augment its core products with related information and service functions

- Charging a fee for mobile games, entertainment, and fun; and
- Providing convenience to implement a transaction at any time or place

<table>
<thead>
<tr>
<th>Application Samples</th>
<th>Issuing electronic payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending or receiving e-mails, searching for specific information,</td>
<td>Buying products from physical shops</td>
</tr>
<tr>
<td>Receiving time sensitive news</td>
<td>Transferring money from a preconfigured bank account</td>
</tr>
<tr>
<td>Receiving weather report.</td>
<td></td>
</tr>
<tr>
<td>Personalized financial news</td>
<td></td>
</tr>
<tr>
<td>Premium games</td>
<td></td>
</tr>
<tr>
<td>Mobile greeting cards</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Mahatanankoon et al., 2005)

On the other hand they figured out that in the transaction mode:

- Consumers’ concerns over the security and privacy of their mobile transactions remain high. Many location-based services, such as the ability to pinpoint the location of mobile users, reduce consumers’ sense of security and privacy.
- Many mobile applications include activities related to entertainment and social activities. Even though some of these applications were technologically feasible of being implemented, consumers did not value them highly (Mahatanankoon et al., 2005).

Durlacher identifies four main categories of applications for mobile devices including communication, information, entertainment, and transaction services. Communication services are the foundation of mobile services (Durlacher, 2001).
Varshney and Vetter identified several important classes of m-commerce applications including mobile financial applications, mobile advertising, mobile inventory management, locating and shopping for products, proactive service management, wireless re-engineering, mobile auctions or reverse auctions, mobile entertainment services and games, mobile offices, mobile distance education, and wireless data centers (Varshney and Vetter, 2002).

Clearly, these technologies will affect peoples’ lives in ways that have yet to be pictured. Indeed, if the internet experts are correct, few areas of our lives will remain untouched (Negroponte, 1995).

Sadeh and Gordon and Gebauer see major applications of mobile commerce in a number of categories which are shown in Table 2.6.

Mobile shopping, mobile ticketing and reservation, electronic signature, m-banking and electronic payment are very important applications for the development of m-commerce (Buellingen and Woerter, 2004).

Mobile applications, by definition, can be used in various locations, meaning that the context of the application and the device must be taken into account when looking at usability.

Mahatanankoon et al. in their research studied a number of mobile commerce applications for customer perception and they found out that not all applications had the same level of importance for the users and that the users perceived some of them as the most important and beneficial applications of the mobile commerce and the others as less important (Mahatanankoon et al., 2005).

<table>
<thead>
<tr>
<th>Mobile Category</th>
<th>Major Applications</th>
<th>Clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commerce</td>
<td>Mobile Transactions and payments</td>
<td>Businesses</td>
</tr>
<tr>
<td>Education</td>
<td>Mobile classrooms and labs</td>
<td>Schools and training centers</td>
</tr>
<tr>
<td>Enterprise resource planning</td>
<td>Resource management</td>
<td>All</td>
</tr>
</tbody>
</table>
### Table 2.7: Mobile Commerce Applications by the Level of Importance

<table>
<thead>
<tr>
<th>Mobile Commerce Applications</th>
<th>Perceived as the most important</th>
<th>Perceived as middle level of importance</th>
<th>Perceived as the lowest level of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reading or sending messages from/to a specific newsgroup</td>
<td>Chatting with others on the Internet</td>
<td>Sending or receiving e-mails</td>
</tr>
<tr>
<td></td>
<td>Reading downloaded e-books</td>
<td>Viewing or sending pictures via the Internet</td>
<td>Reporting (transmitting information)</td>
</tr>
<tr>
<td></td>
<td>Paying a parking ticket on the spot</td>
<td>Calendaring and alerting Internet services (not using internal mobile functions)</td>
<td>Emergencies based on location (e.g., roadside assistance, accidents, etc.)</td>
</tr>
<tr>
<td></td>
<td>Posting or viewing on-line classified ads</td>
<td>Listening to music from the Internet, including</td>
<td>Searching for</td>
</tr>
<tr>
<td></td>
<td>Reserving a restaurant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: (Sadeh, 2002; and Gordon and Gebauer, 2001)

Table 2.7 illustrates different categories of mobile commerce applications by the level of importance to the customer.
<table>
<thead>
<tr>
<th>table</th>
<th>downloaded MP3 songs</th>
<th>specific information on the Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>實際 錢票（e.g., e-coupon 基於即將 營業）</td>
<td>跟蹤產品和 服務的位置</td>
<td>使用目錄 服務（e.g., Google 搜索, 黃頁, 等.),</td>
</tr>
<tr>
<td>觀看從互聯網 製作的視頻</td>
<td>轉移銀行帳戶 (自動)</td>
<td>電腦災害信息（e.g., 人際上 援, 高速修路, 等.),</td>
</tr>
<tr>
<td>買一束飲料</td>
<td>練習銀行服務（付帳單,</td>
<td>使用互聯網 搜索引擎（e.g., yahoo, lycos, hotbot, 等.),</td>
</tr>
<tr>
<td>在自動售貨機 中付款</td>
<td>購物於網際</td>
<td>在交通 堵塞, 機場, 或 機會中與移動裝置一起工作</td>
</tr>
<tr>
<td>填寫和 發送損害報告（申報文件）</td>
<td>設定網站</td>
<td>接收時間 敏感的文件或 信息，包括天氣 報告，金融 信息，交通 信息，等.</td>
</tr>
<tr>
<td>參加網際拍賣</td>
<td>格式化於顯示於移動裝置</td>
<td>共享數位 文件或 个人信息於 直系，家族，或 陌生人</td>
</tr>
<tr>
<td>接收位置 敏感的折扣票</td>
<td>下載 MP3 歌曲</td>
<td></td>
</tr>
</tbody>
</table>
about a new lower fare
- Managing in-house and inventory-on-move
- Trading stocks and initiating a request to have the money transferred
- Controlling home appliances (heating system, car, etc.) through remote activation
- Conducting advanced banking services (e.g., loan negotiations, ordering credit cards)
- Receiving personalized shopping offers
- Receiving personal advertisements

- Reading and receiving news (through subscription service or browsing)
- Surfing the Internet casually
- Managing personal appointments and meetings through Intranet/Internet

Source: (Mahatananakoon et al., 2005)

The results of this study which was done in the US show how the trends are towards the use of mobile commerce applications.

**2.2.4. Mobile Commerce Application Requirements**

In order to apply a technology there are a few needs that are to be met in order to provide the basements for implementations. Hereby, basic requirements in the implementation of mobile commerce applications are introduced.
Basically the application needs of the mobile commerce implementation are divided into three categories including wireless network infrastructure, mobile middleware, and wireless user infrastructure.

2.2.4.1. Wireless Network Infrastructure

Wireless network infrastructure is one of the pillar technologies of m-commerce that supports the development of m-commerce applications. Wireless network infrastructure plays an important role in m-commerce as this is the core part of m-commerce technology (Staton, 2001). Network infrastructure provides essential voice and data communication capability for consumers and vendors in cyberspace. Evolving from electronic commerce to mobile commerce, it is necessary for a wired network infrastructure, such as the internet, to be augmented by wireless networks that support mobility for end users (Staton, 2001).

Wireless networking technologies are advancing at a tremendous pace, and each represents a solution for a certain phase, such as 1st Generation, 2nd Generation, and 3rd Generation, in a particular geographical area, such as the United States, Europe, or Japan (Hu et al.,2004). They provide wireless networks and network standards such as the Global System for Mobile Communication (GSM), Bluetooth, the wireless local area network (WLAN), radio frequency identification (RFID), the Third- generation (3G) network, etc.( Ngai and Gunasekaran,2007). Ngai and Gunasekaran also state that in order to ensure the reliability and efficiency of the m-commerce applications and services running in a mobile environment, necessarily, all networking requirements should be implemented in the wireless and mobile networks.

2.2.4.2. Mobile Middleware

Mobile middleware refers to the software layer between the wireless networks and the operating systems of the mobile devices to connect the m-commerce applications (Varshney and Vetter, 2002). According to Geihs the term refers to the software layer between the operating system and the distributed applications that interact via the networks. The most important role of a middleware layer is to conceal the beneath networked environment's complexity by covering applications from plain protocol
handling disjoint memories, data replication, network faults, and parallelism (Geihs, 2001).

Because of its function this issue is crucial to driving applications. Saha et al. describes the function of mobile middleware as translating requests from mobile stations to a host computer and adapting content from the host to the mobile station (Saha et al., 2001).

2.2.4.3. Wireless User Infrastructure

Wireless user infrastructure consists of two parts, i.e., software and hardware (Mennecke and Strader, 2003). Software refers to the operating systems and their interfaces while hardware means the mobile devices to communicate with the m-commerce applications, such as PDAs and mobile phones. Two issues relating to wireless user infrastructure were identified in this category. ‘Mobile interfaces’ which consist of interface designs or issues relating to the mobile applications or devices. A well-designed and usable interface is relatively difficult to achieve in a mobile environment because the mobile applications normally execute on a small and portable mobile hand-held device. Corresponding guidelines for designing suitable mobile interfaces are necessary. Clearly, the classification cluster, ‘Mobile handheld devices’ covers the area related to mobile devices (Ngai and Gunasekaran, 2007).

2.3. Mobile Ticketing in Public Transportation

Public transportation ticketing systems, especially subway transportation system in Tehran which serves more than 1,300,000 customers a day, should be able to handle large volumes of passenger transactions while providing the minimum possible impedance to travel. Therefore, it is hardly surprising that some of the world’s busiest public transportation systems are at the forefront of electronic payment and mobile ticketing technologies.

According to Chen and Lu digital ticket service is a beneficial application of mobile commerce (Chen and Lu, 2004). The mobile ticketing service has been applied in a few European countries such as England, Germany and Spain successfully and has attracted more and more companies in applying the same service and offering it to their
customers. The mobile ticketing system used customer’s mobile hand set to purchase public transport tickets, instead of special devices owned by the transport operators (Bohm et al., 2005). Me mentions mobile ticketing for transportation systems as a beneficial service besides other mobile ticketing services such as flights, concerts, cinemas, museums, sports events, solariums and gyms (Me, 2003). The benefits as mentioned by Chen and Lu could be reduced time for waiting and, reduced risk of storing tickets (Chen and Lu, 2004).

An instance of this service is Helsinki tram transportation system. Mallat et al., in their study described the mobile ticketing service provided by the public transport system in Helsinki, Finland as a short message (SMS) based system for selling public traffic tickets (Mallat et al., 2008).

The simplest system for mobile ticketing applies SMS to send the request and the ticket information. Because almost all types of cell phones whatever made or operating system their performance is based on, including windows or Java are able to send and receive short messages easily. The user in demand of a mobile ticket sends a number code via SMS to the operating system then the operating system will process the order and fulfill the order by sending back an SMS which includes a barcode as the content of the demanded ticket. Then the customer can show the barcode on the screen and put it on a scanner reader at the gate which will read the barcode information and in case the information is correct it will let the gate open and the customer can check-in.

2.4. Tehran Urban and Suburban Railway Operation Company (Tehran Metro)

Preliminary studies including Tehran’s socio-economic and traffic condition and forecast from 1971 up to 1991 began by Sofretu and RATP companies. The final report with a so-called (street-metro) proposal was tendered. The street-metro system recommended a road network with a loop express way in the central area and 2 highways for new urban areas and a 7-line metro network which were complemented by bus network and taxi services.

By the year 1975 the law of “Establishment of Tehran Urban and Suburban Railway Co. (Metro)” was ratified. Geological land surveying and executive studies started by 1976. By the year 1999, Tehran – Karaj suburban line (Line 5) was officially inaugurated and in
2000 the first urban line was mobilized. Now, with 4 active lines and 55 stations Tehran Metro is serving more than 1,300,000 daily trips.

2.5. Mobile Commerce Adoption

Mobile devices have been among the fastest adopted consumer products of all times (Clarke, 2001).

There has not been much research about the user acceptance and use intention of mobile applications. Major researches which have been done for mobile commerce adoption have applied Technology Acceptance Model (TAM) introduced by Davis (1989) and Innovation Diffusion Theory (IDT) which has been developed by Rogers (1983).

As mentioned by Davis and Palen, the benefits of adopting mobile commerce for the user include removal of space and time constraints (Davis 2002; Palen, 2002).

