MOBILE GOVERNMENT IN TURKEY:
INVESTIGATING CRITICAL SUCCESS FACTORS, DRIVERS AND BARRIERS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF INFORMATICS
OF
THE MIDDLE EAST TECHNICAL UNIVERSITY

BY

ANIL ÜSTÜN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
THE DEPARTMENT OF INFORMATION SYSTEMS

SEPTEMBER 2007

Approval of the Graduate School of Informatics

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ABSTRACT

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September 2007, 129 pages

The number of mobile phone users in Turkey has already exceeded the number of households with the internet access. The presence of technologies which allowed more bandwidth and access from almost everywhere such as UMTS, Wi-Fi, or Wi-Max is putting a pressure on governments to enter into a new direction: m-government. As mobile phone penetration increases, its presence in the public sector is increasingly being viewed as inevitable.

In this thesis, a strategic action plan model for the developing countries to achieve success in the development of m-government will be constructed. Meanwhile, critical success factors for Turkey are to be identified by a comparison of selected country cases. Moreoever, drivers and barriers for mobile government in Turkey and the affects of the demographic factors are examined by using the One-Way ANOVA and Pearson Chi-Square tests.

Keywords: Mobility, M-Government, Wireless Mobile Technologies, Critical Success Factors

ÖZ

TÜRKİYE'DE MOBİL DEVLET:
KRİTİK BAŞARI FAKTÖRLERİ, YÖNLENDİRİCİLER VE ENGELLERİN ARAŞTIRILMASI

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Eylül 2007, 129 sayfa

Türkiye'de cep telefonu kullanıcılarının sayısı internet erişimine sahip hane sayısını çoktan aşmıştır. UMTS, Wi-Fi, veya WiMax gibi hemen her yerden daha çok bant genişliği ve erişim sağlayan teknolojilerin varlığı hükümetlere yeni bir düzene geçmeleri için baskı yapmaktadır: m-devlet. Cep telefonu kullanımı arttıkça, m-devletin varlığı kamu sektörü açısından gittikçe kaçınılmaz görünmektedir.

Bu araştırmada, gelişmekte olan ülkelerin m-devlet gelişiminde başarı kazanmalarına yönelik bir stratejik hareket plan modeli oluşturulacaktır. Aynı zamanda, seçilmiş ülke vakaları karşılaştırılarak, Türkiye için kritik başarı faktörleri saptanacaktır. Ayrıca, Tek-Yönlü ANOVA ve Pearson Ki-Kare testleri uygulanarak, Türkiye'de m-devlet açısından yönlendiriciler, engeller, ve demografik faktörlerin etkileri incelenecektir.

Anahtar Sözcükler: Mobilite, M-Devlet, Kablosuz Mobil Teknolojiler, Kritik Başarı Faktörleri

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. Ali Arifoğlu and co-supervisor Prof. Dr. Ali Yazıcı for their help, guidance and insight throughout the research. I would also like to thank Prof. Dr. İbrahim Akman for his valuable support and constructive criticism.

Throughout my studies, all my friends helped me in one way or another and provided support with their invaluable friendship. Special thanks to Deniz Uzun, without her patience, encouragement, support and valuable comments, I would not have completed this thesis. She deserves more than a simple “thank you”.

Finally I wish to thank my mother, for her love, support, understanding, and faith in me.

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LIST OF ABBREVIATIONS

‘m’: Mobile

M-gov: Mobile Government

E-gov: Electronic Government

3G: Third Generation

ADSL: Asymmetric Digital Subscriber Line

CATV: Cable Television

CDMA: Code Division Multiple Access

EC: European Community

EU: European Union

G2B: Government-to-Business

G2C: Government-to-Citizen

G2G: Government-to-Government

GDP: Gross Domestic Product

GPRS: General Packet Radio Service

GSM: Global System for Mobile communications

HSDPA: High-Speed Downlink Packet Access

IEEE: Institute of Electrical and Electronics Engineers

ISP: Internet Service Provider

IT: Information Technology

iDEN: Integrated Digital Enhanced Network

LDAP: Lightweight Directory Access Protocol

MMS: Multimedia Messaging Service

MNP: Mobile Number Portability

MVNO: Mobile Virtual Network Operator

NGO: Non-Governmental Organization

DoCoMo: Do Communications Over the Mobile Network

OECD: Organization for Economic Cooperation and Development

OTC: Overseas Telecommunications Commission

PC: Personal Computer

PIN: Personal Identification Number

PSTN: Public Switched Telephone Network

RFID: Radio-Frequency Identification

SK: South Korea Corporation

SMS: Short Message Service

STAP: Short Term Action Plan

TA: Telecommunications Authority (Turkey)

TDMA: Time Division Multiple Access

UMTS: Universal Mobile Telecommunications System

UN: United Nations

VDSL: Very High Speed DSL

VoIP: Voice over IP

WAN: Wide Area Network

WAP: Wireless Application Protocol

W-CDMA: Wideband Code Division Multiple Access

WEP: Wireless Encryption Protocol

Wi-Fi: Wireless Fidelity

Wi-Max: Worldwide Interoperability for Microwave Access

WLAN: Wireless Local Area Network

VPN: Virtual Private Network

XML: Extensible Markup Language

CHAPTER 1

INTRODUCTION

This chapter explains the e-gov and m-gov concepts. First we look at mobility in general. Afterwards the motivation behind that study and the problem is defined in the context of mobile government in Turkey. Consequently, the thesis structure is included.

1.1 Overview

1.1.1 E-Government and M-Government

The OECD [1] defines e-gov as *"the use of information and communication technologies, and particularly the Internet, as a tool to achieve better government"*. In addition, Gang [2] defines e-gov as *"Conventional government services made available for citizens through electronic means such as internet connected computers and other devices."*. Main objective of e-gov applications is to increase the productivity in the public sector, so that services can be provided by various channels, at a lower cost and time [3].

The rapid development of mobile technologies such as internet enabled mobile phones, PDA, Wi-Fi and wireless networks has created a new direction and spurred the

development of m-commerce and m-business models, which are perhaps equally relevant to government [2]. Such use of wireless technologies to deliver government services is usually called mobile government or simply m-gov [4]. From a citizen perspective, m-gov stands for a new kind of access to public services that have been made available specifically for mobile devices or adapted from existing e-gov applications [5].

Kushchu and Kuscu (as cited in [6]) defined m-gov as *"Strategy and its implementation involving the utilization of all kinds of wireless and mobile technology, services, applications and devices for improving benefits for citizens, business and all government units"* [6]. This definition corrects our understanding of m-gov that m-gov is not about a pure information provision via mobile phones from government to citizens but a complex strategy for efficient utilization of all wireless/mobile devices (mobile phones, handhelds, PDAs, wearable PCs, Blackberry pagers, etc.) with maximal added value to all involved parties – government on one side and citizens and business on the other [7].

Mobile government is a new research area with respect to electronic government. There is no certainty whether it will replace e-Gov or if it is an alternative access channel, however in the oncoming parts of the thesis we will witness that m-gov cannot be seen as replacing e-gov and in many cases it will be complementary to e-gov efforts [6].

While e-gov is interested in the handling of government operations, m-gov deals with the mobility of the government itself. To better comprehend what lies behind m-gov we should understand mobility concept in advance [7]. In the following section this concept is analyzed.

1.1.2 Investigating Mobility

The adjective “mobile” goes back to the Latin word “mobilis”, meaning movable. In this sense, mobile objects are capable of moving, being moved or not fixed in place or condition [7].

There are functional characterizations of mobile technology use [9]. For instance, in some cases mobility can be seperated as regional and global mobility [10], and in some cases it can be classified in three modality of traveling, visiting and wandering [11]; on the other side, there are three aspects of mobility: spatial, temporal, and contextual [12]. Spatial mobility considers the mobility of people, objects, symbols, and space itself. Temporal mobility means change from linear clock time to social time [8]. Contextual mobility means a shift from locally conditioned to flexibly coordinated interaction [2].

The mentioned levels of mobility help to illustrate the relationship between mobility and human interaction. The below stated levels mention mobility from the user point of view [7].

- *Device mobility:* the continued access to services with a device while moving.
- *User mobility:* location and device independent service access.
- *Service mobility:* the capability to provide a certain service irrespective of device and user.

There is an important difference between “Wireless” and “Mobile” concepts. “Wireless” simply describes devices which can communicate wireslessly, on the other side “Mobile” is something capable of moving or being moved. Therefore, communication is available anytime and anywhere in the sense of mobility. For instance, desktop PC can be wireless as mobile phone, however it does not have

mobility. Thus, a common misunderstanding in mobile technology has to be corrected: wireless ≠ mobile [7].

1.2 Problem Statement

Turkey is well-developed in the ICT sector with modern networks in both fixed and mobile technologies and it is a very large country with a mix of market segments. However, it is the only country that doesn't have 3G licences among European member or candidate countries. On the Turkey's 2007 agenda will be awarding of 3G licenses, mobile number portability (numerical carriage) and entry of four operators. Full liberalization and effective regulation of the market are expected to attract many other foreign investments into the sector as operators, subcontractors or service providers and equity suppliers.

Most European countries had made mistakes by requesting high license fees in tenders, and implementing wrong strategies in the development of m-gov. On the other side, Asian Pasific region countries were very successful as their governments implement the correct strategies, for instance Japanese government gave the licenses for free and kept good relationships with the operator and manufacturers. Moreover, South Korea launched a training program for their citizens to increase their technology readiness. Meanwhile, Australia decreased regulations to create an open environment for the competition. Therefore, Turkey has to follow the correct footsteps and take good lessons from successful m-gov country cases. Hence, comparing country cases is a good way to derive good lessons from.

In the light of these explanations, there are three main goals of this thesis. Primarily, to evaluate m-gov in Turkey and discuss the odds of Turkey's success in m-gov. Secondly, to develop a strategical plan model for the success of m-gov by identifying critical success factors and other related components for m-gov, as we believe such a

model would prove useful for any developing government involved in the the initial phase of planning, development and implementation of m-gov service delivery. Moreover, when a country implements such strategical plan, there will be challenges to be faced. Therefore, with respect to this, we investigate the drivers and barriers for mobile government in Turkey and examine how they are affected.

1.3 Motivation

The starting point of this work can be described under three major trends [6]:

(1) mobile device penetration in Turkey;
(2) convergence of wired Internet and wireless telecommunication networks in the world;
(3) the upcoming 3G services and higher data transfer rates in Turkey.

In Turkey, use and development of wireless services by a critical mass is achieved. We are witnessing a great amount of demand on mobile and wireless internet appliances, including internet-ready mobile phones and PDAs. As the number of mobile and wireless internet appliances continues to grow, it is apparent that citizens will demand e-gov services via the wireless medium besides wired medium. Wireless access will include public and private partnerships to extend Internet access in rural and remote areas.

Mobile technology use is not just a strategic choice at macro level, but the technology is increasingly used by millions of Turkish citizens. As of early 2006, 44 million mobile phones are estimated to be owned in Turkey. Ten years ago, this number was only 0.8 million as you can see in Figure 1. Such a development gives developing countries such as Turkey a leapfrog in adopting new technologies [12].