Previous researchers on the adoption of mobile commerce and services adoption have applied different models. Most commonly applied models are TAM and IDT among the others. Table 2.8 shows a table of recent studies on mobile commerce services adoption and illustrates different models and factors applied in these studies.

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Year</th>
<th>Subject</th>
<th>Applied Models</th>
<th>Identified Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mallat et al.</td>
<td>2008</td>
<td>Mobile ticketing</td>
<td>TAM, Diffusion of Innovation, other factors in the literature</td>
<td>Ease of Use, Usefulness, Prior Experience, Compatibility, Social Influence, Attitude towards technology, Trust, Risk, Mobility, Use Context</td>
</tr>
<tr>
<td>2</td>
<td>Biljon and Kotze</td>
<td>2007</td>
<td>Building A Conceptual Model for Mobile Commerce Adoption</td>
<td>MOPTAM</td>
<td>Social influence, Perceived usefulness, Perceived ease of use, Facilitating conditions, Demographic factors, Socio-economic factors</td>
</tr>
<tr>
<td></td>
<td>Author(s)</td>
<td>Year</td>
<td>Title</td>
<td>Framework/Model</td>
<td>Factors</td>
</tr>
<tr>
<td>---</td>
<td>----------------------</td>
<td>------</td>
<td>--------------------------------------------</td>
<td>-----------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Mallat</td>
<td>2007</td>
<td>Mobile payment adoption</td>
<td>IDT</td>
<td>Relative advantage, Complexity, Compatibility, Trialibility, Observability, Network externalities, Security, Trust, Use situation</td>
</tr>
<tr>
<td>4</td>
<td>Turel et al.</td>
<td>2007</td>
<td>User acceptance of short messaging service</td>
<td>Perceived value</td>
<td>Performance quality value, Emotional value, Value for money, Social value, Perceived value,</td>
</tr>
<tr>
<td>5</td>
<td>Luaren and Lin</td>
<td>2005</td>
<td>Mobile Banking</td>
<td>Theory of Planned Behavior, TAM, other factors in the literature</td>
<td>Perceived Usefulness, Perceived Ease of Use, Perceived Credibility, Perceived Self-efficiency, Perceived financial cost</td>
</tr>
<tr>
<td>6</td>
<td>Bruner II &amp; Kumar</td>
<td>2005</td>
<td>Mobile Internet Adoption</td>
<td>TAM, Technology Adoption, Innovation, Fun</td>
<td>Customer Visual Orientation Internet Device (PC, Wireless Phone, PDA) Usefulness, Ease of use, Fun</td>
</tr>
<tr>
<td>7</td>
<td>Fan et al.</td>
<td>2005</td>
<td>Speech interface an enhancer to the acceptance of mobile commerce applications</td>
<td>TAM, and other factors available in the literature</td>
<td>Perceived usefulness, Perceived ease of use, Social influence, Confidence belief, Affective attitude</td>
</tr>
<tr>
<td>No.</td>
<td>Author(s)</td>
<td>Year</td>
<td>Application</td>
<td>Frameworks/Variables</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------------</td>
<td>------</td>
<td>--------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Wu and Wang</td>
<td>2005</td>
<td>Drivers of mobile commerce</td>
<td>TAM, DIT, Cost, Perceived risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Perceived usefulness, Perceived ease of use, Compatibility, Cost, Perceived risk</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hung et al.</td>
<td>2003</td>
<td>WAP services adoption</td>
<td>Theory of planned behavior, Diffusion of innovation theory, Information technology acceptance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Connection speed, Service cost, User satisfaction, Personal innovativeness, Perceived ease of use, Perceived usefulness, Peer influence, External influence, Facilitating condition, Self-efficacy, Facilitating conditions, Service costs, Attitude, Subjective norm, Perceived behavioral control</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Barnes and Huff</td>
<td>2003</td>
<td>I-mode adoption</td>
<td>TAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Relative advantage, Complexity, Trialibility, Observability, Image, Trust Subjective norm, Attitude</td>
<td></td>
</tr>
</tbody>
</table>

### 2.5.1. Theories on the Adoption of Mobile Applications and Services

Based on the application which has been chosen as the case of this study, metro ticketing application, the proposed research model of this study is based on two different research models which have been developed to study the intention to use mobile commerce applications.

Use intention in the information technology field is a valid predictor of use and adoption behavior, so it will be necessary to have an overview of the theories that will explain more about behavior and intention to use.
There are a number of models explaining the consumers’ behavioral intention and use intention of technology (Sendecka, 2006; Shantiyi, 2008).

- Theory of Reasoned Action (TRA; Fishbein and Ajzen, 1975)
- Theory of Planned Behavior (TPB; Ajzen, 1991)
- Technology Acceptance Model (TAM; Davis, 1989)
- Innovation Diffusion Theory (IDT; Rogers, 1983)
- Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003)

2.5.1.1. Theory of Reasoned Action

TRA is a widely studied model from social psychology which concerns the determinants of consciously intended behaviors (Fishbein and Ajzen 1975). It is the extended model of Fishbein’s multi-attribute model to account for the relationship between attitude and behavior (Shantiyi, 2008). According to TRA, a person's performance of a specified behavior is determined by his or her behavioral intention to perform the behavior, and is jointly determined by the person's attitude and subjective norm concerning the behavior in question. Behavior intention is a measure of the strength of one's intention to perform a specified behavior. Attitude is defined as an individual's positive or negative feelings (evaluative affect) about performing the target behavior (Fishbein and Ajzen 1975).

When attitude towards behavior is added as a new component it means that in order to predict a specific behavior it is necessary to measure an individual’s attitude towards performing the behavior, and not just general attitude towards the object at which the behavior is directed (Kassarjian and Robertson, 1991).

Subjective norm refers to the person's perception that most people who are important to him think he should or should not perform the behavior in question (Fishbein and Azen 1975).

Subjective norms are intended to account for social influences that the individual’s behavior is exposed to. So, performing a particular behavior is also influenced by other individuals’ opinions about the behavior. According to Venkatesh and Davis, the rationale for direct effect of subjective norms on intention is that people may
choose to perform a behavior, though they do not have trends towards the behavior or its consequences, if they believe one or more important individuals think they should and they are sufficiently motivated to comply with the important individuals (Venkatesh and Davis, 2000).

Subjective norm in itself is further composed of two factors, namely normative beliefs and motivation to comply. Normative beliefs are beliefs of a specific individual about what a person should or should not perform. Normative beliefs are in other words beliefs about what others expect. Motivation to comply is an individual’s motivation to comply with normative beliefs which are the beliefs that other specific individuals have (Shantiyai, 2008).

According to Davis et al. (1989) TRA is a general model, and does not specify the beliefs that are operative for a particular behavior. Researchers using TRA must first identify the beliefs that are salient for subjects regarding the behavior under investigation (Davis et al., 1989). Yet Venkatesh et al. believe that theory of reasoned action is one of the most influential theories of wide range human behavior (Venkatesh et al., 2003). Figure 2.1 shows the TRA conceptual model.

2.5.1.2. Theory of Planned Behavior

This theory has been developed by Ajzen 1991. In his theory Ajzen revised the Theory of Reasoned Action and suggested an extended form of perceived behavioral control. He defined the perceived behavioral control as “the perceived ease or difficulty of performing the behavior” (Ajzen, 1991). In a research done by Taylor and Todd the definition of perceived behavioral control is modified in the context of Information Systems research and is defined as “perceptions of internal and external constrains on behavior” (Taylor and Todd, 1995).

An additional determinant of intentions and behaviors, which is included, is perceived behavioral control. It is about the situations where people do not have a complete control over their behavior. It means that the behavior can be influenced by other factors than just the personal intention to perform the behavior and other individual’s opinion about the behavior such as that of Theory of Reasoned Action. Other
Individuals will perform a particular behavior based on the extent to which one possesses time, skills and money. So, whether or not a behavior is performed is based on the intention and availability of resources (Sendecka, 2006; Shantiyai, 2008).

Perceived behavioral control itself is broken into control belief and perceived power. Control beliefs are beliefs of resources and opportunities that can be either part of an individual’s previous experience with the behavior or can be influenced by second hand information which will increase or decrease the previous difficulty of performing the particular behavior (Ajzen, 1988; Sendecka, 2006; Shantiyai, 2008). Perceived behavioral control can be both weighted and not weighted like in other models.

Ajzen shows that attitudes, subjective norms, and perceived behavioral control are all related to the behavior intention in a positive way. Thus, behavior intention will predict the actual behavior of the customer (Ajzen, 1991).
This theory has been successfully applied to the acceptance and usage behavior of a variety of technologies. For instance, Harrison et al. summarize the wide range of settings (Sendecka, 2006, Shantiyai, 2008), Schifter used this theory to predict weight loss behavior. Ajzen and Maddan (1986) used it to predict students’ intention to attend classes and making good marks, also Mathieson (1991) predicted an individual’s intention to apply a specific information system. Figure 2.2 shows the TPB conceptual model.

2.5.1.3. Technology Acceptance Model

Technology acceptance model (TAM), introduced by Davis in 1989, was developed to predict end-user acceptance of information systems within the organizations (Davis et al.1989; Mallat et al., 2008). Several mobile commerce applications and services studies have applied Technology Acceptance Model (TAM) which is designed to predict user’s acceptance and/or use of information technology. It can be said that this model has become the most widely applied model for identifying the user acceptance of technology (Ma and Liu, 2004; Sendecka, 2006; Shantiyai, 2008). According to Venkatesh and Davis this model has become a well established, strong and powerful model for predicting user acceptance of a technology (Venkatesh et al., 2000).

This model has its roots in Theory of Reasoned Action and is specifically developed for user acceptance of technology. According to Ajzen, this theory is grounded in the theory of Reasoned Action and Theory of Planned Behavior (Ajzen, 1991). TAM provides a basis for tracing the impact of external factors on internal beliefs, attitude and intention (Davis et al., 1989; Shantiyai, 2008). The core of this theory lies in the hypothesis that intention to use a system is determined by two different variables which are “perceived usefulness” and “perceived ease of use”. Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort (Davis, 1989).

TAM theorizes that these two determining variables mediate the relationship between external variables, including system characteristics, development process,
training and intention to use a system (Venkatesh and Davis, 2000; Sendecka, 2006; Shantiyai, 2008). So, these two determinant factors are individual’s beliefs on information technology and form individual’s attitude towards technology which will, in turn, predict acceptance intention to use a technology. Figure 2.3 shows the TAM conceptual model.
According to Taylor and Todd the rationale behind these relationships is that the technology which is easy to use and particularly useful to an individual will have positive influence on the individual’s attitude and intention towards using the technology. Thus, the acceptance of the technology will increase (Taylor and Todd, 1995).

In his researches Davis found out that perceived usefulness had more correlation with the technology usage than ease of use. Also, he concluded that perceived ease of use influences the technology acceptance via perceived usefulness, rather than directly. The reason is that the easier the system is to use, the more useful it can be (Sendecka, 2006; Shantiyai, 2008).

Venkatesh and Davis extended the previous TAM model to TAM2 by including “subjective norms” as an additional variable effective on the individual’s acceptance of the technology (Venkatesh and Davis, 2000). The result of their study shows that subjective norms have significant direct effect on the individual’s use intention. Thus, they suggested that TAM2 provides a detailed evidence of the key factors behind perceived usefulness, while explaining 60 percent of the variance in it (Shantiyai, 2008). In this regard, ease of use and subjective norms are important drivers of use intention (Sendecka, 2006).

**Figure 2.3: Technology Acceptance Model (TAM)**

Source: (Davis, 1989)

In their analysis Ma and Liu carried out a meta-analysis of TAM to integrate all their findings and generate a quantitative and objective synthesis. The result of their research confirmed Davis’ findings that the relationship between perceived usefulness
and ease of use, and perceived usefulness and technology acceptance are strong, while relationship between perceived ease of use and technology acceptance is weak. Thus, there is a relationship between usefulness and ease of use (Sendecka, 2006).

During the years TAM has been developed there have been lots of adoption researches done successfully applying this model (Sendecka, 2006) with different tools and in different contexts (Gefen et al., 2000).

2.5.1.4. Innovation Diffusion Theory

Innovation Diffusion Theory, developed by Rogers, is a theory that explains the user acceptance of technology (Teo and Pok, 2003). Rogers, in his book, defines this theory as the process by which innovation is communicated through certain channels over time among the members of social system. This model conceptualizes the sequence of events where individual passes through initial point of basic knowledge of innovation, through forming a positive or negative attitude towards the technology, a decision to either adopt or reject it, or utilization of innovation to finally seeking reinforcement of the adoption decision which is made (Rogers, 1983; Sendecka, 2006; Shantiyai, 2008). The key elements of this process are communication channels, innovation, innovation’s perceived characteristics or time and social systems, communication received by the individual from the social environment in which the individual is interacting and the individual’s attitude and belief (Sendecka, 2006; Shantiyai, 2008).

Rogers considers five variables of innovation, which are relative advantage, compatibility, complexity, trialibility and observability, as attributes which influence the adoption and intention to use an innovation. He claims that these attributes are to some extend interrelated with each other, meanwhile, they are conceptually different. The selection of these attributes is based upon past researches (Rogers, 1983; Sendecka, 2006; Shantiyai, 2008).

“Relative advantage” is the degree to which innovation is perceived as being better than the idea it substitutes. The degree of relative advantage can be expressed in economic profitability or in status giving, for instance. Researchers have found out that “relative advantage” is one of the most effective factors on the innovation’s rate of adoption. This is because when individuals or organizations pass through the innovation
process, they are motivated to seek information to decrease uncertainty about the relative advantage of an innovation. Potentials who can be adopters want to know about the advantage of applying the new idea over the existing one (Rogers, 1983; Sendecka, 2006; Shantiyai, 2008).

“Compatibility” is the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters (Rogers, 1983). The more compatible the idea will be the less uncertain to the potential adopter. So, compatibility has a positive direct effect on the adoption rate of an innovation (Sendecka, 2006).

“Complexity” stands for the degree to which an innovation is perceived as relatively difficult to understand and use (Rogers, 1983). Rogers suggest that the complexity of an innovation is negatively related to the rate of adoption by potentials. The reason is that the less difficult the innovation will be to understand and use, the less complex it will be perceived. This way, the adoption rate will increase (Shantiyai, 2008).

“Trialibility” is the degree to which an innovation may be experimented on a limited basis (Rogers, 1983). According to Rogers, innovations that have been experimented will have more and faster adoption than those which are not experimented. Rogers supports the idea that trialibility is positively and directly related to the adoption rate of innovation (Sendecka, 2006; Shantiyai, 2008).

“Observability” is the degree to which the results of an innovation are visible to others (Rogers, 1983). The more visible the innovation to others, the faster the adoption rate of it. This is the reason why Rogers suggest the positive relation between observability and adoption rate (Sendecka, 2006; Shantiyai, 2008).

As explained by Rogers, all these five factors which underlie the rate of adoption of innovation, except complexity, will have positive and direct effect on the adoption rate of innovation (Sendecka, 2006; Shantiyai, 2008). Figure 2.4 shows the IDT conceptual model.

2.5.1.5. Unified Theory of Acceptance and Use of Technology

This model was developed by Venkatesh et al. 2003, for analyzing the effective factors on the adoption of technology by users. In their theory Venkatesh et al. identified
four variables, which are performance expectancy, effort expectancy, social influence, and facilitating conditions, as directly effective on the adoption of technology. They also applied and tested gender, age, experience and voluntariness of use as the four moderators of these variables (Venkatesh et al., 2003).

“Performance expectancy” is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh et al., 2003). This construct has the same description as the perceived usefulness which has been identified by Davis in his Technology Acceptance Model. Also, it is similar to the construct outcome expectations from the social cognitive theory (Venkatesh et al., 2003). Venkatesh et al. see similarities in different constructs from different models and theories in the literature.

The findings of their research also show that performance expectancy is the most effective factor on the adoption. They also believe that the relationship between

![Figure 2.4: Innovation Diffusion Theory](Figure)

Source: (Rogers, 1983)

performance expectancy and intention will be moderated by gender and age (Venkatesh et al., 2003).

“Effort expectancy” is defined as the degree of ease associated with use of the system. The definition of this variable is the same as the definition for variables,
perceived ease of use (TAM/TAM2) and ease of use in innovation diffusion theory. The similarities between constructs of some models have been discussed previously by researchers (Davis et al., 1989; Moore and Benbasat, 1991; Thompson et al., 1991; Plouffe et al., 2001).

“Social influence” is defined as the degree to which an individual perceives that important others believe he or she should use the new system. This construct is represented in other models as subjective norm in TRA, TAM2 and TPB (Venkatesh et al., 2003). The idea comes from the concept that the individual’s behavior is influenced by the view in which they believe other individuals will view them as a result of having applied the technology. As stated by Venkatesh et al. (2003) the role of social influence in technology acceptance decisions is complex and subject to a range of dependent influences (Venkatesh et al.). This construct has an impact on individual’s usage behavior through three mechanisms: compliance, internationalization and identification (Warshaw 1980; Venkatesh and Davis, 2000; Venkatesh et al., 2003). The compliance makes an individual simply alter his or her intention in response to the social pressure which means that the individual intends to comply with the social influence, the latter two relate to altering an individual’s belief structure and/or causing an individual to respond to potential social status gains (Venkatesh et al., 2003).

“Facilitating conditions” are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. The definition comes from variables defined in the other theories, such as perceived behavioral control from (TPB) and complexity from (IDT). In their findings Venkatesh et al., 2003 show that the relationships between each of the constructs (perceived behavioral control, facilitating conditions, and compatibility) and intention are similar (Venkatesh et al., 2003). Figure 2.5 shows the UTAUT conceptual model.

2.5.2. The Initial Research Conceptual Model

Mallat et al. (2008) proposed a research model for mobile ticketing adoption in public transport based on the TAM and IDT theories. In their model they also augmented a few constructs which have been discussed as important determinants of mobile commerce adoption including risk, use context, mobility and trust. The constructs they applied for their empirical study are discussed successively:
2.5.2.1. Perceived ease of use

It is taken from the Technology Acceptance Model which was discussed previously in this chapter and is defined as the degree to which a person believes that using a particular system would be free of effort (Davis, 1989) and as discussed by Venkatesh et al. (2003) this construct is the same as the “complexity” construct in IDT and effort expectancy in UTAUT (Venkatesh et al., 2003).

2.5.2.2. Perceived usefulness

This construct is also taken from the TAM and is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). According to Mallat et al. perceived usefulness besides perceived ease of use are the primary predictors of use intentions (Mallat et al., 2008). Based on the research
done by Venkatesh et al. (2003), this construct is the same as the relative advantage in IDT and performance expectancy in their UTAUT (Venkatesh et al., 2003).

2.5.2.3. Attitude

Attitude which is also taken from the TAM is found to be a determinant factor in the individual’s use intention and adoption of mobile commerce applications. According to Mallat et al. (2008) perceived ease of use besides perceived usefulness determine the attitude towards using the system and the attitude with perceived usefulness will determine the actual use intention (Mallat et al., 2008).

2.5.2.4. Social influence

In a study done by Kleijnen et al. (2004) social influence was determined as another effective factor on customer’s use intention towards WAP mobile financial services. Mallat et al. (2008) added this factor as an important factor in their study.

2.5.2.5. Compatibility

Compatibility is another factor which has been added by Mallat et al. for their study. This construct has been taken from the IDT by Rogers (1983) and it is defined as the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters (Rogers, 1983).

2.5.2.6. Cost

Though cost has been found to be unimportant in the individual level adoption in the organization by Moore and Benbasat (1991) it has been discussed as a relevant factor in predicting mobile commerce adoption (Wu and Wang, 2005; Kim et al., 2004; Mallat et al., 2008).

2.5.2.7. Prior experience

Based on the study by Lee et al. (2003) besides relative advantage and complexity, ability to test the service before the adoption and observe the successful outcomes is another determinant factor in customer’s adoption of mobile commerce services (Lee et al., 2003).
2.5.2.8. Trust

Perceived trust and risk emerged as important determinants of electronic and mobile commerce (Jarvenpaa et al., 2000; Pavlou, 2003; Mallat et al., 2008). Trust is announced to be important in electronic and mobile commerce because of the spatial separation between buyer and seller, and also because the buyer is required to give his or her personal information such as telephone number or credit card number to the seller (Grabner-Krauter and Kaluscha, 2003).

Siau and Shen proposed a framework for customer trust in mobile commerce and assumed that perceptions on both mobile vendor and on mobile technology are influential in trust information (Siau and Shen, 2003).

2.5.2.9. Risk

In addition, perceived risk has been found to have a significant negative effect on the users’ adoption of mobile commerce (Wu and Wang, 2005). It is mostly derived from the perceived limitations of the mobile networks, devices and the actual payment solutions (Mallat et al., 2008).

Mobile networks have limitations in connection and speed (Siau and Shen, 2003) as well as network coverage (Mallat et al., 2008). Similarly limitations in mobile device features include small screens, keypads, limited power, memory and short battery life (Mallat et al., 2008) and also the differences between the operating systems on mobile phones. These features can bring the risk towards using a specific mobile application.

2.5.2.10. Use context

When discussing about mobile commerce adoption and use, use context has significant importance (Mallat et al., 2008). Mobile users could take their mobile phones wherever they want to take it with them. Use context becomes an issue in research and raises questions about the relation of the behavior and the environment in which it takes place (Dourish, 2004; Mallat et al., 2008). According to Dey et al. (2001) context can be defined as information that characterizes a situation related to the interaction between humans, applications and the surrounding environment (Dey et al., 2001).

Kakihara and Soensen (2001) define contexts as continuous frames for individual’s interaction with other individuals (Kakihara and Soensen, 2001). Schmidt et
al. (1999) and Lee et al. (2005) give a more structured definition and categorize context to physical environment and human/personal factors and provide more detailed subgroups within these categories (Schmidt et al., 1999; Lee et al., 2005).

Belk (1975) defined five categories of different situational characteristics including, physical context, social context, temporal context, task definition specifying the task at hand and the role in which the task is performed; and antecedent states defined by momentary moods or momentary conditions such as loose change available (Belk, 1975).

Previous researches have approved the effect of use situation on consumer choice of products, stores and other purchase channels as well as mobile computing (Mallat et al., 2008). Lee et al. (2005) in their study have found that contextual factors had significant correlations with specific types of mobile services (Lee et al., 2005).

2.5.2.11. Mobility

The most outstanding feature of mobile technology is mobility (Mallat et al., 2006; Mallat et al., 2008). It is the ability to access services ubiquitously, on the move, and through wireless networks and various devices such as PDA and mobile phone (Coursaris and Hassanein, 2002).

It also refers to movement of technologies, people, settings and information access (Weilenmann, 2003) and to the means of mobile technologies to facilitate this movement. It is so much related to ubiquitous computing (Weiser, 1991) and nomadic computing (Kleinrock, 1996). It is considered because of the time and place benefits users can get from mobile computing (Mallat et al., 2008). Kleinrock’s expression of anytime and anywhere computing became the essence of mobility, which is independent of time and place (Kleinrock, 1996). The mobility feature brings the opportunity for the users to use the demanded application whenever they want and wherever they are.

The main research model has been taken from the research model done by Mallat et al. (2008). Figure 2.6 shows the conceptual framework of their study.
2.5.3. The Expert Interviews

After identifying and selecting the research model which is based on the model proposed by Mallat et al. (2008) the constructs of the model were discussed with information systems and mobile services experts.

Since the purpose of this research is to identify effective factors in the customer use intention towards using a mobile commerce application in Iran, we conducted in-depth interviews with Iranian experts active in information systems and mobile commerce application services to understand whether these factors can be effective in Iran. 2 of the experts were academics and 4 were information systems professionals. In order to choose the experts few qualifications were taken into account, including:

- Complete familiarity with the mobile commerce applications
- Remarkable experience in implementing, supervising or consulting companies active in the field of providing mobile commerce applications such as mobile banking
- More than 10 years of experience in the field of marketing and sales in the Iranian software companies, or the department of organization they are working
- High level of academic education in the related fields

Based on the interviews with these experts we decided to eliminate, merge and combine few elements of our framework. The recommendations of the experts are listed below;

- Because different people have different payment trends and habits, also different cell phone operators offer different methods of payment to their customers, it was suggested to add the payment method of interest as a question in the questionnaire. This should be done to understand whether individuals accept or reject different available payment methods such as cell phone bill, cell phone account charge, bank account and ATM card.
- Because the concept of mobile ticketing service is a new concept for Iranian individuals it is better to define the system completely and in an easy way for the users to make them familiar with the system.
- Also it has been suggested to make the questions on the questionnaire easily understandable for every individual who is going to fill out the questionnaire.
After the interviews the questionnaire was developed according to the recommendations of the experts.