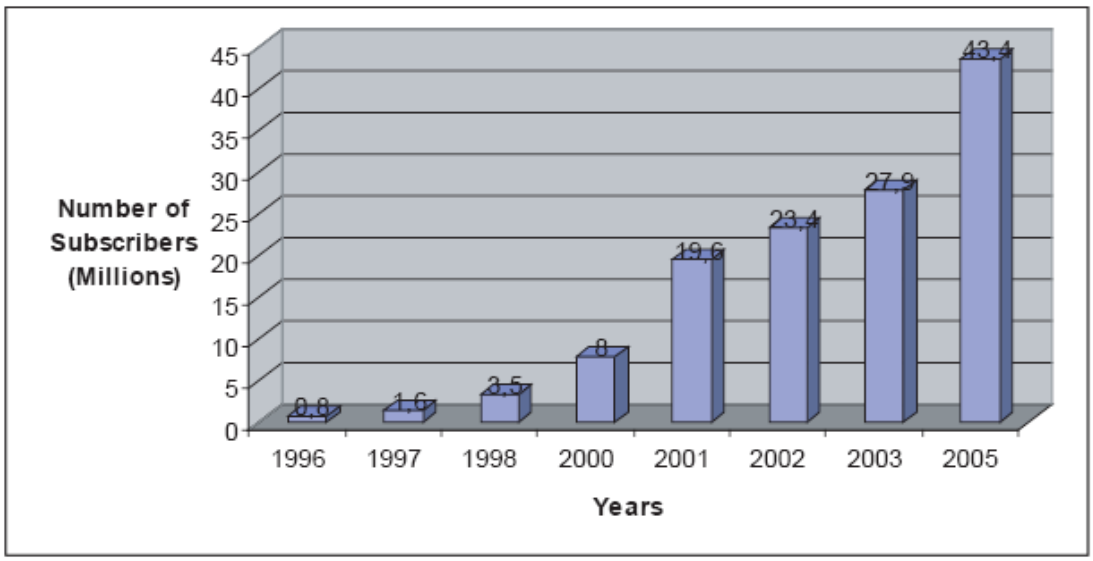

Figure 1. Diffusion of mobile phone ownership in Turkey [12]

In developing countries with insufficient communication infrastructures and greater penetration of mobile phones, m-gov applications may become an efficient solution to reach citizens in those rural areas. For instance, Turkey is a great example for this situation with having high levels of mobile phone penetration [12]. From Table 1, we clearly see that the percentage (72.68%) of owning mobile phones by households are a close second to the household television ownership (97%) in the country. When considering low GDP per capita around $6.700 in 2005 [13,14], such a high level of mobile penetration is more interesting [12,15]. However, this result should not be very suprising for Turkey, because generally Turkish users see mobile phone not only as a status symbol, but also as a leisure device (SMS, game-playing) and a practical tool for satisfying sociability and security needs [12,16].

The Turkish mobile market is currently home to three operators, Turkcell, Vodafone-Telsim and Avea [12]. The mobile government infrastructure supports 2.5G services as of January 2006. 3G licences are expected to be available in 2007 [17].

Table 1. Household technology ownership in Turkey (%) [8]

Technology	Percentage of Households Owning a Technological Device		Percentage of Households Having a Device that Connects to the Internet	
Year	2004	2005	2004	2005
Television (including satellite and cable TV)	92.19	97.74	0.13	0.05
Mobile Phone	53.64	72.62	2.08	3.21
PC	9.98	11.62	5.86	5.86
Game Console	2.85	2.9	0.24	0.02
Laptop	0.85	1.13	0.55	0.74
PDA	0.13	0.14	0.06	0.08

Turkey's telecoms regulator has delayed the country's planned 3G license tender after Turkish general elections. In conclusion, in the sight of these developments in Turkey, transformation from e-gov to m-gov become inevitable [6].

1.4 Thesis Structure

The thesis is organized as follows:

Chapter 2 is followed by a general literature overview of m-gov. Primarily, the conceptual context for m-gov is described. Afterwards, different projects and business modes are discussed. In addition to this, regarding technology, infrastructure and achitecture is reviewed. Consequently, case studies about the different m-gov services are given and different types of m-gov applications are explained.

In Chapter 3, comparison of four country cases is made, including the case of Turkey. Odds for Turkey’s success in the context of m-gov is discussed. Critical success factors are identified. With respect to this, a strategic plan model considering developing countries is developed.

In Chapter 4, the most significant drivers/barriers, in the design of a successful strategic action plan model for m-gov, are analyzed by a quantitative analysis, through a total of 238 completed survey questionnaires. In addition to this, affects of demographic factors on these drivers/barriers are analyzed and discussed by implementing One-Way ANOVA test. Consequently, the findings are supported with Pearson Chi-Square test.

Chapter 5 concludes by summarizing the literature survey, discussing findings, and contributions and limitations of the work.

CHAPTER 2

REVIEW OF LITERATURE

2.1 The Conceptual Context for M-Government

2.1.1 Understanding M-Government

M-gov is a subset of e-gov. While in e-gov, use of information and communication technologies (ICTs) is unlimited, in the case of m-gov, those ICTs are limited to mobile and/or wireless technologies like cellular/mobile phones, and laptops and PDAs connected to wireless local area networks (LANs). M-gov can help make public information and government services available "anytime, anywhere" to citizens and officials [18-20].

As discussed earlier, m-gov is not a replacement for e-gov, they complement each other [6,18]. While mobile devices are very suitable for access from anywhere, anytime, they are not suitable for complex and voluminous information transmission. In time, more sophisticated mobile devices such as PDAs, Blakberrry pagers emerged, however they do not have the same amount of features and services as PC-based Internet applications.

Citizens may see m-gov as a tip of an iceberg, because they see only the the final delivery channel to the citizen. Underneath is a complex and costly infrastructure that is required in order to make that final delivery device work.

2.1.2 The transition from E-Government to M-Government

Today, in every country, societies are becoming connected to each other due to the fast development of Internet and similar technologies. This coming decade seems to be the era of e-gov. Citizens and customers who are aware of the improvement and efficiency of these technologies are demanding more from their governments in terms of better quality government and business services [6].

While e-gov is a very significant step for governments to close the digital divide, wireless access, adoption of mobility, and providing improved services via mobile technologies is now inevitable [6,21]. Wireless access and adoption of mobility will not be only over GSM operators but also be via wide area government networks. For instance, in some cases like in the developing countries, public and private institution collaboration to extend Internet access in rural and remote areas should be realized to ensure the adoption of mobility [8,22].

M-gov is particularly suited for the developing world where Internet access rates are low but mobile phone penetration is growing rapidly, particularly in urban areas [6,18]. Globally, the number of mobile phones has surpassed the number of fixed/wired phones. This is also the case in many individual nations, including 49 middle-income and 36 low-income countries. Among these countries are Burkina Faso, Chad, Honduras, Indonesia, Jordan, Mexico, Mongolia, Nigeria, Philippines, Saudi Arabia, South Africa and Turkey. According to a recent study, the population of global SMS users will grow to 1.36 billion in 2006.

2.1.3 M-Government and Its Differentiating Characteristics

It is very important to indicate that the specific use of mobile technologies and applications differentiates m-gov from any other developments in the public sector using new technologies, including e-gov. Based on a study of mobile technologies, and their practical applications in governmental agencies, the following differentiating factors are apparent [22]:

- *Convenient accessibility and availability:*
    - Citizens can use the online governmental services not only "anytime" but also "anywhere".
    - Mobile devices are always "switched on" compared to laptop computer.
    - Applications are designed to provide instant information to the users, for instance, sending out warnings about forthcoming bad weather conditions or emergencies.
- *Precision and personalisation:*
    - Mobile devices are designed for personal use by one individual, but a computer might be shared among different users person.
    - M-gov reaches end users through a more personal, familiar and friendly device.
- *Larger and wider user base:*
    - Mobile/wireless communication often far exceeds the wired Internet user community, therefore m-gov reaches a larger number of people through mobile devices.
    - M-gov reaches not only experienced or active users of internet, but also people who have no training or experience with computers and the internet.

2.1.4 The Impact of Mobile Government on the Internal Organization

In this section, we summarize some of the potential impacts of mobile technologies on organizational structure, civil workers, and business processes [22].

2.1.4.1 The Impact on Structure

One expected outcome of deploying m-gov is increase in productivity with the increasing demands of the citizens for faster and better service. Mobile government applications may reflect itself in the structure of the organization in the following possible ways:

- *Reduction in the number of people performing the job:* With the advent of new mobile applications bureaucracy decreases.
- *Establishment of new virtual departments:* Civil workers working in the local, regional, and national government entities work online as they do not require office space anymore to perform their tasks.
- *Consolidation of divisions/departments and reduction in hierarchical levels:* With the initialization usage of new mobile applications, interrelated divisions/departments will expect to integrate their databases or information sharing processes and then move into a consolidation.

2.1.4.2 The Impact on Civil Workers

Depending on the demographic characters (age, background, etc.) of the users, adaptation of using new wireless devices and learning process to enter information via wireless/mobile networks may take longer than expected. This may cause delays in project achievements. Furthermore, some adjustments in the civil workers' job descriptions can be required or hiring new people with different skills into the

organization can be necessary. To do some adjustments, extra training lessons may be required for those who are not familiar with information technologies, and other workers that have some deficiencies in their skills which are necessary for the adaption of these new wireless/mobile technologies.

Although, these training sessions are successful, during the implementation phase, some technical problems may arise. This may demorilize the officers and affect the projects in a unfavorable way. Therefore, it is very crucial that civil workers involve in part of the mobile solution during the planning and implementation phase. This policy will encourage and convince workers that they can perform beter and save time by using these applications.

Moreover, wireless/mobile technologies may reduce the amount of personal communication between people. For instance, workers may acquire additional information by using his/her mobile/wireless device, this enables workers to not need to go the office and ask for additional information to their colleagues. Thus, besides decreasing the working process of civil workers, m-gov applications make authorities to track their own workers using the location-base characteristic of the mobile devices. This may improve efficiency by making governments' assignment task easier as calling the person on duty located closest to the incident. On the other hand, this may create a discipline environment, due to workers being monitored and tracked anytime and anywhere.

2.1.4.3 The Impact on Business Processes

Within the same same government organization, information is scattered through its different divisions/departments. Process time and costs can be reduced with the support of m-gov by combining all organizational knowledge on a real-time basis. This

combining enables the civil workers who have different roles/tasks in the same process to perform faster and more efficiently.

As discussed before, with the usage of mobile devices workers do not require any office space, therefore civil workers could be viewed as virtual workers, and offices could be visualized as virtual offices. This creates a more flexible environment for those workers. The major impact of mobile government is likely to be on streamlining business processes on a single, shared platform by gathering, updating, and processing data from all departments anytime and anywhere. Figure 2 shows the evolution of mobile government.

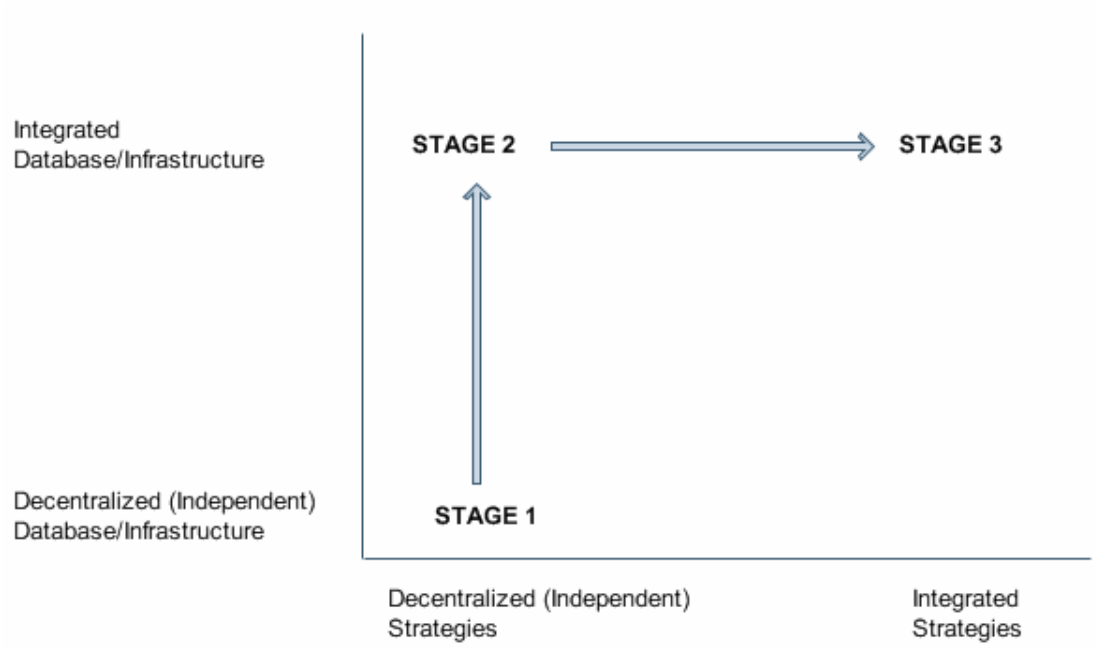

Figure 2. The evolution of mobile government [22]

In the first stage, mobile government strategies are decentralized, because it is reasonable that strategies are initially tried out locally than on a city or country basis. At this phase, m-gov strategies will be independent of a unified database or infrastructure. As we come to the second stage, m-gov applications wll become more

common to the public, and more local authorities will adopt it. In the last stage, it is appropriate to use integrated database and infrastructure that will allow the information to be shared across all government entities [22].