2.5.4. Research Hypotheses

Based on the present research model the research hypotheses are presented accordingly as shown in the Table 2.9.

![Proposed Research Model](Source: (Mallat et al., 2008))
<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis</th>
<th>Description of Hypotheses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H1</td>
<td>There is a positive relationship between perceived ease of use of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>2</td>
<td>H2</td>
<td>There is a positive relationship between perceived usefulness of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>3</td>
<td>H3</td>
<td>There is a positive relationship between attitude towards ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>4</td>
<td>H4</td>
<td>There is a positive relationship between social influence on ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>5</td>
<td>H5</td>
<td>There is a positive relationship between compatibility of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>6</td>
<td>H6</td>
<td>There is a positive relationship between cost of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>7</td>
<td>H7</td>
<td>There is a positive relationship between prior experience in ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>8</td>
<td>H8</td>
<td>There is a positive relationship between trust on ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>9</td>
<td>H9</td>
<td>There is a positive relationship between risk of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>10</td>
<td>H10</td>
<td>There is a positive relationship between use context for ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
<tr>
<td>11</td>
<td>H11</td>
<td>There is a positive relationship between mobility of ticket purchasing by mobile and intention to buy tickets with mobile</td>
</tr>
</tbody>
</table>
3. Chapter Three

Research Methodology

3.1. Introduction

In this chapter the research methods used in the study will be discussed. Also, the research process, research purpose, research approach, research strategy, sample selection and data collection, research variables and measurement tools validity and reliability will be discussed. Finally the statistical methods for data analysis will be presented.
3.2. Research Approach

There are two research approaches to be considered in a research:

- Qualitative
- Quantitative (Cooper and Schindler, 2003). They are two broad approaches and are mostly applied in social science research studies (Zikmund, 2000).

Quantitative research involves numerical representation and manipulation observation in order to describe and explain the phenomena that these observations reflect (Zikmund, 2000). According to Cooper and Schindler this method involves large randomized samples, more application of statistical and few applications of cases demonstrating findings (Cooper and Schindler, 2003).

The objective of quantitative research is to determine the relationship between dependent variable on the one hand, and an independent variable on the other (Cooper and Schindler, 2003). It emphasizes measurement and analysis of causal relationships between variables, and not processes (Zikmund, 2000). This is because, in this type of research variables and relationships between them are the central idea (Neuman, 2003).

This method is used to provide, detailed planning before data collection and analysis, for it provides tools for measuring concepts, planning design stages and dealing with population and sampling issues. As well, it applies a deductive model in testing the relationship between variables and to provide evidence for or against pre-specific hypothesis (Neuman, 2003).

Qualitative research, on the other hand, involves non-numerical examination and interpretation of observations to discover the underlying meaning and pattern of relationships (Zikmund, 2000). The emphasis is on the processes and meanings that are not rigorously examined or measured, in terms of quantity, amount of intensity or frequency (Zikmund, 2000).

The objective of this type of research is to gain qualitative understanding of underlying reasons and motivations (Chisnal, 1997). Also, the focus in this research is on providing a complete picture of the situation to increase the understanding of social processes and interrelations. It is defined as a research to explore and understand the opinions and strive for in-depth understanding of different types of findings in a library.
research (Cooper and Schindler, 2003). Table 3.1 shows the differences between these two models which are identified by Chisnal (1997).

<table>
<thead>
<tr>
<th>Objective</th>
<th>Quantitative</th>
<th>Qualitative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Quantify the data and generalized results from sample to the population of interest</td>
<td>Gain qualitative understanding of underlying reasons and motivations</td>
</tr>
<tr>
<td><strong>Sample</strong></td>
<td>Large number of representative cases</td>
<td>Small number of non-representative cases</td>
</tr>
<tr>
<td><strong>Data Collection</strong></td>
<td>Structured</td>
<td>Unstructured</td>
</tr>
<tr>
<td><strong>Data Analysis</strong></td>
<td>Statistical</td>
<td>Non-statistical</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td>Recommend a final course of action</td>
<td>Develop an initial understanding</td>
</tr>
</tbody>
</table>

Source, (Chisnal, 1997)

The main objective of this research is to identify effective factors in customer use intention of mobile ticketing for public transportation. To achieve this, a library research on the mobile commerce adoption and use intention literature is done besides personal interviews with Iranian experts to validate the identified factors and to identify any other effective factors which have not been found in the library research. Thus, the first step of the study is qualitative. Then, in order to examine the relationship between research variables in the applied model a multivariate data analysis is done based on the data collected in the survey. So, the second step of the study is quantitative.

Also, a research can be both deductive and inductive (Saunders, 2000). In the deductive approach authors collect data and develop theory as a result of the data analysis. But in the inductive approach authors develop a theory and hypothesis (or hypotheses) and design a research strategy in order to test the hypotheses (Saunders, 2000).
According to Trochim (2002) while the research, in the deductive approach, moves from more general to more specific ideas, so-called “top-bottom” approach, the latter, moves from specific observations to generalizations and theories, which is also known as “bottom-up” approach (Trochim, 2002).

In this study, the general topic of interest is narrowed down into more specific hypotheses which can be tested. Then, it is further narrowed down by collecting data and addressing the hypotheses. This will lead the research to test the hypotheses with specific data, resulting in confirmation or verification of the original theories. So, the approach for this research is deductive.

### 3.3. Research Purpose

A research can be conducted for three purposes: exploration, description, and explanation (Zikmund, 2000). Exploratory researches are more valuable means of finding out what is happening. They seek more insights, and ask more questions to assess phenomenon in a new style (Saunders et al, 2000). According to Yin (1994) it is a useful approach if one wishes to clarify the understanding of a problem. The advantage is that it has great flexibility and is adaptable to change. The flexibility concealed in exploratory research does not mean it does not have direction. Researchers use exploration as a primary step when a problem is broad and not specifically defined (Yin, 1994).

Descriptive research is described within problem areas where there already exists plenty of literature and the aim is to study events that have occurred or happening in present time. The aim of descriptive research is to describe characteristics of a population or phenomenon. It seeks to determine the answers to who, what, when, where, and how questions (Zikmund, 2000). The object of this type of research is to show an accurate profile of persons, events or situations (Robson, 1993). This type of research might be an extension of exploratory research. According to Zikmund (2000), accuracy is of huge importance in descriptive research.

Explanatory research aims at establishing causal relationship between variables (Saunders et al, 2000). It focuses on cause-effect relationships explaining what causes produces what effects (Yin, 1994). The emphasis in this type of research is on studying a
situation or a problem in order to explain the relationships between variables (Saunders et al, 2000).

The main question of this research is “what are the factors influencing the adoption of mobile ticketing?” Depending on research problem literature review has been conducted to specify the research questions and construct framework. The research purpose and question reveals that this study is primarily explanatory.

3.4. Research Strategy

Three conditions will affect the choice of research distinctively:

- the type of asked questions
- the extent of control an investigator has over actual behavioral events
- the degree of focus on contemporary events (Yin, 1994).

According to Yin, there are five primary research strategies in social sciences: experiments, surveys, archival analysis, histories and case studies.

<table>
<thead>
<tr>
<th>Research Strategy</th>
<th>Form of Research Question</th>
<th>Control Required over Behavioral System</th>
<th>Focus on Contemporary Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>How, why</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, what, where, how many, how much</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival Analysis</td>
<td>Who, what, where, how many, how much</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>History</td>
<td>How, why</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case Study</td>
<td>How, why</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Source: (Yin, 1994)

Because the aim of this study was to collect the answers from a large scale of metro passengers who have not yet experiences purchasing metro tickets by their mobiles,
and in order to formulate the main factors affecting the intention to adopt the mobile ticketing system, for the research strategy the survey has been chosen. This strategy is also chosen based on the research approach, and the nature of the research which is quantitative.

A survey is an appropriate strategy because the aim is to answer who, where, how many, how much or what questions of the research. There is no faster, more affordable way to conduct a survey. Also, because of the nature of this research, a survey is appropriate for its quantitative characters.

### 3.5. Research Process

The research process is shown in Figure 3.1.

![Figure 3.1: The research process](image)
3.6. Research Design

According to Cooper and Schindler the design of a research is the structure and plan of investigation in an understandable way to obtain answers to research question. The plan is the scheme of the whole research and includes an outline of all the processes the investigator will take from writing hypotheses and their operational implications to the final data analysis. It also illustrates both the structure of the research problem and the plan of investigation applied to obtain empirical evidence or relations of the problem (Cooper and Schindler, 2003). The research design must be appropriate to the subject to be investigated. A well-designed research will ensure that the collected data will be consistent with the objective of the study and the procedures regarding the data collection is accurate and efficient (Cooper and Schindler, 2003).

In a research the distinction between variables is necessary in order to reach the response to a research question or hypothetical tests. Mostly, researchers are interested in relationship among variables (Cooper and Schindler, 2003). Two types of variables have been taken into account in this research:

- Independent Variables: Specialty from physical and social environment that are accepted after the selection interference or modification by a quantitative researcher so that their impact may be observed on other variables (dependent variables).
- Dependent Variables: Are variables in which changes occur under the impact of independent variables (Cooper and Schindler, 2003).

In this research ease of use, usefulness, attitude, social influence, compatibility, cost, prior experience, trust, risk, use context, mobility and payment method are considered as independent variables and use intention is considered as dependent variable.

3.7. Methods and resources of data collection

Based on the nature of this research which is descriptive, following methods have been applied during the data collection:

- Library method: Information related with the research background and literature (secondary data) is collected this way. More than 50 articles dealing with
mobile commerce, 14 of which were specifically about mobile ticketing, were collected from the internet especially from Emerald Insight, Business Source Elite (Ebsco), Science Direct, Global Insight etc.

- Expert interviews: In order to examine the two measurement models, personal interview with experts were applied followed up by a questionnaire to approve the comprehensiveness and understandability of the model.
- Questionnaire: A questionnaire containing 36 questions was developed and used to collect the required data during a survey of more than 600 Tehran metro users.

3.8. Statistical population

Sampling design begins with defining the target population. This is the collection of elements which contain the information needed by the researcher, about the conclusion and presumption to be made (Malhotra and Brikes, 2003).

Based on the fact that mobile ticketing for transportation systems has not been implemented or even tested in Iran yet, the target population is inexperienced users of mobile ticketing system (they have never used the system) who use Tehran Metro for their urban trips. Also, because the concept of this study is “use intention” of the users, inexperience of the users does not interfere with the result of this study.

According to Malhotra and Brikes (2003), the target population should be defined in terms of elements, sampling units, extent and time. The object from or about which the information is desired is known as the element. In survey research, the element is usually known as the respondent. A sampling unit is an element or unit containing elements, which is available for selection at some stages of the sampling process.

Extent refers to the geographical boundaries of the research and the time refers to the period under consideration (Malhotra and Brikes, 2003).

According to the explanations mentioned above, the target population of the current study is defined as follows:
Element: inexperienced users of the mobile ticketing system who are using Tehran metro for their urban trips
Sampling units: metro trains travelling in the main metro routes in Tehran
Extent: metro trains travelling in the three main routes within Tehran metropolitan areas
Statistical population of this research are all Tehran metro users whose number was estimated to be about 1,300,000 by August 11th, 2009 based on the Tehran Metro Admin Automation Database.

3.9. Sampling Technique Selection

The sample of a research can be selected in various ways. As stated by Zikmund, major sampling plans can be categorized into two different groups which are probability techniques and non-probability techniques (Zikmund, 2000).

In probability sampling, all sampling units are selected by chance. This method of sampling is commonly associated with survey-based research and permits the researcher to make inferences or projections about the target population from which the sample was taken (Saunders et al, 2000).

Non probability sampling on the other hand, relies on the personal judgment of the researcher rather than on chance to select sample elements. The samples of this type may provide acceptable estimates of characteristics of the population, but do not allow the researcher to evaluate the accuracy of the sample results objectively (Malhotra and Brikes, 2003). Since this study aims at generalizing the results of the whole inexperienced metro users’ population, so the probability sampling seemed to be the best fit for this study.

3.10. Questionnaire Development

To ensure that the list of items included is comprehensive, previous conducted researches available in the literature were reviewed. To ensure the reliability of the research constructs while doing the research, it has been tried to choose previously validated items in the literature. Besides this, one item has been suggested to be added by the experts.

Likert five scales ranging from “strongly agree” to “strongly disagree” has been selected as the basis to rank the answers for the questions. The mentioned scale has been previously applied in the literature.
3.11. Pilot Testing

The developed questionnaire then was translated into Persian (Farsi) language, and a pilot study was conducted. At this stage 10 metro passengers who had never experienced using the system were chosen. First of all they were oriented about the system and how it works and then they were asked for any ambiguity points. Then they were exposed to answering the questions and any ambiguous points they see in the questions.

At the final point the original questionnaire was refined and some corrections were made to prepare the final version of the questionnaire. A copy if the questionnaire is presented in Appendix A (English version) and B (Persian version).

3.12. Data Collection

A survey was conducted to verify the research model. The sample was taken randomly from Tehran metro users. The questionnaires were distributed during August 1st to September 12th, 2009 for 41 days within the metro stations. To reduce the time place and time bias in collecting the data all three metro routes in Tehran were chosen as data collection points and all the 600 questionnaires were distributed with the same rate on every route during the day, with 200 on each route. Also, the questionnaires were distributed with the same rate at 6 different times during the day on 7 days of the week.

Since all respondents were inexperienced about using the system, they were oriented about the systems, how it works and how they can get the final result. They were oriented through the exposure to a few slides which explained the system and how it works as well as a short video about how the system works to purchase metro tickets. Then they were asked to answer the questions if they do not have any question. At the end all the collected questionnaires were checked if they are correctly filled-out or not. The results are shown in Table 3.3.

3.13. Reliability

Reliability is the degree to which measurements are free from error, thus, yield consistent results. In other words, reliability concerns the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials (Carmines and Zeller, 1979).
### Table 3.3: Questionnaire Distribution Results

<table>
<thead>
<tr>
<th>Number of Distributed Questionnaires</th>
<th>Number of Completed Ones</th>
<th>Number of Incomplete Ones</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>462</td>
<td>138</td>
<td>77%</td>
</tr>
</tbody>
</table>

Functionally, reliability is defined as the internal consistency of a scale, which assesses the degree to which the items are homogenous. Werts et al. (1974) proposed a compound reliability measure which is an alternate conceptualization of reliability and represents the proportion of measure variance attributable to the underlying trait. (Werts et al., 1974). The compound reliability was applied to assess the reliability of the scales for the current study. Bagozzi and Yi (1988) believe that a scale is considered reliable if the reliability values of constructs are greater than 0.60 (Bagozzi and Yin, 1988).

Hair et al. (2003) have provided rules of thumb for interpreting the value of the alpha (Hair et al., 2003). As they mentioned, if the alpha is 0.70 or higher the question is consistent and reliable.

Thus, for this purpose Cronbach’s alpha value has been measured for all questions. This is a popular method in assessing the internal consistency of the questions. The total Cronbach’s alpha was equal to .0882 which is acceptable according to the reliability value mentioned by Hair et al.

### 3.13.1 Content Validity

Content validity or internal validity responds to the question that how precisely the questions measure corresponding components. To determine the validity of the questionnaire various methods are available. One of these methods is content validity. This method is applied to study the formation ingredients of a measurement tool. It is usually determined by the experts in the proposed subject of study. Content validity in the questionnaire of the current study was approved with the help of research advisor, supervisor and mobile-commerce professionals.

The questionnaire has been reviewed by the research supervisor in both English and Persian version and all the ambiguities and problems were removed, then they were
distributed to the metro users after they were corrected, validated and approved by experts.

### 3.13.2. Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity

The Kaiser-Meyer-Olkin measure of sampling adequacy tests whether the partial correlations among variables are small. The value of Kaiser-Meyer-Olkin test should be greater than 0.5 (KMO > .5) to support the validity of the used variables. Bartlett's test of sphericity tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate. The significance level for the Bartlett’s test should not be greater than .05 (Sig.< .05).

### 3.14. Statistical Analysis

To achieve this and for testing the hypotheses (H1 to H 11) it was decided to apply the Structural Equation Modeling (SEM) approach to evaluate the model. Also, some other statistical analysis and descriptive statistics will be applied to provide more interpretations of the study. Following a brief description of SEM, the reasons for its selection and advantages of applying SEM will be presented.

### 3.14.1. Structural Equation Modeling (SEM)

Structural Equation Modeling techniques have got much popularity as validating instruments and testing the linkage between constructs in information systems researches (Gefen et al., 2000). Structural Equation Modeling techniques are a new generation in data analysis which can be applied to test the extent to which information systems research meets recognized standards for high quality statistical analysis. In fact the term SEM refers to a family of related procedures and not limited to a single statistical technique (Kline, 1998). This technique provides the answers to a set of interrelated research questions in a single, systematic and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously (Gefen et al., 2000). This capability differs considerably from most first generation regression models which can analyze one layer of linkage between independent and dependent variables concurrently. The result of this test applying SEM will be presented.
in the following chapter. Figure 3.2 and Table 3.4 will overview the hypotheses to be tested applying SEM.

Figure 3.2: Research model overview
<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>PU-UI</td>
</tr>
<tr>
<td>H2</td>
<td>EOU-UI</td>
</tr>
<tr>
<td>H3</td>
<td>ATT-UI</td>
</tr>
<tr>
<td>H4</td>
<td>CP-UI</td>
</tr>
<tr>
<td>H5</td>
<td>PEX-UI</td>
</tr>
<tr>
<td>H6</td>
<td>SOI-UI</td>
</tr>
<tr>
<td>H7</td>
<td>COS-UI</td>
</tr>
<tr>
<td>H8</td>
<td>TR-UI</td>
</tr>
<tr>
<td>H9</td>
<td>RIS-UI</td>
</tr>
<tr>
<td>H10</td>
<td>MOB-UI</td>
</tr>
<tr>
<td>H11</td>
<td>USC-UI</td>
</tr>
</tbody>
</table>
4. Chapter Four

Data Analysis and Results

4.1. Introduction

In this chapter the collected data will be analyzed on the basis of frame of reference of this chapter. The Structural Equation Modeling method is applied for analyzing the collected data. The analysis of the data was done using SPSS version 17 and AMOS version 16.

4.2. Demographic and descriptive statistics

Table 4.1 shows the sample demographics based on the collected data.
### Table 4.1: Sample demographics

<table>
<thead>
<tr>
<th>Measure</th>
<th>Item</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>309</td>
<td>66.8%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>153</td>
<td>33.2%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Age Group</td>
<td>15-24</td>
<td>172</td>
<td>37.2%</td>
</tr>
<tr>
<td></td>
<td>25-34</td>
<td>196</td>
<td>42.4%</td>
</tr>
<tr>
<td></td>
<td>35-44</td>
<td>63</td>
<td>13.6%</td>
</tr>
<tr>
<td></td>
<td>45-54</td>
<td>21</td>
<td>4.6%</td>
</tr>
<tr>
<td></td>
<td>55 and more</td>
<td>10</td>
<td>2.2%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Education</td>
<td>Below high school diploma</td>
<td>17</td>
<td>3.6%</td>
</tr>
<tr>
<td></td>
<td>High-school Diploma</td>
<td>121</td>
<td>26.2%</td>
</tr>
<tr>
<td></td>
<td>Associate/Bachelor Degree</td>
<td>263</td>
<td>56.9%</td>
</tr>
<tr>
<td></td>
<td>Graduate/Post graduate</td>
<td>61</td>
<td>13.3%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Cell phone use per day</td>
<td>Less than 10 minutes</td>
<td>125</td>
<td>27.0%</td>
</tr>
<tr>
<td></td>
<td>10 to 30 minutes</td>
<td>195</td>
<td>42.3%</td>
</tr>
<tr>
<td></td>
<td>30 to 60 minutes</td>
<td>83</td>
<td>17.9%</td>
</tr>
<tr>
<td></td>
<td>more than an hour</td>
<td>59</td>
<td>12.8%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Measure</td>
<td>Item</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------</td>
<td>-----------</td>
<td>---------</td>
</tr>
<tr>
<td>SMSs sent per day</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 or none</td>
<td>97</td>
<td>97</td>
<td>20.9%</td>
</tr>
<tr>
<td>2 to 5</td>
<td>195</td>
<td>195</td>
<td>42.3%</td>
</tr>
<tr>
<td>more than 5</td>
<td>170</td>
<td>170</td>
<td>36.8%</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Cell phone operator used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ITC (912/919)</td>
<td>367</td>
<td>367</td>
<td>79.5%</td>
</tr>
<tr>
<td>MTN (935-7)</td>
<td>87</td>
<td>87</td>
<td>18.8%</td>
</tr>
<tr>
<td>Talia (932)</td>
<td>8</td>
<td>8</td>
<td>1.7%</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Feeling and understanding of the system use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovator</td>
<td>111</td>
<td>111</td>
<td>24.0%</td>
</tr>
<tr>
<td>Early adopter</td>
<td>124</td>
<td>124</td>
<td>26.8%</td>
</tr>
<tr>
<td>Majority adopter</td>
<td>106</td>
<td>106</td>
<td>22.9%</td>
</tr>
<tr>
<td>Late adopter</td>
<td>99</td>
<td>99</td>
<td>21.5%</td>
</tr>
<tr>
<td>Reluctant</td>
<td>22</td>
<td>22</td>
<td>4.8%</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>462</td>
<td>100%</td>
</tr>
<tr>
<td>Interested/more interested payment method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Through bank account</td>
<td>52</td>
<td>52</td>
<td>11.3%</td>
</tr>
<tr>
<td>Through ATM card</td>
<td>96</td>
<td>96</td>
<td>20.8%</td>
</tr>
<tr>
<td>Through bill/credit charge</td>
<td>314</td>
<td>314</td>
<td>67.9%</td>
</tr>
<tr>
<td>Total</td>
<td>462</td>
<td>462</td>
<td>100%</td>
</tr>
</tbody>
</table>

As show in table 4.1 the ration of male respondents comparing with female ones is approximately 65 to 35. Also, most respondents were young people about 37% between ages from 15 to 24 and 42% from 25 to 34. Also about 55 percent of the respondents were undergraduate people. From the education side most of the respondents, about 55%, had associate or bachelor degrees. Besides the information given in the table above following are given pie charts which describe the information given in the table.
Figure 4.1: Respondents’ Gender

- Male: 72%
- Female: 28%

Figure 4.2: Respondents’ Age Group

- 15-24: 5%
- 25-34: 14%
- 35-44: 42%
- 45-54: 37%
- 55 or more: 2%
Figure 4.3: Respondents’ Educational Background

Mobile speech service can be a reliable source for understanding if the users have trends towards using their cell-phone for commercial activities such as purchasing tickets or not. Users’ trends towards using their cell-phones can bring the understanding whether the mobile ticketing system will be intended to apply or not. Figure 4.4 shows respondents trends towards using their mobile phones during the day.

Figure 4.4: Respondents’ cell-phone use per day
As the results show, most of the respondents (42%) have trends to use their cell-phones for 10 to 30 minutes during the day. Also, about 30% have trends to use their cell-phone at least 30 minutes during the day. It can be concluded that because of the habits in using the cell-phone by the Iranian people commercial activities and services can be accepted by them.

Because the mobile ticketing system which has been introduced in the research and to the respondents is based on the Short Message Service (SMS), in the questionnaire it has been tried to understand respondents’ SMS use per day. This information will be helpful in understanding the trends in applying the platform for implementing and providing the service. Figure 4.5 shows respondents’ trends towards using SMS on a daily basis.

![Figure 4.5: Respondents’ SMSs sent per day](image)

As it is shown in table 4.4, respondents have trends to use two or more SMSs per day in Iran. About 42% of respondents have trends to send 2-5 SMSs per day and also about 37% of them have trends to sent more than 5 SMSs per day. This result shows that SMS use in the Iran is high and SMS can be a popular platform for implementing and offering a ticketing system.

There are a number of cell-phone operators working in the Iranian market, each have their own services and make their own service differentiations to compete in the
market. Because of the different services offered by these different operators it would be better to understand the most popular cell-phone operator with the Iranian people. Figure 4.6 shows the cell-phone operators popularity with the respondents.

Figure 4.6: Cell-phone operators’ popularity with Iranians

As the results show, the most popular cell-phone operator in Iran is Iran Telecommunication Company (ITC) with about 80% popularity with Iranians. To implement and provide a service it will be helpful to understand the customers’ view points about the service and using the service in order to understand their habits and use the best suited strategies to target the customers. So, the respondents were asked about their feeling and understanding of the mobile ticketing service. Figure 4.7 shows the results of this question.