2.1.5 Soft Success Factors for M-Government

Companies and institutions increasingly feel the need for strong organizational frameworks and soft skills, that is, behavioral and managerial skills to be integrated with technical competences [22,27]. "Soft" framework refers to organizational factors and competences that enable successful e-gov and m-gov implementation. It supports the implementation of m-gov actions and the management of related organizational changes. For example, OECD [26] has highlighted the importance of leadership and soft skills for successful e-gov.

2.1.5.1 A Soft Reference Framework for M-Government Success

Public administration management and employees should develop a citizen-oriented attitude and learn to share information society values in order to succeed in m-gov services.

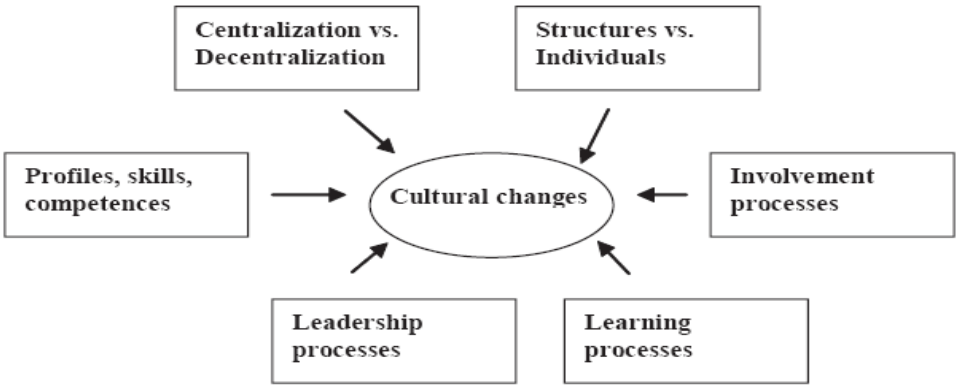

Figure 3. Cultural changes: Related enablers [27]

According to this organization theory, a reference framework developed within the 12 countries considered, and validated by online questionnaires and field surveys which incorporates a set of organizational, behavioral, and learning dimensions as well as skills and attitudes.

In Figure 3, the mentioned reference framework dimensions are represented as [27]:

- *Centralization vs. Decentralization:* This dimension describes the relationship between central government and local agencies.
- *Structures vs. Individuals:* This dimension classifies projects according to the importance which is given to structures rather than to individuals.
- *Involvement Processes:* This dimensions focuses on the meaning of "involvement" within e-gov and m-gov policies. When a new e-gov or m-gov project needs to be promoted, involment is very crucial. This process can be done both internally and externally. Internally, for instance, toward employees and public servants, and externally, for example, toward customers (citizens and companies) and stakeholders.
- *Learning Processes:* This dimension focuses on how public administrations "learn" and on which role is attributed to formal training. Learning is a key factor for cultural changes. Organizational models and size can have a significant influence on informal (unaware/natural) or non-formal (non-structured even if explicit) learning processes such as learning during their job, through mentoring and coaching, team working, working by projects, job rotation, business trips, and so on.
- *Leadership Processes*: This dimension focuses on leadership, which is the capability to manage a complex process and become a recognized guide as well, could be referred to structures or to individuals.

- *Profiles, Skills, Competences*: This dimension aims at identifying the skills and competences, that is, knowledge and skills put into action. Actors with different job profiles need to develop and manage m-gov projects.

2.2 M-Government Projects and Business Models

This section will evaluate the business and revenue models for running m-gov services in a sustainable way. Moreover, it will analyze information strategies based on the results of EC-funded projects and discuss some related issues like payments, advertisement, sponsoring, funding and platform sharing [29].

2.2.1 Projects APNEE and APNEE-TU

The vision of APNEE (Air Pollution Network for Early warning and on-line information Exchange in Europe) was to establish an information service which informs citizens about the current air quality taking into account the current location of the citizen, the preferences of the citizen, and the availability of different information access channels (mobile: mobile phones, smart phones, PDAs, street panels; at home: PC with Internet, voice server) [29,30]. Based on the successful implementation of an online information service for the citizen, a major European field trial was launched with project APNEE-TU (Take-UP measure). APNEE finally operates air pollution information service in Norway, Germany, Spain, France, and Greece on different channels according acceptance and business models [31].

2.2.2 USE-ME.GOV

Project USE-ME.GOV developed an open service platform for m-gov that can be shared by networked authorities and institutions that is both cost-effective and efficient. This open platform promotes usability, sharing, openness, interoperability,

and scalability, thus enabling service deployment and access [29,31]. Moreover, this project developed attractive business models for the sustainable operation of such services and also provide the sharing of services by several authorities as well as public-private partnerships between authorities and commercial companies. Hence, project USE-ME.GOV's key objective was to support and encourage public administrations to provide new e-gov services at any time and anywhere through the use of mobile communications technologies allowing:

- To share common modules with other departments or other authorities (for example subscription, alerting components).
- To secure development and operation by open source transparency.
- To attract further mobile operator independent of respective interfaces.
- To estimate efforts, outcome and benefits in advance.

Open service platform that can be shared by networked authorities and institutions in terms of technical resources as well as commercial means will increase the quality of public services and will help in closing the digital divide phenomena. The platform has been finalized and validated in four European regions and will be operated on the basis of different business models depending on the individual validation results [3, 29,31,32].

2.2.3 Value Chains for Multi-Channel Services Model

APNEE implemented a value chain with several stakeholders seen in Figure 4 [29]:

- *Authorities and Non-Governmental Environmental Organizations* provide the data and the knowledge about the data, its sources, measurement networks, quality measures and of course legislation background.

- *Research Institutes and Universities* supplement this information with forecasting models and impact analysis.
- *Private Portal Operators* are bringing in the contacts and knowledge about information markets and specific customer requirements. Therefore, they supplement the data with background information (like health impacts) and user-friendly visualization means.
- *Telecommunication Operators* are delivering the information and service to the customers via multi-channel platforms. They might also enhance the service with location based features.

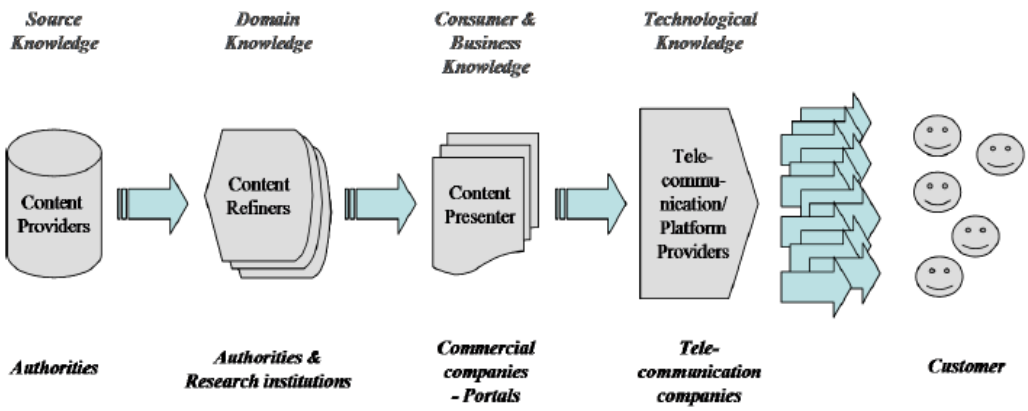

Figure 4. Structure of the information value chain in APNEE-TU [29]

This value chain proved to be successful because:

- High-quality data is available.
- The impacts of air pollution elements are well researched.
- Internet and mobile end user devices are common and widespread; multi-channel service provision will therefore better reach the citizen.

- Telecommunication providers host multi-channel systems and are eager for content with demand.
- Authorities want and have to reach the public with modern communication means.
- Authorities and NGOs foster the capitalization of their data and services to create value.

This value chain allows authorities an easier implementation of multi-channel information services for reaching the public [3, 29,30,31].

2.2.4 PPP Business Model

Public-private partnerships (PPP) combine partners from the public and the private sector. They are differently structured, have a different policy and business aim, and underlie different legislations. Let us examine the different partnership models between them [29].

Firstly, governments deliver their data and service to a well-defined interface, afterwards commercial organizations pick it up and revalue them for their business purposes, respecting to the rules agreed upon concerning the end-user price. This business model could increase the efficiency of the market of public sector information, gives each commercial partner a fair access, and avoids competition by public authorities operating such services themselves.

Secondly, the private sector carries the cost of initial implementations in order to prove the effectiveness of the technology, and further costs are covered by the government, if the service is successful [33]. This business model is established by the government of Hong Kong for electronic services delivery named as *electronic service delivery (ESD)* [34]. Here, the private sector operator was responsible for developing, financing,

operating, and maintaining the system, and the government started to pay transaction fees to the operator after the transaction level has reached a pre-agreed volume. In this case, the business risk to the government is low; while the private sector operator has continuous incentive to promote the wider use of the e-gov services and to introduce service enhancement.

Lastly, an another alternative option for a PPP is the one where commercial company builds and operates the mobile service, and charges the customer/citizen for using the service [35]. Revenues can be shared between authority and private partner, or retained completely by the private company as reimbursement for efforts. This business model is successfully implemented in the U.S. with a company named NIC (National Information Consortium, Inc.) currently operating 18 U.S. state portals through the so-called "self-funded model".

2.2.4.1 Problems of Partnerships (PPP)

The problems of partnerships regarding PPP model are identified as [29]:

- *Law concerning exchange of data and ownership/copyright of data:* Issues on how to deliver public data and services to external parties, how to process the data to different countries, and how to resell the data.
- *PPP contracts missing:* PPPs are rare in most European countries because for each binding agreement lawyers have to negotiate service level agreements between the accuracy-oriented authorities and the reliability-oriented commercial providers, so Nationwide and moreover European-wide standard contracts would ease this negotiation process and spare time and costs.
- *Documentation ownership:* The ownerships of documentation must be clarified on a public or research site before presented, otherwise this could result in a

fight between parties to detect who is the originator and such owner of which piece of information.

- *Niche product versus public policy:* It is very important for governments to to reach most citizens in order to inform and protect, however commercial organizations concentrate on high revenues and they don't want to invest in niche services. To be successful, it is very important to balance the investment on the private and the public site for a win-win-situation of both parties.
- *Intermediator:* External parties may intermediate the channel to the citizens. In some cases, there is possibility of misuse of individual data of the citizen. Therefore, private companies have to provide trustiness over customers in the case of using sensitive data to overcome the suspicion. For instance, when commercial companies are involved in service provision, USE-ME-GOV validation interviews showed a clear expression of mistrust by citizens with regard to data privacy. This can be solved by a flexible and clear contract between public and private organizations to overcome misuse and incorrect interpretations.

2.2.4.2 Advantages of Partnerships (PPP)

The advantages of partnerships regarding PPP model are identified as [29]:

- *Provision of multi-channel services:* Multi-channel services enables maximum reach towards the citizen, anyhow, anywhere, and anytime. Public and private organizations can provide financial resources for required investment more easily when working together than working alone .
- *New information markets:* The PIRA study [30] estimated in the year 2000 that public sector information presents an economic value of between 28 billion and 134 billion Euro per annum in Europe.

- *Market driven approach of commercial partners:* Market driven approach is more creative in getting value out of data and services and are hence inventing new service types and new demand.
- *Bundling of information:* Citizens are attracted to an information bundle which is combined by several sources. For instance citizens may not only be curious about their regions but other regions as well, and they also may desire to check water, weather, sun, UV, and the like.
- *Reselling of data:* Not only one commercial partner is allowed to reach the information from authorities, other parties have the same right to access the data. Therefore, reselling of data is allowed and this will spread the availability and use.

2.2.4.3 Advertising and Sponsoring

A survey of e-gov services showed in 2005 that only around 4% of government Web sites world-wide relied on ads. They were presented as banners, pop-ups, and fly-by advertisements [31].

It is experienced in project APNEE-TU [32] that the authorities involved agreed on commercial advertising to be on the same interface where the environmental information is presented, because someone had to pay for the servers and software that will make e-gov work. However they restricted the type of advertising, for instance they hinder commercials like cigarettes and offending material like gambling and the like .