The results show that majority of respondents show positive feelings about using the mobile ticketing system. About 27% of the respondents see themselves as innovators who are eager to get information about the system and how it works. Also, about 50% of them are eager to use the system as early adopters or majority adopter and only 5% of them show their reluctance in using the system. These results can help the implementers to understand the optimistic trend of Iranian people to use such a system. As suggested by the experts, the respondents also were exposed to a question about their intention to pay for their ticket purchasing via their cell phones. The question
Figure 4.7: Respondents’ feeling about using the system

provided them three different options, the first option is payment through their bank account, the second through their ATM card and the third is through their cell-phone bills/credit charges. Figure 4.8 shows their interest in paying the ticket price.

Figure 4.8: Respondents’ preferred payment method

The results show that more than half of the respondents show interest in paying the ticket cost via their cell-phone bills or their cell-phone credit charges. Also, only
about 10% of the respondents show interests in paying the ticket charge via their bank accounts.

Before digging deeper into the research to answer the research questions it is needed to measure the reliability and validity of the measurement tools applied for the research.

4.3. Reliability of the Questions

The reliability of the measurement tools was assessed by the Cronbach’s alpha reliability coefficient. The results of this assessment are shown in table 4.2.

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Number of items</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness</td>
<td>4</td>
<td>.774</td>
</tr>
<tr>
<td>Perceived ease of use</td>
<td>3</td>
<td>.719</td>
</tr>
<tr>
<td>Attitude</td>
<td>2</td>
<td>.713</td>
</tr>
<tr>
<td>Compatibility</td>
<td>3</td>
<td>.705</td>
</tr>
<tr>
<td>Prior experience</td>
<td>2</td>
<td>.741</td>
</tr>
<tr>
<td>Social influence</td>
<td>3</td>
<td>.723</td>
</tr>
<tr>
<td>Cost</td>
<td>3</td>
<td>.764</td>
</tr>
<tr>
<td>Trust</td>
<td>4</td>
<td>.721</td>
</tr>
<tr>
<td>Risk</td>
<td>4</td>
<td>.779</td>
</tr>
<tr>
<td>Mobility</td>
<td>4</td>
<td>.816</td>
</tr>
<tr>
<td>Use context</td>
<td>4</td>
<td>.749</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>.882</td>
</tr>
</tbody>
</table>
The result of the assessment shows that all items are in an acceptable level of reliability ($\alpha \geq 0.7$). Thus, all the questions used in the questionnaire as the measurement tools are reliable.

### 4.4. Factor Analysis

Hereby, the validity of the measurement tools will be discussed for each construct of the content. The results for each of the validity tests are given below in figures. Table 4.3 shows the result for KMO and Bartlett’s test for Sphericity on perceived usefulness (PU).

**Table 4.3: KMO and Bartlett’s test for Perceived usefulness**

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>.774</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett’s Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>478.397</td>
</tr>
<tr>
<td>Df</td>
<td>6</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Perceived usefulness shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5 (0.774). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information.

Also, The result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.5). Figure 4.9 shows the result of Scree Plot for Perceived usefulness.

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 61% of the total variance. Table 4.4 shows the communalities of the Perceived usefulness.

Sufficiency and suitability test of data KMO for the execution of factor analysis for Perceived ease of use (EOU) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5 (0.642). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that
indicates correlation matrix possesses significant information. Table 4.3 shows the result for KMO and Bartlett’s test for Sphericity on Perceived ease of use (PU).

Table 4.5: KMO and Bartlett’s test for Perceived ease of use

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</th>
<th>.642</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>294.244</td>
</tr>
<tr>
<td>Df</td>
<td>3</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.25). Figure 4.10 shows the result of Scree Plot for Perceived ease of use.
Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 61% of the total variance. Table 4.6 shows the communalities of the Perceived ease of use.

### Table 4.6: Communalities of Perceived ease of use factors

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.635</td>
<td>61.366</td>
<td>61.366</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Attitude (ATT) shows that data set were suitable to execute factor analysis, because the acquired number equals to 0.5(0.500). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.7 shows the results of these tests.

### Table 4.7: KMO and Bartlett’s test for Attitude
Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (4.0). Figure 4.11 shows the result of Scree Plot for Attitude.

![Scree Plot](image)

**Figure 4.11: Scree Plot for Attitude**

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 89% of the total variance. Table 4.8 shows the communalities of the Attitude.
Table 4.8: Communalities of Attitude factors

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.038</td>
<td>89.203</td>
<td>89.203</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Compatibility (CP) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5 (0.662). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.9 shows the results of these tests.

Table 4.9: KMO and Bartlett’s test for Compatibility

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>.662</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>222.574</td>
</tr>
<tr>
<td>df</td>
<td>3</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.25). Figure 4.12 shows the result of Scree Plot for Compatibility. Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 60% of the total variance. Table 4.10 shows the communalities of the Compatibility.

Sufficiency and suitability test of data KMO for the execution of factor analysis for Prior experience (PEX) shows that data set were suitable to execute factor analysis, because the acquired number equals to 0.5. Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.11 shows the results of these tests.
Figure 4.12: Scree Plot for Compatibility

Table 4.10: Communalities of Compatibility factors

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.303</td>
<td>60.340</td>
<td>60.340</td>
</tr>
</tbody>
</table>

Table 4.11: KMO and Bartlett's test for Prior experience

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</td>
<td>.500</td>
</tr>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>198.021</td>
</tr>
<tr>
<td>Df</td>
<td>1</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>
Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.2). Figure 4.13 shows the result of Scree Plot for Prior experience.

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 79% of the total variance. Table 4.12 shows the communalities of the Prior experience.

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.123</td>
<td>79.881</td>
<td>79.881</td>
</tr>
</tbody>
</table>

Figure 4.13: Scree Plot for Prior experience

Sufficiency and suitability test of data KMO for the execution of factor analysis for Social influence (SOI) shows that data set were suitable to execute factor analysis,
because the acquired number is greater than 0.5(0.646). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.13 shows the results of these tests.

Table 4.13: KMO and Bartlett’s test for Social influence

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .646 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 178.904 |
| df | 3 |
| Sig. | .000 |

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.50). Figure 4.14 shows the result of Scree Plot for Social influence.

Figure 4.14: Scree Plot for Social influence

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this
factor can explain 60% of the total variance. Table 4.14 shows the communalities of the Social influence.

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.538</td>
<td>60.881</td>
<td>60.881</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Cost (COS) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5(0.601). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.15 shows the results of these tests.

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | .601 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 205.261 |
| df | Sig. | .000 |

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.50).Figure 4.15 shows the result of Scree Plot for Cost.

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 60% of the total variance. Table 4.16 shows the communalities of the Cost.

Sufficiency and suitability test of data KMO for the execution of factor analysis for Trust (TR) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5(0.652). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.17 shows the results of these tests.
Figure 4.15: Scree Plot for Cost

Table 4.16: Communalities of Cost factors

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.194</td>
<td>60.448</td>
<td>60.448</td>
</tr>
</tbody>
</table>

Table 4.17: KMO and Bartlett’s test for Trust

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>.652</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>551.159</td>
</tr>
<tr>
<td>df</td>
<td>6</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>
Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.50). Figure 4.16 shows the result of Scree Plot for Trust.

Figure 4.16: Scree Plot for Trust

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 60% of the total variance. Table 4.18 shows the communalities of the Trust.

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.604</td>
<td>60.178</td>
<td>60.178</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Risk (RIS) shows that data set were suitable to execute factor analysis, because the
acquired number is greater than 0.5(0.751). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.19 shows the results of these tests.

Table 4.19: KMO and Bartlett’s test for Risk

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>0.751</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>534.998</td>
</tr>
<tr>
<td>df</td>
<td>6</td>
</tr>
<tr>
<td>Sig.</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (2.50). Figure 4.17 shows the result of Scree Plot for Risk.

Figure 4.17: Scree Plot for Risk
Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 60% of the total variance. Table 4.20 shows the communalities of the Risk.

<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.604</td>
<td>60.744</td>
<td>60.744</td>
</tr>
</tbody>
</table>

Sufficiency and suitability test of data KMO for the execution of factor analysis for Mobility (MOB) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5(0.790). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.21 shows the results of these tests.

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th>.790</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>737.527</td>
</tr>
<tr>
<td>df</td>
<td>6</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.25). Figure 4.18 shows the result of Scree Plot for Mobility. Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 65% of the total variance. Table 4.22 shows the communalities of the Mobility.
Sufficiency and suitability test of data KMO for the execution of factor analysis for Use context (USC) shows that data set were suitable to execute factor analysis, because the acquired number is greater than 0.5 (0.721). Similarly, the number of significant Bartlett’s test equals to 0.00 and is smaller than significant level 0.05 that indicates correlation matrix possesses significant information. Table 4.23 shows the results of these tests.

Also, the result of the Scree Plot shows that only one factor has an eigenvalue of over 1 (1.25). Figure 4.19 shows the result of Scree Plot for Use context.
Table 4.23: KMO and Bartlett’s test for Use context

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin Measure of Sampling Adequacy.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bartlett's Test of Sphericity</td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>474.006</td>
</tr>
<tr>
<td>df</td>
<td>6</td>
</tr>
<tr>
<td>Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

Figure 4.19: Scree Plot for Use context

Furthermore, communalities table, which shows the suitability of data ration question commonality, is greater than 0.05 for all the questions. This means that this factor can explain 57% of the total variance. Table 4.24 shows the communalities of the Use context.
<table>
<thead>
<tr>
<th>Total</th>
<th>% of Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.385</td>
<td>57.786</td>
<td>57.786</td>
</tr>
</tbody>
</table>

4.5. Hypotheses Testing

Hereby it has been tried to estimate and present the results of research hypotheses by using Structural Equation Modeling (SEM) technique. Nowadays, SEM is a commonly used method for path analysis. One of the software which supports this analysis is SPSS Amos. Since the software package which has been used for the whole previous analyses in the research is SPSS we used Amos software which is complementary software for SPSS package. Thus, all the analyses in this section will be done by Amos v. 16. Figures 4.20 and 4.21 indicate the models with non-standardized path coefficients and standardized path coefficients.

In order to get better results two restrictions have been put on variables ATT1 and TR. These restrictions have been put with regression weight 1.

As it can be seen on figure 4.21 factor loadings of most variables are higher than 0.5 which shows that almost all variables explain the total use intention. Still there are few variables which cannot explain the effect of variables. For Perceived usefulness (PU) all variables have loading more than 0.5 and factor loadings are successively 0.64, 0.70, 0.72, 0.69. This shows that these variables explain the total use intention very well so the construct Use intention can be defined as marvelously indicative of the total use intention. The value of $R^2$ for this construct equals to 0.467.

For Perceived ease of use (EOU) all variables have loading more than 0.5 and factor loadings are successively 0.61, 0.88, 0.58. This shows that these variables explain the total use intention in a good way so the construct Perceived ease of use can be defined as a good indicator of the total use intention. The value of $R^2$ for this construct equals to 0.494.

For Attitude (ATT) the first variable has loading more than 0.5 (ATT1=0.76) which means that this variable is a very good indicator of the total use intention. But factor loading for the second variable is lower than 0.5 (ATT2=0.30) which means that
Figure 4.20: Model with non-standardized path coefficients
Figure 4.21: Model with standardized path coefficients
this variable is not a good indicator of the total use intention. The value of $R^2$ for this construct equals to 0.333.

For Compatibility (CP) two of the variables (CP1 and CP3) have loadings equal to 0.5 which shows these variables can be indicators of the use intention. But the second variable (CP2) has a loading more than 0.5 (CP2 = 0.86) which shows this variable can remarkably explain the total use intention. The value of $R^2$ for this construct equals to 0.436.

For Prior experience (PEX) both variables have loadings more than 0.5 (PEX1 and PEX2 = 0.77). This shows that these variables explain the total use intention very well so the construct Prior experience can be defined as a good indicator of the total use intention. The value of $R^2$ for this construct equals to 0.592.

For Social influence (SOI) all three variables have loadings more than 0.5 and factor loadings are successively 0.55, 0.70, 0.59. This shows that all three variables are good indicators of the use intention, yet the second variable (SOI2) is a better indicator of the total use intention than the other two. The value of $R^2$ for this construct equals to 0.380.

For Cost (COS) only two variables (COS1 and COS2) have loadings more than 0.5 which respectively equal to 0.79 and 0.67, but the third variable (COS3) has a loading equal to 0.39. This means that COS1 and COS2 can indicate the total use intention very well but the third variable cannot indicate the total use intention. The value of $R^2$ for this construct equals to 0.408.

For Trust (TR) the factor loadings for variables TR1, TR2, TR3 and TR4 are successively 0.12, 0.50, 0.82, and 0.82. This shows that the first variable (TR1) does not indicate the total use intention. Also variables TR3 and TR4 are indicators of the use intention. TR2 is a marvelous indicator of use intention because it has a loading equal to 0.87. The value of $R^2$ for this construct equals to 0.461.

For Risk (RIS) the factor loadings for variables RIS1, RIS2, RIS3 and RIS4 are respectively 0.72, 0.87, 0.50, 0.65. This shows that all the variables are indicators of the total use intention but the second variable (TR2) which has a loading equal to 0.87 is a better indicator of the use intention. The value of $R^2$ for this construct equals to 0.491.
For Mobility (MOB) the factor loadings for variables MOB1, MOB2, MOB3 and MOB4 are respectively 0.72, 0.83, 0.86, 0.58. This shows that all variables are indicators of the total use intention but the second and the third variables (TR2 and TR3) are better indicators of the use intention. The value of $R^2$ for this construct equals to 0.565.

For Use context (USC) the factor loadings for variables USC1, USC2, USC3 and USC4 are respectively 0.58, 0.73, 0.81, 0.54. This shows that all variables are indicators of the total use intention but the third variable (TR3) is a better indicator of the use intention. The value of $R^2$ for this construct equals to 0.452.

### 4.6. Goodness of fit

In the last section it has been tried to present the model’s goodness of fit. The results indicate that the model is overall fitted. For a good fit the result of the Chi Square divided on the Degree of Freedom should be around value 3 or less. The Result shows that this value is 2.477 in this research. Also, the goodness of fit for this model is valued 0.813 which is more than the standard value of 0.80 which indicated a good model fit. All the results of the goodness of fit are presented in table 4.25.

<table>
<thead>
<tr>
<th>Item</th>
<th>Measure Value</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi Square/Degree of Freedom</td>
<td>1831.48/739 = 2.477</td>
<td>≤ 3.00</td>
</tr>
<tr>
<td>Goodness of Fit Index (GFI)</td>
<td>0.813</td>
<td>≥ 0.80</td>
</tr>
<tr>
<td>Adjusted Goodness of Fit (AGFI)</td>
<td>0.862</td>
<td>≥ 0.80</td>
</tr>
<tr>
<td>Root Mean Square Residual (RSMR)</td>
<td>0.121</td>
<td>≥ 0.10</td>
</tr>
</tbody>
</table>

Table 4.25: Model’s Goodness of Fit
5. Chapter Five

Conclusion and Implications

5.1. Introduction

The conclusions and managerial implications presented in this chapter are mainly based upon the quantitative data presented in the previous chapter and in attempt to answer the research questions stated in the first chapter. Furthermore, our research contribution to the mobile ticketing as well as managerial implications is described. Finally, the research limitations are explained and few recommendations for further research are proposed.
5.2. Overall Conclusions

This research was designed to answer the following main questions:

- What are the constructs effective on the customer adoption and intention to use mobile ticketing in public transportations?
- What are the most important factors involved in the customer acceptance and intention to use a mobile ticketing service?
- What measures should service providers take to handle the adoption of mobile ticketing by their customers?

To answer these questions, an exploratory research approach has been adopted to identify the influential factors for customer use intention and adoption of mobile ticketing.

Our initial research model which is taken from the study done by Mallat et al. (2008) is mainly derived from two models in the Information Systems (IS) adoption literature. The first is TAM developed by Davis (1986) and the second IDT developed by Rogers (1983). Also, some other factors have been found in the literature which has been added to the main model.

Finally the research frame of reference was constructed based on both the literature and 6 interviews with the experts. Expert interviews were helpful to approve the research model, to fit it with regards to requirements of Iranian business environment, and the questions which are to be given to the potential respondents. When the model was approved by the experts, the recommended modifications have been made to make the questionnaire more understandable and easy to answer by the potential respondents. In the current model the following constructs have been considered as the effective factors in the customer intention to use mobile ticketing service:

- Perceived usefulness
- Perceived ease of use
- Attitude
- Social influence
- Compatibility
- Cost
After conducting the research model based on an exploratory approach, a quantitative research has been applied to describe the causal relations between variables of the model. So, an explanatory approach was adopted by the use of a research strategy. The statistical population of the study was all Tehran metro users the number of which equals to 1,300,000 by August 11th, 2009 based on the information available in Tehran Metro Admin Automation Database.

Out of 600 collected questionnaires, 138 of them were excluded for inaccuracy reasons, so the response rate equals to 77%. The statistical indicators of validity and reliability of the questionnaire such as Cronbach alpha, KMO and Bartlett’s tests, and factor loadings show that the results of the study have good validity and reliability.

**5.3. Discussions**

The results of this research show that Prior experience (PEX) is the most effective factor in the customer use intention of mobile ticketing and, Mobility (MOB), Ease of use (EOU), Risk (RIS), Perceived usefulness (PU), Trust (TR) and Use context (USC) show importance at a lower level, also Compatibility (CP), Cost (COS), Social influence (SOI) and Attitude (ATT) are unimportant in the customer use intention of mobile ticketing. So, Prior experience is a more important factor than Mobility. Also, Mobility shows nearly the same level of importance as Prior experience and they both show more importance than Perceived ease of use, Risk, Perceived usefulness, Trust and Use context. Social influence and attitude shows the minimum importance in customer use intention of mobile ticketing. They show less importance than Compatibility and Cost.

Thus, the second research question can be answered this way that the most important factors in the customer mobile ticketing use intention are successively Prior experience, Mobility, Ease of use, Risk, Perceived usefulness, Trust and Use context. Also Compatibility, Cost, Social influence and Attitude are regarded as the constructs.
with the least level of importance in the customer’s intention to use mobile ticketing system.

5.4. Managerial implications

Regarding the third research question which is “What measures should service providers take to handle the adoption of mobile ticketing by their customers?” here are suggested few guidelines for implementing this service based on results and findings of this research.

- As the results of the data analysis show, customers show interests in experiencing the system prior to the complete use intention and adoption of the service. So, it will be a genius marketing strategy to offer a limited or unlimited free service use, based on resources, to the customers prior to the system launch. This will be a helpful pull strategy for evaluating and even reinforcing the customer interest on the system and its capabilities. Also, the results of this promotion strategy will help for further understanding of customers’ view on the system and system use. Also, this information will be valuable for service providers to have a better system customization according to the demands and needs of Iranian market.

- Mobility also is of great importance to the customers. The fact that customers can purchase their tickets anytime, anywhere and free of staying in the queues is an opportunity for service providers to meet customer needs prior to service launch. Still the network coverage for the cell-phone operators is not fully covered in all urban and suburban areas. The best network coverage is for ITC, but still 20% of the respondents are users of MTN (Iran cell) and Talia operators which do not have good network coverage whether on the ground in the urban and suburban areas or underground. So, cell-phone operators should improve the quality of their messaging services and should also improve their network coverage facilities underground in cooperation with Tehran Metro Company.

- Because ease of use is identified as an important factor in customer’s intention to use mobile ticketing service, the system should be really easy to use with a user-friendly interface. Also, demanding and choosing the type of ticket should be made easy, by e.g. sending numbers as ticket type request codes.
• Risk is as important as ease of use in the customers’ intention to use mobile ticketing system. Mobile networks and devices are of great importance and customers consider them to be really important for the adoption of mobile ticketing. Mobile wireless networks infrastructure, mobile middleware and wireless user infrastructure, all should support the system use in order to satisfy the customers and result in their constant use of the system. Mobile wireless network infrastructures which are facilitated by mobile service providers should be strong enough to support the data transfer from the mobile set to the ticketing service operator. Mobile middleware should also be considered an important issue in this regards, which can influence the risk of success in the transaction. So, this software layer should be comprehensively compatible with the wireless network and the operating system. Wireless user infrastructure is also another important issue here. Because the suggested system works with SMS and all 2nd Generation and higher technologies support the SMS and because all mobile operating systems have compatibility of sending and receiving SMSs, so this user infrastructure is chosen for this system.

• As the results of the analysis represent, customers show their trust on the cell phone operators and see them capable and competent in providing the mobile ticketing service. This is not the same for Tehran metro. Customers do not show their trust on Tehran metro, but they see this company competent and capable of providing this service. So Tehran metro should attract the customers in a way that makes them repurchase the ticket and results in trust on Tehran metro as a service provider.

• Use context is of importance for the customers as well. Customers show remarkable trends towards using it when they unexpectedly need a ticket, and they need it very fast. Also, because it takes some time for the customer to wait in the queue to purchase a physical ticket, this experience will help the customer consider the fast access to the virtual ticket and to prevent from staying in the queue for a few minutes. Thus, the operating ticketing system should be designed in a way that it responds really fast to a ticket purchase request.
5.5. Research contributions

Theoretically, a wide range of literature review of mobile commerce and its applications is given up from mobile commerce history down to the mobile ticketing system as an application of the mobile commerce. As well, different frameworks in the literature are reviewed and one of the recently applied frameworks was applied to study and find the research questions. From the methodology point of view, it is dedicated to exploration and explanation. It is exploratory because all over the research it has been tried to identify different frameworks and factors involving the adoption of mobile ticketing by the customers. Also, it is explanatory because of the objective to analyze the effects of different factors on the customer use intention of mobile ticketing system. In the application this research is contributed to one of the most recent innovative applications of mobile commerce, which is mobile ticketing, and a few guidelines have been suggested to the service providers to be considered before implementing the service.

5.6. Limitations

Exploration and investigation of research problems, construction and approval of research conceptual framework and model, data collection and analysis and documentation of results in a limited amount of time caused some limitations in the scope and size of the current research. First, because of time constraints only 462 samples were collected. The use of more samples in the current study would add up more confidence in the accuracy of the results as well as improve the fitness indices of our measurement and structural models.

Second, the number of research variables is almost limited because of a compromise between the depth of research and the desired survey response rate. Taking effects of some market demographic characteristics such as age, gender, as moderating variables, would enrich the quality and soundness of the proposed models.

Third, this research has been applied in Tehran Metro ticketing system, and for other transportation systems whether urban, road, rail-way and air a new research should be applied and the conceptual framework should be studied again. The current conceptual framework should be studied again to do another ticketing system in another transportation system.
5.7. Suggestions for further research

- to perform the same study in other transportation systems and other industries other than transportation
- to take into account the demographic characteristics such as age, gender, literacy level and other factors as the moderators in the conceptual model
- to perform the same research with the PLS technique
- to extract new factors from the literature, build-up a study with a new conceptual model and assess the model
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Shantiayi, A. (2008),”Adoption of the multimedia message services (MMS) in Iran”, LULEA UNIVERSITY OF TECHNOLOGY, Sweden.


شکه‌های تلفن همراه یکی از تکنولوژی‌های محبوب می‌گردد که در سال‌های اخیر در کشورهای ایران رشد چشمگیری داشته‌اند. یکی از قابلیت‌هایی که تلفن همراه بروز کاربران استفاده می‌آورد امکان انجام تجارت و داد و سند با استفاده از آن می‌پاشند که خرید بلیط الکترونیکی از نمونه‌های آن است (SMS) مقدار می‌گردد.

در این تحقیق کودکان یک تکنولوژی که در بکارگیری خرید بلیط الکترونیکی با استفاده از تلفن همراه شان ترغیب می‌گردد. یعنی شناسایی شده و راهکارهای مثری در جهت راه اندازی این سرویس بیزه در بخش حال و نقل و سفرگری‌های مشتریان با توجه به دوکی‌های ایران گردید.

"اطلاعیه پرسشنامه به صورت کلی پاکه دهد.

جنسيت:

□ مرد
□ زن

مدت زمان سکونت (سال):

□ 15-24
□ 25-34
□ 35-44
□ 45-54

میزان تحصیلات:

□ دیپلم
□ فوق دیپلم/لیسانس
□ لیسانس و بالاتر

کرایه ارسال پیام کوتاه (SMS) در طول روز:

□ 1 و بیشتر
□ بین 10 تا 30 دقیقه
□ بین 30 تا 60 دقیقه

از کدام ایران‌سال تلفن همراه استفاده می‌نمایید/بیشتر استفاده می‌نمایید؟

□ ایران‌سال (0935) (0933)/تالیف (2140) (0919)

کد ایمنی از گزینه‌های زیر بایگانی حساس و درک شما نسبت به هنگام پیام سروری می‌باشد؟

□ نوآوری‌های ارائه و اجرای سرویس/سیستم علاقوی بوده و سعی در کسب اطلاعات بیشتر در مورد آن را دارم. حتی در این گام اگر سیستم ایمنی برقرار نیست

□ داشته باش از آن استفاده خواهم کرد.