Sponsoring is defined as financial support of an information service by an external non-public party, with the service in turn showing the sponsor's name on the Web or mobile interface, and/or mentioning them in other official publications [29]. Citizens sometimes don't welcome advertising, and in this case sponsoring could be a good

alternative for financial support. For instance, car drivers concern about deteriorated streets and highways, therefore automobile clubs might sponsor a public infrastructure complaint service as additional support service for their members.

2.2.4.4 Payment by Citizens

Citizens are unwilling to pay for governmental services since thay argue that the tax payer is stressed enough with payments to the state, so governmental services should be as free as possible [29]. Previously, we discussed about financial issues, so it is reasonable for governments to support their specific personalized services with a clear added-value by the citizens with an additional payment. This payment can be based on subscriptions, pay-per-use, or transactions. For instance, micro-payment systems such as FirstGate, PayPal or MobiPay can be used, and also authorities may collect charges via the phone bill and transfers to the authority by the mobile operator.

Citizens in different regions may show different acceptance of technology, use and pricing. In project APNEE it is shown that, North-European countries accept higher prices for mobile services more than the citizens from southern Europe [33]. In addition to this, age of customers may also show different acceptance levels of technology especially with regard to mobile technology. Thus, authorities should carefully examine their customer profiles, and act accordingly. Especially, this is a very important issue for developing countries not to be confronted with the digital divide phenomena.

2.2.4.5 Sharing of the Service or the Platform with Other Authorities

If several authorities including commercial orgranizations share the service and operation of the mobile offer, costs and efforts can be naturally reduced. Of course, including a commercial organization into this sharing model may create problems

regarding trust, privacy, and regulations. Besides, this problem may be valid for authorities as well as a result of having different leadership and work-sharing models, hierarchy, and structure. On the other hand, sharing model has clear advantages [29]:

- Sharing of costs and efforts, exchange of experiences and results.
- Provision of a larger dissemination field for services, possibility to offer cross border services (also municipality borders), giving one anchor point for all services—one-stop shop.
- Stronger negotiation position against mobile operators by bundling and increasing
- Customer base.
- Implementation of chained and combined services (i.e., move from one city to another; notifications of a move in one service instead of two notifications at two city portals).
- Bundling of services according to citizen needs, not the authority structure.

2.2.5 Mobile Government Response Model

Governments implement mobile technologies either as a response to those complementing e-gov efforts or as a response to take advantage of the benefits of mobility.

The model highlights three interrelated issues: First, it identifies unique characteristics of mobile government developments. Second, it highligths the various pressures bureaucratic governments face in adopting mobile technologies. Finally, based on examination of various mobile government applications; it specifies the response of governments to address those pressures.

As you can see from Figure 5 governments are giving more priority to satisfying the requirements of external stakeholders such citizens and businesses rather than intra-governmental agencies, units, departments, and so forth at local, state, and national levels [34].

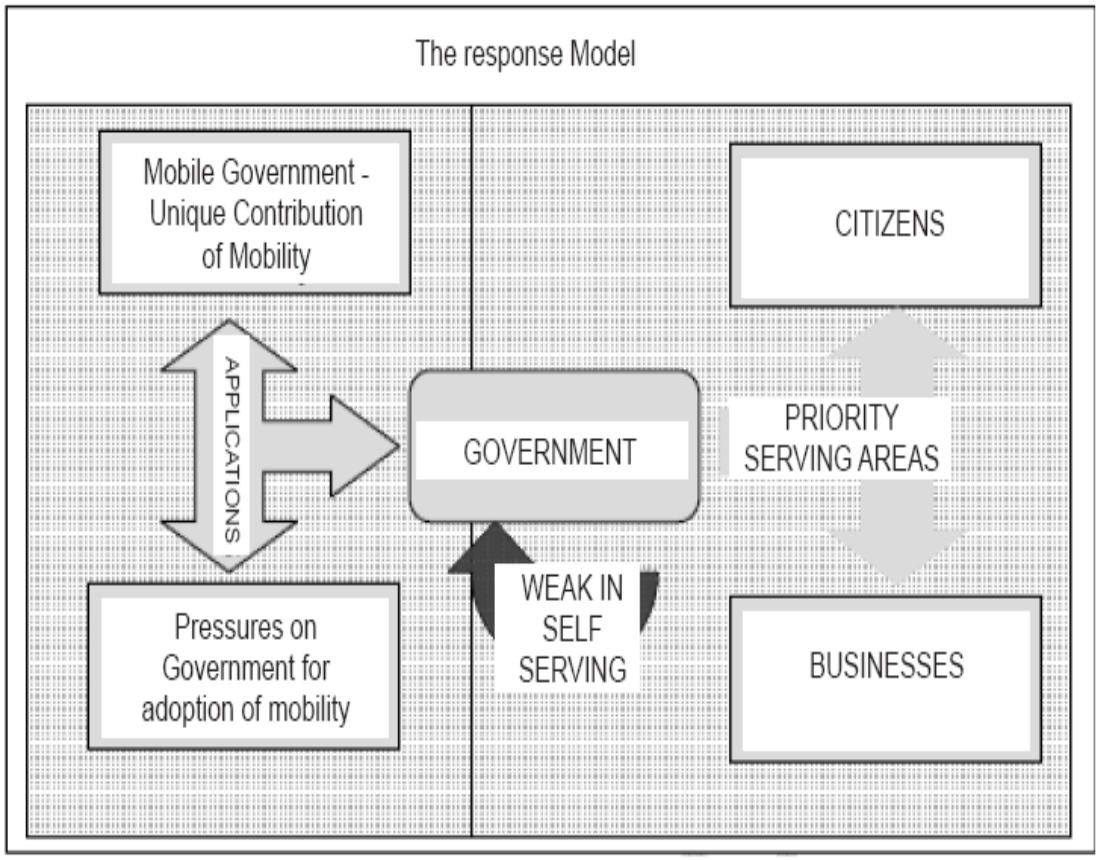

Figure 5. A Mobility Response Model for Government [34]

- *Upgrading efforts:* Upgrading mobile government applications to confront technological and user expectation pressures. This increases the value of electronic government applications by adding the "anywhere" component to the "anytime" value proposition. Mobile government applications includes complementary e-gov applications.
- *Innovative efforts:* Building new m-gov applications that carry unique

characteristics of mobile Technologies. This creates a new value with the implementation of unique mobile applications, and new kind of services that is not dependent on e-gov applications.

2.3 M-Government Technology, Architecture and Trends

2.3.1 Wireless/Mobile Technology Trends

Complexity of the mobile phones is ranked by generations. First Generation (1G) mobile phones began to increase in the 1980s with the introduction of "cellular" phones based on cellular networks with multiple base stations located relatively close to each other, and protocols for the automated "handover" between two cells when a phone moved from one cell to the other. At this time analog transmission was in use in all systems and data transmission was not available. In Figure 6 the functionalities of the systems can be seen.

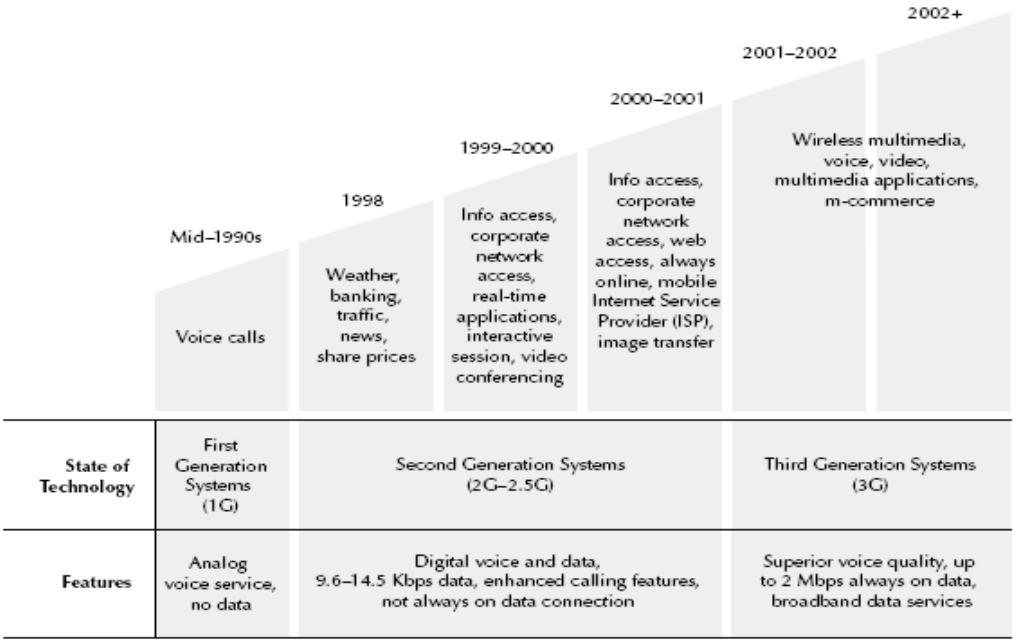

Figure 6. Functionalities of the Systems [35]

Systems such as GSM, IS-136 (TDMA), iDEN and IS-95 (CDMA) called Second Generation (2G) mobile phone systems [35]. These systems were introduced in the 1990s. They were characterized by digital circuit switched transmission and the introduction of advanced and fast phone to network signaling. Second generation of wireless/mobile technology includes cellular phones, pagers, wireless-enabled laptop computers, PDAs, wireless local area networks (WLANs), and GPSs, with the wireless service providers' technology enabling transmittal of voice and text/data (at 9.6 to 14.5 Kbps) working fairly well.

Turkey is currently using 2.5G mobile phone systems. This system is implemented a packet switched domain in addition to the circuit switched domain. 2.5G phones does not necessarily provide faster services, however it provides some of the benefits of 3G and can use some of the existing 2G infrastructure in GSM and CDMA networks. It is important to note that 3G technology is fully compatible with GSM, in other words, all 3G mobile phones support GSM [36]. GPRS is a 2.5G technology used by GSM operators in Turkey. GSM has become the world's fastest growing communications technology of all time and the leading global mobile standard, spanning 214 countries. Today, GSM technology is in use by more than one in five of the world's population - by the end of first quarter of 2007 there are over 2,8 billion cellular subscribers. In the world, GSM subscribers have reached to 2.3 billion, representing approximately 80% of the world's cellular market. In Figure 7 world's GSM connections are represented.

With the arrival of Third Generation (3G) technology, wireless devices can be content rich, enabling transmittal of content rich graphics, video, and other information at speeds up to 2 Mbps. Currently, technology such as Bluetooth can provide short-range wireless connectivity that can link several types of devices enabling seamless interactions among various devices. 3G technology can further extend the similar functionality and coverage [35]. 3G provide the ability to transfer simultaneously both

voice data and non-voice data such as downloading information, exchanging email, and instant messaging.

Figure 7. World's GSM Connections [36]

2.3.2 Characteristics of Mobile Technology

In this section, we analyze the key characteristics of wireless/mobile devices and technology and the characteristics of the environment within which the applications are embedded.

2.3.2.1 Device Characteristics

Primarily, one of the key characteristics of the wireless environment is "accessibility". Citizens are able to reach and access government services at any time and from any place. Not only citizens benefit from this property but also employees and government agencies benefits from this in a way that they are able to access each other at any time. Secondly, wireless devices are "distinctly personal".

This is a very important property due to its usage can be reached instantaneously by a government because the device can be associated with particular citizen/consumer rather than a household or IP address. This creates more efficient channel for organizations to provide services and reach consumers/citizens faster. Lastly, wireless technology is "location aware" [35]. Government or organizations can track citizens/consumers easily as long as the wireless device is on. This can be useful in an emergency situation when the user of the device needs to be located or helped. On the other side, this is also an invasion of privacy.

2.3.2.2 Usage Characteristics

It is very important to consider the current form and technology capacity of the wireless/mobile devices [35]. Small size of the devices seem to be convenient for the users, however limited size of user interfaces prevent to display information-rich content in a useful way. Laptops have appropriate monitor to display such information in an efficient way, however they are not as handy as small size devices. Also, the bandwidth over the air for wireless transmission is another constraint for the users today. These constraints limit customers' capabilities for processing and storing information and data, and also limit wireless technology to text-based and less information intensive exchanges.

2.3.2.3 Environmental Characteristics

In the context of the characteristics of the wireless/mobile environment, three significant issues need to be considered. These are security, privacy, and application [35,36].

- *Security:* Security is one of the most important environmental characteristics of wireless/mobile environment. When compared to

wired networks, wireless networks, such as Wi-Fi, are more vulnerable to security risks. Security can exist at different levels: at the over-the-air level, at the networks infrastructure level, at the software application level, and at the device level. To prevent the security risks, governments and organizations should implement the proper security measures and employ sophisticated authentication and data encryption technology.

- *Privacy:* Tracking citizens/consumers easily as long as wireless/mobile device is on can cause privacy concerns because some people may not want to be tracked geographically. From the perspective of B2C market, organizations are willing to use this property, as if a consumer were tracked walking in a shopping mall, then personalized messages can be transmitted to his/her wireless device regarding a product or service. So, to prevent privacy concerns and emerging litigation problems, technology should only be used during emergency situations.
- *Application Platforms:* So far, we discussed about device and environmental characteristics of the wireless/mobile environment. Multiplicity of application platforms is another characteristic of the current environment. These platforms range from WAP and GSM, to DoCoMo's I-Mode, Windows CE, Palm OS, and Nokia's open middleware. For instance, WAP is an open platform, whereas I-Mode is a proprietary platform. The challenge with the presence of platforms is to understand what platforms will accept a larger user base.

2.3.3 Main Types of Wireless Technology

Two main types of wireless technology are available to municipatilies in implementing a large-scale wireless network. These technologies are local area networks (LANs) using Wi-Fi technology or metropolitan area networks (MANs) using Wi-Max

technology. Like every other technology these technologies have benefits and weaknesses.

2.3.3.1 Wi-Fi Technology and Brief Description of IEEE Wireless Communication Standards

Wi-Fi is a promising short-range high-speed wireless access method using the IEEE 802.11 standard for mobile communication. This standard operates on three different levels. First standart to be released was 802.11b and this standart provides transfer speeds up to 11 mbps and operates in the 2.4 GHz range. Several years later, 802.11a which operated in the more expensive 5.0 GHz range was released and enabled transfers speeds up to 54 mbps. Recently, 802.11g has been introduced and it operated in 2.4 GHz range which was relatively cheap to 5.0 GHz range, however it still provided transfer speeds up to 54 mbps.

Advantage of Wi-Fi technology is that it is relatively inexpensive to other technologies. Main disadvantage of Wi-Fi is the limited signal range. After approximately 30 meters signal starts to degrade. An effective operating area of Wi-Fi is a little more than one city block (9,500 m^2) [36]. If a municipatliy chooses Wi-Fi technology for deployment, then that municipality will have to put one node on approximately every corner in the covered area. Large portion nodes will need to be hard wired to an Internet server. Another disadvantage of this technology is that, as more and more users access the system Wi-Fi performance starts to decrease. In order to solve this problem, several Wi-Fi nodes will need to tie directly into an Internet server, giving the wireless network several access points needed to cope with the anticipated volume.

Today, there are many Wi-Fi hotspots on trains and in coffee shops,bookstores, hotels, airports, train stations, stadiums, and educational institutions all over the world. Users

can use mobile devices, appropriately-equipped laptops and PDAs to stay connected to the Internet or a local area network (LAN) without Ethernet wiring with Wi-Fi technology [36]. In addition to this, many governments around the world are implementing Wi-Fi pilot applications and trials to show leadership in using this technology.

2.3.3.2 Wi-Max Technology

Wi-MAX, the Worldwide Interoperability for Microwave Access, is a telecommunications technology aimed at providing wireless data over long distances in a variety of ways, from point-to-point links to full mobile cellular type access. MANs uses Wi-MAX which is based on the IEEE 802.16 standard. Wi-Max has much greater effective operation area than Wi-Fi with up to 30 miles under ideal conditions.

There are two main applications of Wi-MAX today: fixed WiMAX applications are point-to-multipoint enabling broadband access to homes and businesses, whereas mobile WiMAX offers the full mobility of cellular networks at true broadband speeds. Both fixed and mobile applications of WiMAX are engineered to help deliver ubiquitous, high-throughput broadband wireless services at a low cost.

As you can see from the Figure 8, Wi-Max operates in one of two ways. Firstly, through line of site from one tower directly to another, up to 30 miles under ideal conditions. A steady stream of data is beamed from these towers. Distance may change depending on external conditions such as weather. Secondly, Wi-Max operates is through non-line-of-sight when it is not rely on line of sight, similar to the way Wi-Fi works [36-38]. From the Figure, there is a visual explanation of Wi-Max. Internet Backbone, ISP Network, Wi-Max Transmitter, Backhauls, LANs are some components of Wi-Max system.

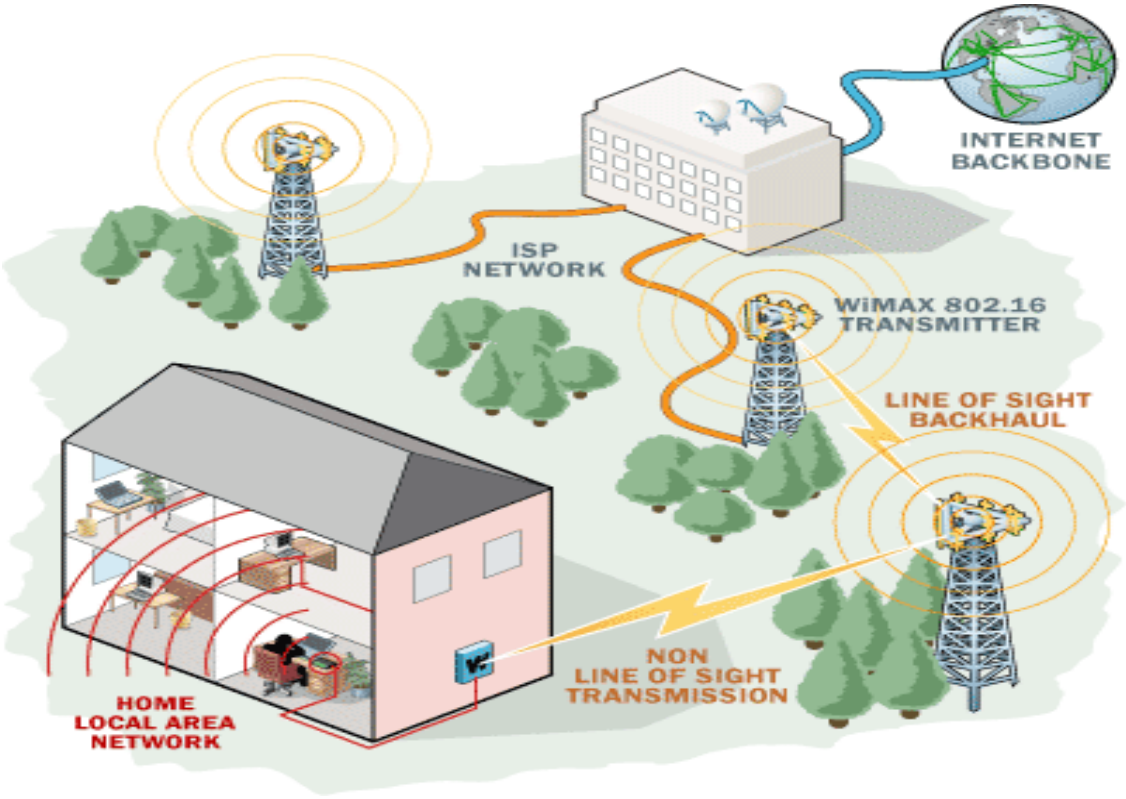

Figure 8. Settlement of WiMAX Technology [36]

According to this operation, its effective distance is cut to about a 5 mile radius that entire city can be covered with four to six towers strategically placed to provide maximum coverage. Also, since the line of sight aspect of Wi-Max can carry such high capacities, very few towers (possibly only one) will need to be hardwired into an Internet server.

2.3.4 Introduction to M-Government Infrastructure

In this section, an open, integrated, and interoperable infrastructure model which enables secure delivery of multichannel services of e-gov and m-gov is identified. Infrastructure includes type of applications such as between governments , government and businesses, and government and citizens as well as the type of applications

installed for the interactive and efficient communication between the participating actors. Also, infrastructure components will also be explanied compherensively [37].

2.3.4.1 M-Government Infrastructure Design

Major investments have been made to legacy systems, however legacy systems are standalone systems that do not corporate with other systems. Since there is a need for intercommunication (G2G, G2B, and G2C), it is very important to build the technological base for those systems that could be attached to and with some necessary changes to become interoperable and integrated mobility.

The mentioned technological infrastructure is designed to comply with a general legal and procedural framework as well as with a number of principles, rules, and regulations and ready for services 24 hours a day and seven days a week.

Furthermore, the architectural design used all the necessary technologies (wired and wireless), mechanisms and procedures that will best satisfy all the e-gov and m-gov objectives and purposes. The particular infrastructure is composed of three main parts [37]:

- *User interface (front-end):* It provides a single point of access to informational, interactive and transactional public and business services.
- *Integration middleware:* The middleware layer represents the nervous system of the platform. It enables service/user requests and helps to assemble/dispatch data from across governments, and enables related transactions to be conducted. It is based on XML messaging [39] and Web services.
- *Back-end layer:* It stores the actual internal and external services and related requested information retrieved.

2.3.4.2 Principle Drivers of M-Government Open Service Infrastructure

Today, with the wireless technology availability of an e-gov infrastructure extends to mobile and wireless channels [38]. The deployment of an m-gov open service platform that could be shared by networked private and public authorities and institutions could be a promising approach.

For a deep understanding of m-gov open service platform, critical requirements like broadband, interoperability, scalability, transparency, personalization, privacy, and security such should be analyzed and discussed [37].

- *Broadband:* Broadband is considered a new initiative that will have a unique impact on the further development of the m-gov channels and infrastructure.
- *Interoperability:* To deploy mobile broadband services successfully interoperability issue becomes very critical aspect. It is a multi-faceted issue and is necessary at various levels: device-to-network; device-to-device; network-to-network; and between content and/or applications. Without appropriate interoperability between different infrastructure and terminal solutions, the 3G reality could remain fragmented.
- *Transparency and Scalability:* Requirements such as design of software applications and systems, the number of concurrent clients that access the application, response times, transparency issues, transaction throughput, and so forth are affected as new enterprise business requirements and constraints changes. Actual design of the applications shifts due to these changes.
- *Personalization:* Such issues include, but are not limited to, the following: what content to present to the user, how to show the content to the user, how to ensure the user's privacy, or how to create a global personalization scheme.
- *Privacy and Security:* Corporate and consumer mobile applications involves personal and sensitive data. For these transactions, a trusted and secure

environment is needed. More specifically, the following areas are identified with respect to mobile privacy and security research: trusted platforms for mobile security and privacy, mobile network/transport security and privacy, mobile application security and privacy, mobile privacy and identity management, basic security and privacy technologies for mobile environments, mobile application security framework, and user-centric mechanisms allowing controlled release of personal information.

2.3.4.3 Multi-Tier Architecture Overview

This kind of archtitecture allows the distribution of components across multiple servers and access of data that is stored in multiple databases. Every particular multi-tier architecture has its own specific design and implementation according to user requirements, therefore number of tiers may change accordingly. However, there are some general principles that should be established for all multi-tire systems [37]:

- *Scalable architecture and location transparency:* It should be possible for each application layer to be located (distributed) on a physical different piece of hardware (server).
- *Information exchange:* Each layer should exchange information only with its lower or upper one.
- *Communication interface:* Communication interface should exist to exchange data between layers.

When compared to the traditional two-tier approach (client talks directly to a server with no intervening server), multi-tier architecture performs substantially better than the two-tier architecture and is much more scalable due to moving the business logic from the client to the server where it is possible to perform tasks in parallel. Moreover, this disparity provides much secure environment. To better undertand our multi-

channel infrastructure, an insight regarding the main parts of such a system design is given in the following:

- *Client Tier:* It delivers a friendly user interface such as web browser by receiving HTML, WML, XHTML, XML and so forth.
- *Presentation Logic Tier:* This is where HTML, WML, and so forth, are rendered and delivered for the presentation in the client tier. It handles requests/responses from/to multiple clients.
- *Application Middle Tier:* The middle tier receives requests from the client application over the presentation tier, and retrieves data from the data repository (database).
- *Application Back-End:* It consists various data repositories (database, files system, LDAP), which exist separately from the client and the middle tiers.

Currently, in the market, the most suitable platforms for multi-tier application development are Microsoft .NET and J2EE environments.