□ جزو اولین استفاده کننده: تعیین گزینه بیش از این سرویس را دارد/پیام‌های می‌گیرم برای سروری اولین برای آن تل‌فکن/من برای خود حمایت می‌کنم.

□ انتخاب سیستم استفاده‌کننده: با پیام‌های این سرویس و استفاده از این تل‌فکن/من برای استفاده از آن تل‌فکن/من برای استفاده از این تل‌فکن/من برای خود حمایت می‌کنم.

□ جزو آخرین استفاده کننده: اگر این سرویس بیش از گیر خواهم شد/خواهم داشت این سرویس از آن استفاده خواهم کرد. چنانکه اگر این سرویس بیش از گیر خواهد شد.

□ بی‌سندی/بی‌سروری: هنگام خروه این سرویس این سرویس می‌بایست به شرایط و جواب مناسب بیشتر بیمه و بیمه شیری بیمه خواه شود.
بعدی از نحوه‌های پرداخت‌های موبایل، را می‌پسندید/پسندیم؟

| کدامیک از طریق سیستم بانکی پرداخت از طریق کارت بانکی پرداخت از طریق قبض موبایل/شارژ موبایل |
|---|---|---|

### فایده تهیه بلیط مترو با موبایل

| کاملاً موافق | محدود | نتیجه بهره‌دار | راحتی خرید بلیط مترو با موبایل
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PU1</td>
<td>سریع‌تر انجام می‌پذیرد.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU2</td>
<td>راحت‌تر است.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU3</td>
<td>نتیجه بهتری دارد.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU4</td>
<td>موبایل و سیستم سودمندی جهت تهیه بلیط می‌باشد.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### راحتی خرید بلیط مترو با موبایل

| کاملاً موافق | محدود | نتیجه بهره‌دار | راحتی خرید بلیط مترو با موبایل
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EOU1</td>
<td>یادگیری خرید بلیط موبایل برای من راحت‌تر خواهد بود.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOU2</td>
<td>خرید بلیط با استفاده از موبایل راحت‌تر خواهد بود.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOU3</td>
<td>خرید بلیط با موبایل را از لحاظ راحتی از روی سنتی بهتر است.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### نظر شما در مورد استفاده از این سرویس

| کاملاً موافق | محدود | نتیجه بهره‌دار | راحتی خرید بلیط مترو با موبایل
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ATT1</td>
<td>فکر و ایده‌های حمایتی است.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATT2</td>
<td>به این فکر و ایده علاقمندم و تمامی به استفاده از آن‌ها دارم.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### سازگاری و مطابقت سرویس با کارهای شما

| کاملاً موافق | محدود | نتیجه بهره‌دار | راحتی خرید بلیط مترو با موبایل
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CP1</td>
<td>خلاصی در سایر استفاده‌ها و کاربردی‌های موبایل من ایجاد نخواهد کرد.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP2</td>
<td>خرید بلیط با موبایل با روشهای کاری و عادت‌های من مطابقت خواهد داشت.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP3</td>
<td>خرید بلیط مترو با موبایل با نحوه پرداخت‌های مترو مطابقت دارد.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### تجربه نمودن سرویس قبل از استفاده

| کاملاً موافق | محدود | نتیجه بهره‌دار | راحتی خرید بلیط مترو با موبایل
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PX1</td>
<td>مایلیم قبل از استفاده کامل آزمایشی استفاده کم</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PX2</td>
<td>قبل از استفاده کامل آزمایشی به تعادل دلخواه استفاده کم</td>
<td></td>
<td></td>
</tr>
<tr>
<td>کلاس مشترک</td>
<td>نظری</td>
<td>ندای</td>
<td>موافق</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>SOI</td>
<td>افرادی که آن استفاده می کنند طرفدار ایده های جدید هستند.</td>
<td>اعتقاد به همه گیری بشدت موبایل درآینده نزدیک دارم.</td>
<td>استفاده از آن کلاس اجتماعی را بالا خواهد برد.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>کلاس مشترک</th>
<th>نظری</th>
<th>ندای</th>
<th>موافق</th>
<th>مخالف</th>
<th>مزایه</th>
<th>COS1</th>
<th>COS2</th>
<th>COS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>COS</td>
<td>اگر هزینه کشیدن داشته باشند آن را بهبود می یابد.</td>
<td>اگر قیمت آن معقول باشد آن را بهبود می یابد.</td>
<td>اگر هزینه کشیدن داشته باشد قطعاً نخواهم خرید.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>کلاس مشترک</th>
<th>نظری</th>
<th>ندای</th>
<th>موافق</th>
<th>مخالف</th>
<th>استفاده</th>
<th>TR1</th>
<th>TR2</th>
<th>TR3</th>
<th>TR4</th>
</tr>
</thead>
</table>
| TR | شرکت متروی تهران تنها کننده قابل اعتماد برای ارائه این سرویس است. | شرکت متروی تهران نوآوران ارائه این سرویس را دارد. | اپرانتور تلفن همراه من تنها کننده قابل اعتماد برای ارائه این سرویس است. | اپرانتور تلفن همراه ارائه این سرویس را دارد.

<table>
<thead>
<tr>
<th>کلاس مشترک</th>
<th>نظری</th>
<th>ندای</th>
<th>موافق</th>
<th>مخالف</th>
<th>ریسک</th>
<th>RIS1</th>
<th>RIS2</th>
<th>RIS3</th>
<th>RIS4</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIS</td>
<td>تلفن همراه ابزار مطمئن جهت خرید بیلیت متروی باند.</td>
<td>شبکه های تلفن همراه به میزان کافی برای خرید بیلیت متروی باند.</td>
<td>در استفاده از بیلیت موبایل ریسک بوجود آمد مشکلات بخت شارز کم باطری و یا قطع ارتباط با شبکه کم می باشد.</td>
<td>ریسک بر روی مشکلات فی در سیستم خرید بیلیت موبایل پایین می باشد.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>کلاس مشترک</th>
<th>نظری</th>
<th>ندای</th>
<th>موافق</th>
<th>مخالف</th>
<th>سیار بودن</th>
<th>MOB1</th>
<th>MOB2</th>
<th>MOB3</th>
<th>MOB4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOB</td>
<td>صف خرید بیلیت نخواهم داشت.</td>
<td>خرید بیلیت توسط موبایل در هر ساعت از شبانه روز ممکن می شود.</td>
<td>خرید بیلیت توسط موبایل در هر محل که بخواهم</td>
<td>خرید بیلیت با استفاده از موبایل چاپ‌گذاری مناسب برای پول نقد يا کارت اعتباری است.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
پول نقد برای خرید بلیط به همراه نداشته باش.

عجله داشته باشم و یا فورا به بلیط نیاز داشته باشم.

به طور غیر منتظره به بلیط نیازمند باشم و برای خرید بلیط آماده نباشم.

در محل‌های فروش بلیط صف وجود داشته باشد.

با تشکر از همکاری شما
Appendix 2: the research questionnaire (in English)

"Investigating Effective Factors and Presenting a Practical Guideline to Adoption of Mobile Ticketing"

(Case of purchasing public transport tickets-Metro)

Mobile networks are one of the technologies with remarkable growth in Iran. One of the applications cell-phones have provided for users is to do commerce via cell phones, mobile ticketing being a sample of it. This service can be implemented and applied through mobile services and facilities such as SMS.

In this research it has been tried to determine the effective factors in customer acceptance of mobile electronic tickets (m-tickets) through cell-phones and practical guidelines to implement this service in public transportation systems will be introduced.

"Please answer all the following questions"

Gender
- Male
- Female

Age Group
- 15-24
- 25-34
- 35-44
- 45-54
- 55 or more

Education
- less than high school
- High-School Diploma
- Associate/Bachelor
- Graduate and Post-Degree

SMSs sent per day
- 1 or none
- 2 to 5
- more than 5

Cell-phone use per day
- less than 10 minutes
- 10 to 30 minutes
- 30 to 60 minutes
- more than 60 minutes

Which cell-phone operator do you use (more)?
- ITC(0912/0919)
- MTN/Iran-Cell(0935/6/7)
- Talia(0932)

Which of the following choices shows your feelings and understanding of purchasing metro tickets via cell-phone?
- Innovative: before implementation I am interested in getting more information about it. If I face any problem at the beginning of the system implementation I will use the system.
- Early adopter: Surely, I will use the system. Also, I think it will be and efficient and useful. I will be one of those who will use the system at the very beginning it is introduced.
- Majority Adopter: Before the system use is spread I do not have the desire to apply it and will not use the system till the efficiency is proven.
- Late Adopter: I am sure that this service will be widespread but I will use the system, when all the conditions and aspects are defined, the service is supported and ready to be implemented.
- Reluctant: I am sure that I will not use the system, even if, the use is widespread.

Which payment method are you interested in/most interested in for purchasing mobile tickets?
- Payment through bank account
- Payment through ATM Card
- Payment through mobile bill/credit charge

<table>
<thead>
<tr>
<th>PU</th>
<th>Usefulness of purchasing metro ticket with cell phone</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU1</td>
<td>is faster</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU2</td>
<td>is more convenient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU3</td>
<td>has better result</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU4</td>
<td>Cell-phone is a useful tool for purchasing a ticket.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EOU</th>
<th>Ease of Use for purchasing mobile tickets</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOU1</td>
<td>Learning how to purchase mobile tickets is easy for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOU2</td>
<td>Purchasing mobile tickets is convenient</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EOU3</td>
<td>Purchasing a mobile ticket more comfortable than the traditional ticket purchasing</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATT</th>
<th>Attitude towards purchasing mobile tickets</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATT1</td>
<td>It is a good idea.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATT2</td>
<td>I like the idea and have the desire to use the system.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CP</th>
<th>Compatibility of the system with your works</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP1</td>
<td>Purchasing mobile tickets is compatible with my other use of the mobile phone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP2</td>
<td>Using mobile tickets is compatible with my style and habits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP3</td>
<td>Mobile ticket is compatible with my way to pay for metro tickets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PEX</th>
<th>Prior Experience before using the system</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEX1</td>
<td>I want to experience the service prior to the adoption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEX2</td>
<td>I want to experience the service for times, prior to the adoption</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>SOI</th>
<th>Social Influence of purchasing tickets with mobile</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOI1</td>
<td>Mobile ticket users are forerunners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOI2</td>
<td>Using mobile tickets will be trendy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using mobile tickets will give me more respect

<table>
<thead>
<tr>
<th><strong>Cost</strong></th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>COS1</td>
<td>I will purchase the ticket if it costs less</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COS2</td>
<td>I will buy the mobile ticket if the price is reasonable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COS3</td>
<td>If it costs more will not purchase it</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Trust</strong></th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR1</td>
<td>Tehran metro can be a trustworthy mobile ticket provider</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR2</td>
<td>Tehran metro can be a capable and competent mobile ticket provider</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR3</td>
<td>My mobile operator can be a trustworthy mobile ticket provider</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR4</td>
<td>My mobile operator can be a capable and competent mobile ticket provider</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Risk</strong></th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIS1</td>
<td>Mobile phones are reliable enough devices for purchasing mobile tickets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIS2</td>
<td>Mobile networks are reliable enough for purchasing mobile tickets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIS3</td>
<td>In mobile ticket use the risk of problems due to low battery or lost network connection is small</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIS4</td>
<td>The risk of technical problems in mobile ticketing system is small</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Mobility</strong></th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOB1</td>
<td>Purchasing a ticket with a mobile phone reduces queuing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOB2</td>
<td>Purchasing mobile tickets can be done every time during day and night</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOB3</td>
<td>Purchasing mobile tickets is independent of place</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOB4</td>
<td>I can substitute the need for cash or travel card by purchasing a mobile ticket</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Use Context</strong> (when/where I will purchase a mobile ticket)</th>
<th>Completely Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Completely Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>USC1</td>
<td>I have no cash for purchasing the ticket</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USC2</td>
<td>I’m in a hurry or need the ticket fast</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USC3</td>
<td>I need the ticket unexpectedly and have not prepared for purchasing it</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USC4</td>
<td>If there are queues in points of ticket sale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thanks for your cooperation"