2.3.4.4 Multi-Channel Service Delivery

After examining m-gov's infrastructure and architecture, it is suitable to analyze and present concepts and arguments toward the provision of e-gov services via multi-channel (WAP, MMS, SMS, Web, Satellite, etc.) mediums (PC, mobile phones, PDA, tablet PC, Satellite handset, etc.) without loosing their integrity or quality of their content [6,37].

A channel could be defined as "a means for users to contact public administrations (inbound) or for public administrations to contact their users (outbound) with the aim of acquiring or delivering public services. This includes the use of Web-based technologies, telephony, paper media or face-to-face contacts; applications of these

technologies such as the Internet, e-mail, SMS, call centers or the counter; and devices to access the applications such as a personal computer, mobile phone, kiosk or digital TV" (IDA, 2004). Also, the term "channels" is often used as a concept that includes "channel type", "technology", "platform", "media", "device", and "touch point".

Services can be delivered through a wide variety of channels, which have different capabilities and limitations. Every user has his/her own perception of a service. Accordingly, users will choose the channel that realizes the highest relative value for them. If channels are integrated, the integration of channels means more accessible and more flexible service delivery (which leads to better services) to the user. However, inconsistencies such as different data formats or interfaces can occur when there is separate development of different channels (multi-channel delivery) for a single service.

To overcome the drawbacks of multiple-channel service delivery, the common data that are used by the front-office applications should be stored centrally so that they can be shared by the applications. In this way, users can access the services from the locations and mediums (PC, mobile phones, PDA, tablet PC, Satellite handset, etc.) they desire, as all the relevant information retrieval is taking place from the same databases. Thus, with the integration of back-office processes, full-service integration becomes possible (as different data formats or interfaces, or parallel workflow steps) which raises the quality and number of services significantly.

2.3.5 Security for M-Government

In explaining the security issue, we mainly focus on WiFi, especially the IEEE 802.11b standard, and its application [36]. As discussed earlier, privacy and confidentiality are very important for governments in the provision of services and in implementing applications. Compared to wireline networks, wireless networks such as

Wi-Fi have seen more vulnerable to security risks, but by implementing appropriate security measures and employing sophisticated authentication and data encryption technology, security risks can be minimized.

2.3.5.1 Types of Attacks

Main security risks associated with Wi-Fi are as follows: [36,40,41].

- *Spoofing attacks:* Intruder can gain unauthorized access to the wireless network by creating TCP/IP packets with somebody else's IP address.
- *DoS Attacks (Denial of Service):* It is an attempt to make a computer resource unavailable to its intended users. Since many other types of wireless equipment use the 2.4 GHz frequency band, an attacker operating in the same band can "jam" the spectrum and thereby disrupt or block communications.
- *War-driving attacks:* It is the act of locating and possibly exploiting connections to wireless local area networks while driving around a city or elsewhere. An intruder can use applications such as NetStumbler which can detect any unprotected IEEE 802.11b wireless network by scanning for broadcasting access points.
- Man-in-the-Middle attacks: It is an attack in which an attacker is able to read, insert and modify at will, messages between two parties without either party knowing that the link between them has been compromised. Intruder can use sniffer tools such as AirMagnet, Airsnort, Fluke Waverunner, Kismet, NetStumbler, Sniffer Pro, Sniffer Wireless, WEPCrack, Yellow Jacket, and YBT-250.
- Weather conditions: Wi-Fi equipment may be disabled due to bad weather conditions.

You can see the brief descriptions of these tools from A-Table 6 in Appendix-D. Many of these tools are legitimate network management tools, however, they also may be used by hackers to intrude systems, capture legitimate information, collect transaction information, inject false data, or even hijack the session.

2.3.5.2 Security Measures

To prevent these attack, some security measures can be taken [36]:

- *WEP Protocol (Wired Equivalent Privacy):* It is built into 802.11b specification, and it provides a common way to encrypt data and authenticate users by using 128-bit encryption technique with RC4 random number generator and CRC-32 cyclic redundancy code that scrambles data before it goes over the air and an authentication algorithm called shared key authentication to authenticate the client.
- *IEEE 802.1x:* It provides authentication to devices attached to a LAN port, establishing a point-to-point connection or preventing access from that port if authentication fails. It provides much stronger security than WEP alone.
- *VPN (Virtual private network):* It is is an IP security (IPSec) protocol that was developed to enable client systems to securely connect to servers over the public Internet.
- *Careful and proper management:* Sometimes encryption can be broken by hackers. If hackers can gain access to clients system, such as governmental worker PC, as a result of this hackers may able to enter government networks. Therefore the deployment of Wi-Fi should be backed up with employee training, for instance password management education.
- *Physical protection: It is necessary to* necessary to protect Wi-Fi equipment from the weather as well as from theft and vandalism.

As a result, it is recommended that VPN technology plus IEEE 802.1x authentication should be implemented in addition to the WEP protocol built into IEEE 802.11b to provide adequate security for the corporate Wi-Fi networks in government. In addition, users should be educated on the importance of protecting their Wi-Fi equipment from theft, damage, or misuse.

2.3.6 Spectrum Management Policies and Practices

There is a need for efficient frequency spectrum management policy in the deployment of a wireless data access service [59]. For instance, taking consideration into Wi-Fi, even though there are only three channels that an IEEE 802.11b access point can use, governments must be very carefully plan and implement when they assign channels. An effective spectrum management policy ensures that channels are assigned to the network of access points in a manner that minimizes interference and maximizes the performance and coverage for end users [36,42].

Besides Wi-Fi equipment, there are many devices, for example Bluetooth wireless devices, cordless phones, microwave ovens, wireless cameras, wireless headphones, and even certain fluorescent lighting than can interfere with each other due to utilizing in the same IMS frequency band. The spectrum management policy must ensure that all these devices optimally utilize and share the frequency band.

Moreover if a spectrum management policy is not adequately implemented, an employee could easily set up his or her own access point without proper site planning or approval from the network security and information management groups. If there are no security measures for this access point, it may become entry point for intruders into the government networks.

2.4 M-Government Applications

2.4.1 Applying Wireless/Mobile Technology to Government

With the improvement in e-gov and high-tech mobile devices, mobile government applications seem to be inevitable in the coming decade. The potential for wireless/mobile applications within government is vast [35]. Considering the high mobility of targeted employee of government, deploying widespread wireless/mobile environment will be very important step for governments to improve their employee efficiency.

For instance, governments' workforce involved in law enforcement and compliance enforcement, transportation and logistics, and health and social services can be a very good example for government departments that have high mobility workers. This indicates that the potential for deploying wireless technology for intra-governmental applications is significant.

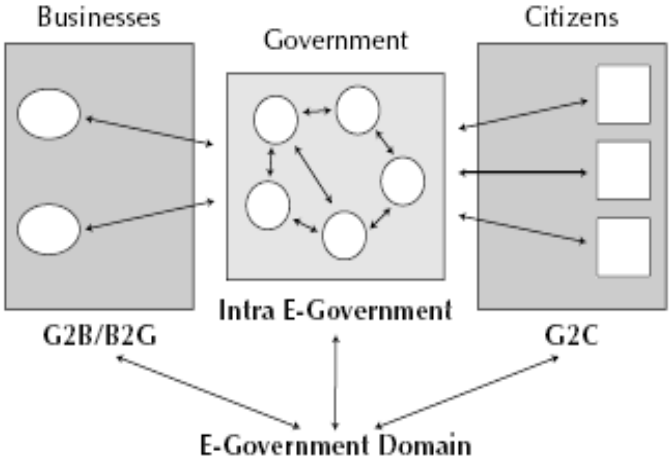

Figure 9. Scope of E-Gov

2.4.2 Types of M-Government Applications

There already exists various m-gov applications and business models in the areas of law enforcement, education, transport, health, and firefighting [20,43]. In the following section, a number of m-gov applications from various countries are briefly presented in order to familiarize the reader with what is actually involved in m-gov. M-Gov can be applied to four main purposes in the public sector, as summarised below:

2.4.2.1 M-Communication (G2C, C2G, G2G)

Government applications can be grouped into a few categories. The most common category is called G2C. The next category is called G2B. The last category, called G2G, is the category in which authorities are connected to each other [6,20,43].

Moreover, the services can be grouped along the rising complexity into three different categories: Information, communication and transaction. The easist one to accomplish is the information services. Communication services enable interaction with the authorities, but it does not finalize processes for instance with an electronic signature. This can be possible in transactional services that with an accepted e-Signature, informational or communicational session can be closed. A number of m-gov services via SMS from various countries are briefly presented below:

2.4.2.2 M-Education

- *Giving Morale:* In Knowsley (Great Britain), SMS messages are sent as a motivation tool for secondary school students (tips about efficient test preperation, wake-up phone calls for permanent late-goers). It is aimed to increase average grades and morales of the students.

- *Tracking Truancy:* In Yishun City School (Singapore), East Riding (Great Britain), and Ireland Schools, SMS messages are sent to the parents in case a student is absent.
- *Support for university education:* Universities in London receive motivation SMS messages regarding their interest in further education, mainly university education.
- *Test results:* In Great Britain, France and South Africa, students can receive their university test results (Bradford University) by SMS.
- *Information channel for university students:* In Leeds University and Univesity of London, students are able to receive information academic life, preparation for future occupation, extracurricular activities, interesting and discounted tips and information. In National University of Ireland, students receive information about jobs, scholarships, education, extracurricular activities and SMS invitations to interesting events.

2.4.2.3 M-Safety

- *Crisis information channel:* In West Midlands (Great Britain), deaf or citizens with hearing difficulties have a problem, can send a message to central police mobile number /service for help. In Amsterdam (Holland), citizens are able to receive caution message (e.g. Go home, close windows and doors) in case of hazardous/toxic fire or other threat).
- *Floods warning systems:* In Malaysia, citizens receive warning messages by automated measuring devices in the case of increased water supply. In Great Britain, citizens receive information messages about emerging floods via SMS, e-mail, fax, and digital TV in case of emergency. On the other hand, citizens in Henan (China) can receive SMS messages to government about emerging bad weather.

- *Special notification cases:* Citizens in USA and London can receive messages about potential terrorist threats/attacks in the case of terrorist acts.
- *Preventing bogus phone calls on emergency line:* Citizens in Amsterdam (Holland), can receive information messages missing phone in the case of theft.
- *General fight against crime:* Citizens in Manila (Philippines) and Leicestershire (Great Britain) can send/receive messages to police department about suspicious activities in their areas. In Ireland, citizens are able to send a photo of wanted criminal act/thief by MMS. A couple of thieves caught in Italy by sending a MMS photo.
- *Search for missing children/citizens and criminals:* In Germany, police can send descriptive message about missing person to bus/taxi drivers. In Sussex (England), citizens can register on special mobile number to receive SMS messages with description of missing child from Sussex police department.

2.4.2.4. M-Democracy

Currently, there are no significant experiments with m-democracy in developing/transitional countries. However, situation is different. For example, in UK experiments with electronic voting are made, including voting via mobile phones. This enables to discover more convenient ways to involve citizens in political decision-making. Top questions are security and secrecy. M-voting system has to ensure that the message sender is a registered voter, and that no-one abuses the system to vote more than once or vote in place of another person. For instance, voters in Liverpool and Sheffield in May 2002 local elections were given PIN numbers to use if they want to vote by text message [6, 43]. Besides technical issues, there is the problem of the voters' willingness to use mobile phones and SMS to vote. Latest studies in Scotland and Wales have shown a general interest in electronic forms of voting, including m-voting. However, another recent UK study ("Public Attitudes Toward the Implementation of Electronic Voting") [6] finds, alongside this overall willingness to

vote electronically and an interest in m-voting, that many citizens appear unwilling to use voting via text message as an electronic voting method.

According to this study, willingness changes according to voters' age. While younger respondents, and those that used text messaging, may find this as an easy option to vote, but others may not. These findings may well have wider implications for all uses of m-gov.

2.4.2.5 M-Administration

M-gov also provides opportunities to improve the internal operation of public agencies. There are very few examples of such applications in developing/transitional countries. M-administration applications can provide a seamless environment for government employees to stay connected from any device. Up-to-date government-to-employee (G2E) information and services can be provided at any time, whether the data they need is on the Internet, on their network, or on a portable device under their control.

2.4.2.6 M-Health

Health online or electronic health is a current priority for many governments. However return of investment for such services is difficult to measure [20]. M-health or mobile e-health applications do not only support healthcare in any particular healthcare environment (hospitals, clinics, long term care facilities, homecare), but also can either eliminate or greatly reduce the use of paper forms. Moreover, significant issues that can affect the pattern of m-Health applications are as follows: usability, adoption, interoperability, change management, risk mitigation, privacy and security, and return on investment [6].

2.4.2.7 Other interesting M-Government services

Some interesting m-government services are presented below [43]:

- *Library transactions:* citizens are able to do library transactions (information about their account, get notifications, extending borrowing periods) via mobile phones in Singapore National Library.
- *Efficient garbage collection:* In Quezon, Philippines, citizens can report to dustman service about increased need for cleaning services in given areas by SMS.
- *Higher rate of employment:* Citizens of Austrialia received SMS messages about potential offers, booking a meeting or updating data. This was a pilot project involving 300 citizens and 96 percent of the citizens positively responsed.
- *Notification to debtor:* In Fifi, Scotland, renters received notification messages about their rent debt. This was a pilot application testing with 200 debtors and 50 percent responsed to this application. In New Zealand, citizens receive notification messages regarding fines (parking, exceeding the speed limit) via mobile phones.
- *General advice to citizens:* Contact centres in Scotland are ready to answer any questions from fellow citizens. Citizens are able to send/receive SMS messages.
- *Political issues:* Philippines government ask citizens to report bribes via SMS. In vice versa, citizens may send complaint messages to directly to the office of president.
- *Tax declaration:* In Norway, citizens are able to do pre-filled tax declaration modification via SMS with specific code and the entire tax collection procedure is cleared for him (relevant for app. 1,5 mil. citizens each year).

2.4.3 Recent M-Government Applications in Turkey

2.4.3.1 MOBESE and TBS

In this section, most recent developments in Turkey are briefly reviewed. In the context of government, two major projects should be discussed. First one is MOBESE (Mobile Electronic System Integration) and TBS (Traffic Information System). Both systems are G2G law and traffic enforcement projects. These projects can be considered as mobile intranet systems, and serve to the goal of increasing the effectiveness and efficiency of law enforcement efforts and better communication between mobile units and the central command equipped with a database [12]. With the MOBESE project, İstanbul, which is one of the crowdest, the most active and the biggest metropolitans of the world with a population of 12 million people, has been kept under control in terms of order and security.

MOBESE is installed at the İstanbul Directorate of Security by the Governorship of İstanbul Provincial Special Administration and successfully installed Command Control Centre under its responsibility. Command Control Centre is the centre where all information which may be necessary during the management of the city of İstanbul. It is a control and management system where the security services are managed and directed during the ordinary or extraordinary events. In this project which serves to the security of İstanbul, huge screens are used to monitor the movements and works of the security forces on the satellite maps of the city. The images that can be obtained from 768 dome cameras can be viewed simultaneously. With the mobile police station practice, the events are promptly reported with the laptop computers, camera and printers to be given to each police vehicle in the project. Reports are made more reliable by taking photos of events like accidents etc. It is possible to manage the operations in coordination with the centre in online connection via satellite and GSM network. Information is evaluated faster with the 155 call centre established at the

centre. All district security directorates are connected to each other online and with images making intervention to incidents possible.

2.4.3.2 MIP and UYAP

Moreover, we can add two other major m-gov projects at national government level. Mobile Information Project (MIP), implemented by the Ministry of Education, together with the Avea Mobile Phone Service Provider Company is a m-gov project [12]. With the project, parents are able to view their childrens' attendance records, exam dates and grades, and the school curricula by connecting to the ministry database via a mobile phone. On the other hand, this application also serves as a mobile intranet that enables the Ministry personnel to access the current information about their promotion and/or placement. Therefore, MIP is a two-sided project, with both C2G and G2G application. Secondly, National Judicial Network Project (UYAP) can also be considered as a major m-gov projects at national government level. In this project, all the courts and other organizations in the judicial system in Turkey are aimed to be integrated with an electronic network. Also, it targets to create a streamlined, more efficient and transparent judicial system transfer by creating more efficient transfer of judicial information among all the courts and other organizations in the system. However, it is important to indicate that this project itself is not based on mobile technologies, but in very soon, courts will be able to send official notification to the mobile phones of attorneys and parties of a lawsuit as an SMS, including a digital signature.

2.4.3.3 EMIS and Various Municipality Applications

Other important m-gov applications at local government level [6] are Earthquake Monitoring and Information System (EMIS) implemented by the Kandilli Observatory of Istanbul and municipality m-gov applications [12]. Primarly, Earthquake

Monitoring and Information System is earthquake detection network, with support from the UK's Export Credits Guarantee Department (ECGD). With this project, ground vibrations are analysed as quickly as possible, thereby identifying the location, time and magnitude of an earthquake. This information allows organisations, including the emergency services, to set into action plans to help minimise the effects of an earthquake. Secondly, the municipalities of Şişli, Kadıköy, Bahçeşehir, and Usküdar (all in Istanbul) provide m-gov applications. This aplications enables citizens to enquire and pay taxes via a mobile phone, municipalities are able to send municipal information and reminders to the citizens' mobile phones. Another interesting project which is still in progress in Turkey is mobile e-Voting. In Bahçeşehir, there is a pilot study for mobile e-Voting. Çorlu, (in Tekirdağ province), Yozgat and Eskişehir are other municipalities that also transmit municipal information to the citizens.

We discussed WiMAX technology in previous sections. In this manner, Turkish Ministry of Education, together with Intel Corporation, works on a pilot project to implement Wi-Max technology to the Boğazlıyan Municipality in the Yozgat Province of Turkey, by connecting five primary public schools to the Internet via wireless network technology.

CHAPTER 3

COUNTRY CASE STUDIES

3.1 Introduction

Most European countries had made mistakes in making strategies in the transformation to m-gov. Turkey has a better chance to success, because they are just at the start of the m-Transformation. In this section we analyze some successful country cases across the Asia Pacific region in the context of mobile government. This region shows a great deal of variety from the point of view of government regulations and business strategies. The chosen countries to be analyzed are:

- Turkey
- Japan
- Australia
- South Korea

Before a deep analysis, let us explain our reason of choosing from Asia Pacific region countries. First of all, Japan is the third largest economy in the world by purchasing power parity and a leader in the use and development of information and communication technologies. It was one of the first countries to launch third-generation mobile services in October 2001 and the first country to launch commercial

services based on the W-CDMA standard. Secondly, South Korea is home to mobile handset manufacturers such as Samsung and LG. They have extremely technology savvy population as a result of the government's information technology training program. Thirdly, Australia has a large landmass and highly dispersed rural population, due to this, their strategies towards to offer telecommunications as widely as possible and to upgrade its fixed network to a broadband fiber are very important. Thus, examined country cases will guide us to determine the critical success factors, in the design of creating a successful strategical plan for Turkey in the transformation to m-gov. The countries are evaluated on four factors listed below:

- e-Readiness
- The Telecommunications Market & Telephony
- Internet
- VoIP

At the end of each country case, we summarized the main points. After the specific country case analysis, we compared the country results and displayed them in tables.

3.2 Turkey

3.2.1 e-Readiness

In the UN e-Government Readiness Index for 2007 [44], Turkey is assigned a rank of 42 out of a total of 69 nations, a placement behind countries such as the Australia (9), South Korea (16), and Japan (18). Back in 2005, Turkey was behind all the Member States, however in 2007, new entered EU Member States such as, Romania (45) and Bulgaria (48) are fall behind Turkey. On the other hand, Turkey's ranking is developing in annual e-Readiness Index of the World Economic Forum [45]. Last year Turkey ranks 45th out of 69 county. Turkey ranks 48th out of 115 country in 2005,

where it was 56th out of 102 country in 2003. Also, in 2005 Turkey comes 9th among EU members and EU candidate countries in terms of modern on-line public services ranking which is done by INSEAD.

3.2.2 The Telecommunications Market & Telephony

e-gov strategies and policies are developed and coordinated centrally, Turkey's national approach to e-gov can be characterised as centralised [45]. E-gov actions were defined in an action plan named the STAP for 2003-2004. 23 actions were contained in the plan's e-gov section, to be carried out in collaboration with public institutions and NGOs. In the STAP, two main actions on e-gov are: preparation of a strategy for the provision of public services through a portal and improvement of the services themselves. As a result, Turkey's national goal is to transform into an information society and close the digital divide. By the year 2006, after STAP, Turkey launched e-Transformation Turkey 2005 Action Plan. There, various activities on IT are proposed and/or monitored for progress. As the most recent development, Turkey's Information Society Strategy (2006-2010) came into force in July 2006. The Strategy contains two basic priority regarding e-gov: Citizen-oriented service transformation and the modernisation of public administration. Some of these strategies can be summarized as:

- Citizen-focused Service Transformation
- Modernization in Public Administration
- Development of broadband infrastructure and usage in Turkey

Telecommunications market was worth $17.7 billion in 2005 and carrier services played the main role. The market grew 16% in 2005 compared to 2004 as the new fixed line backbone companies and ADSL systems are established. Privatization of Turk Telekom is one of the key components of the government to create a more

competitive market structure to help increase service quality while reducing costs. This was completed as the majority of Turk Telekom's shares were sold to the Saudi Oger Telecoms Joint Venture Group. With the entrance of Vodafone through its purchase of Telsim altered the Turkish industry's landscape [46].

3.2.2.1 Telephony

Until 1980, fixed telephony penetration was barely 2.5%; afterwards, Turk Telekom raised penetration rates through new investments. By the early 2000s Turkey's fixed network was the fourteenth largest in the world and the fifth largest in Europe by subscriber volume. Turk Telekom's monopoly over the fixed-line services ended at the beginning of 2004. However PSTN investments slowed down as GSM networks were launched.

3.2.2.2 Mobile Telephony

In early 2006, 44 million mobile phones are estimated to be owned in Turkey. Ten years ago, this number was only 0.8 million. The mobile telephone services were liberalized in 1994. It is still a growing market and the upcoming 3G licenses will offer further business potential. There are three main competitors in the Turkish GSM market. Turkcell is the first service provider and leading the market with 58% market share, followed by Telsim (Vodafone) with 25% and Avea, the last entrant of the market is competing for the second place [12,46].

Telsim, for example, was sold to Bitish company Vodafone for $4.55 billion in December, 2005. Mobile operator Avea, is 49% owned by Telecom Italia Mobile and Telsim, was bought by Vodafone in July 2006. A significant portion of Turkcell is expected to be sold soon. The mobile government infrastructure supports 2.5G services

as of January 2006. There have not been any 3G licenses awarded yet and they 3G license tender expected to be available in 2007 after general elections.

Table 2. Turkish mobile phone service provider market [12]

Name of the Service Provider	**Number of Subscribers (Million)**	**Market Share (%)**	**Entry to the Market**
Turkcell	28	58	May 1994
Vodafone	11	25	February 1994
Avea	7	17	June 2004

3.2.2.3 Mobile Number Portability

National numbering resources are managed and carried out by the TA in compliance with the rules and procedures defined in the Numbering Ordinance. Regarding number portability, the rules and procedures are contained within the number portability ordinance, but number portability is not available in (none)-geographic fixed numbers or in mobile numbers. At the start of 2007, Turkey's officials announced the introduction of mobile number portability (MNP) for its 3 mobile operators, Vodafone, Turkcell and Avea. MNP allows customers to change carriers and keep their number, referred to as porting [46].

Turkcell, the leader mobile operator in Turkey, has called for the cancellation of MNP in case of losing a large number of customers who port for better calls or family reasons. However, Avea, Turkey's third largest mobile operator has launched a legal case in an attempt to make number portability mandatory for all telecoms providers in the country. Avea is strictly in favor of number portability, as it allows subscribers to transfer their own numbers while switching operators.

3.2.3 Internet

Turk Telekom marketed ADSL effectively in 2005. The already existing copper telephone line infrastructure was capable of dealing with speeds up to fifty times faster than dial-up. Moreover, ADSL is playing a strategic role as a locomotive for the Turkish Government's e-gov initiative, as government agencies have moved to ADSL-based Internet technology and have invested in IT equipment. There are over fifty private ISPs in Turkey, some of which include foreign ownership due to no foreign ownership limits affecting ISPs [75].

From Figure 20, we see that broadband still has a very low penetration rate as broadband subscriber lines are reach 2.3% in 2006, which would mean an almost 60% growth from the previous year. Overall Internet user penetration is relatively small compared the EU average of around 38%. The mobile telephony market, however, is facing already three competitors, whereby Turkcell is dominating by far [45]. A Turkish ISP, Turbonet, has marketed ADSL effectively in 2007 and continuing. Apart from this, it has launched its first field trials of WiMAX in Istanbul. The provider, which uses 3.5GHz WiMAX equipment, has received a test license allowing it to carry out the tests [46].

3.2.4 VoIP

Long distance telephony service licenses allow national and international long distance telephony services using any type of technology including VoIP. With this license, its subscribers are allowed to make on-net calls without using E.1645 numbers. However, it is not possible for those VoIP subscribers to receive calls from other networks, as the relevant license does not allow the assignment of E.164 numbers. Twelve companies have obtained licenses from Turk Telekom. However, these firms are allowed to use VoIP only for international destinations, not for local and domestic calls. This means

firms are only permitted to do so within their company structure, despite their location in Turkey [45].

3.2.5 Summing Up / Conclusions

Turkish mobile telephony market is growing fast. Young population and the limited fixed line infrastructure are the important factors of this fast growth. As a part of the EU convergence, E-Transformation Turkey in 2003 and e-gov projects are being implemented. This will create a demand for ICT companies to create large e-gov and m-gov projects with large amounts of public funding and fueling internet use and content creation. The operators are still waiting for the 3G licenses, however there is disagreement of mobile number portability issue between mobile operators. This issue should be solved prior to 3G licences tender. Thus, Turkey is ready for the 3G services as a result of high mobile penetration and presence of young population.

3.3 Japan

3.3.1 e-Readiness

In the UN eGovernment Readiness Index for 2007 [44], Japan is assigned a rank of 18 out of a total of 69 nations as seen in Figure 10, a placement behind countries such as the Australia (9) and South Korea (16).

3.3.2 The Telecommunications Market & Telephony

In April 1985, Nippon Telegraph and Telephone (NTT), which had been a public corporation since 1952, were privatized and the Japanese telecommunication market was opened to new entrants [47]. This marked the start of competition in Japan's telecommunication market. This was a turning point for the Japanese

telecommunications industry, as up until that point, NTT held an unchallenged monopoly. At the end of 2003, there were 77.3 million Internet users in Japan. Of these, there are 14.95 million subscribers enjoying a broadband service based on DSL, cable Internet, or wireless (e.g. FWA). The take-up of DSL (11.20 million subscribers) is the most popular form of broadband.

E-Japan to U-Japan

Until 2000, there was no national policy on IT, in contrast to other countries in Europe and Asia. In this context, in January 2001, the government put forward "e-Japan Strategy", with the main objective of making Japan the most advanced IT country in the world within five years. This strategy was launched as a solution to the social and economic challenges faced as a result of its aging population, falling birthrates, and rapid urban development.

The "e-Japan Priority Policy Programme" [48] with a view to clarify specific action plans. This programme, to be reviewed every year, sets out five policy areas for the country to concentrate on:

(1) Infrastructure;
(2) Human resources;
(3) E-commerce;
(4) E-gov;
(5) Network security.

The programme clearly stated that, "the private sector is to play a leading role in the area of IT". In this case, the government took action in promoting an environment conducive to innovation and investment, through mechanisms such as effective IT policies, tax incentives and deregulation. With the success of first e-Japan strategy, it

was expanded to include the goal of providing always-on, high speed Internet access at the lowest possible prices to households in Japan. This strategy changed the focus from infrastructure to the use of ICTs. In this respect, the main aim is to create a "vigorous, safe, impressive and convenient society".

After achieving its e-Japan goals, the government has created a new vision for the future, u-Japan, with the goal of working towards a ubiquitous network society to make ICTs as seamless as possible and effectively integrate them into daily public life. The country's vision for a u-Japan aspires to connect fixed, mobile, and consumer electronics into a single network.

3.3.2.1 Telephony

In Japan, there is an incease in use of mobile communications and a decline in traditional fixed-line usage. In 2000, mobile subscribers exceeded fixed-line subscribers for the first time, with the mobile operator reporting 66,784,000 subscribers and fixed-line subscribers at 61,957,000. Today, the number of mobile subscribers has outnumbered the number of fixed-line subscribers (See Figure 10) [47].

3.3.2.2 Mobile Telephony

Today, mobile communication is invetiable for Japanese people. Mobile communication in Japan is operated by using digital mobile phone services and the Personal Handy Phone System (PHS) (See Figure 9) [47]. PHS was launched in 1995 as a low cost, high speed cordless telephone. Japan allocated 3G licenses in June 2000. NTT DoCoMo (Do Communications Over the Mobile Network) was the first operator to launch 3G services in Japan in 2001, but did not anticipated at the first time. On the other hand, KDDI, had success in its April 2002 launch. In the deployment of 3G

services in Japan, operators are free to choose which interface to adopt. The choice is between Wideband CDMA (W-CDMA) and CDMA 2000 (CDMA2000 1x and CDMA 2000 1x EV-DO). At the end of 2004, there were over 25 million 3G subscribers in Japan . The figures mean that subscribers to 3G mobile phones in Japan account for 30 % of all mobile phone subscribers, which indicates a steady transition from 2G to 3G.

In the 2G world, Japan was one of the very few countries that have been successful with the "mobile Internet". In Europe, WAP suffered from low transmission speeds, paucity of content and disenchanted users. On the other hand, Japan introduced a wide array of mobile Internet services. In fact, Japan made mobile Internet services an integral part of mobile phone ownership. This let phenomenal growth in usage and subscribers. In 2003, over 89 per cent of mobile users enjoy some form of Internet access in Japan. In terms of devices connected to the Internet, mobile phones now outnumber personal computers. In February 1999, NTT DoCoMo launched its famous Internet connection service for mobile phones, 'i-mode' [49]. The main services are e-mail, information services and applications such as Internet banking and ticket reservation. Other mobile operators also launched similar services at the same time as NTT DoCoMo, however, by far, the most popular service remains NTT DoCoMo's i-mode.

There are several success factors contributing to the mobile networks for Internet access in Japan Primarly, low PC and Internet penetration are the most important ones. Also, analysts point to the large number of citizents that travel long-distance using public transport as a stimulus for growth. In Japan, early adopters of mobile services are usually young users, they also compose the largest proportion of data traffic.

The demand for browsing services has been responsible for transforming NTT DoCoMo into the world's largest ISP almost overnight. The introduction of colour

handset in 1999 and of java-enabled handsets 2001 ("i-appli" service), were also driving forces. Though mobile Internet services are being used for a variety of reasons in Japan, the primary use remains email.

3.3.3 Internet

High-speed Internet access services, such as wireless LAN were launched in 2002 in Japan. In 2005, Japan had over 22 million broadband subscribers. Broadband in Japan is available over ADSL, CATV, W-LAN and FTTH (Fiber to the Home). Most

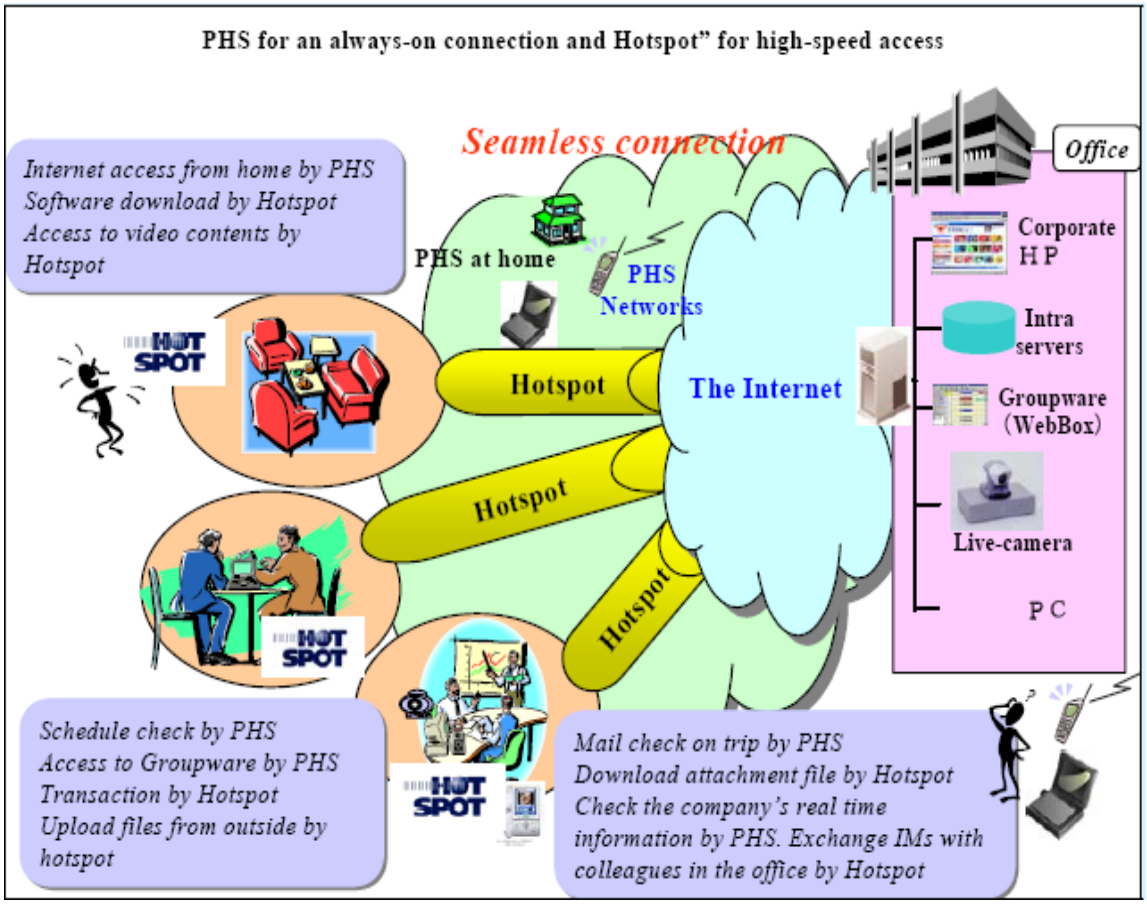

Figure 10. PHS and WLAN nomadic Internet access [48]

broadband subscribers receive service through ADSL with CATV coming in second in terms of penetration [48]. NTT communication leads the market with 1600 hotspots in the Wireless LAN services. Another provider of wireless access is Freespot which provides free access with a wider coverage. However, the non-profitability of wireless LAN service has lead companies to combine wireless Internet with 3G or PHS to provide high speed access and mobility to consumers. This system enables the use of PHS (personal handy phone system) for always-on data connection and WLAN for high-speed stationary access.

3.3.4 VoIP

In the provision of VoIP services, Japan is one of the leading countries. In its move towards the tranformation of a ubiquitous network, Japan made serious investments on IP applications. In December 2005, there were twenty eight service providers offering VoIP service and thirteen operators providing category three VoIP service. The adoption of VoIP services has been steadily rising in each year.

3.3.5 Summing Up / Conclusions

Japan has a clear vision towards a ubiquitous society. One of the most distinguishing aspects of the Japanese mobile industry is that the very close relationship between equipment manufacturers and operators. They work very closely and supply the market with handsets and portable devices in a coordinated effort. The government apply effective IT policies, tax incentives and deregulation to promote an environment open to innovation and investment. With the support of the the right regulatory environment, operators have invested hugely in infrastructure deployment and have made strategic moves using mergers and acquisitions. By merging or acquiring other operators, telecommunications companies are expanding their businesses into new markets or increasing their market. This affects consumers in a positive way by

creating production and distribution efficiencies, and thereby reducing the price of services.

3.4 Australia

3.4.1 e-Readiness

In the UN eGovernment Readiness Index for 2007 [44], Australia is assigned a rank of 9 out of a total of 69 nations as seen in Table 4. Australia haves the best e-Readiness score among other choosen countries: South Korea (16), Japan (18), and Turkey (42).

3.4.2 The Telecommunications Market & Telephony

In the Asia Pacific region, Australia has the fourth largest telecommunications and IT market. The current telecommunications sector is centralized, its monopoly structure is controlled, and it is open to competitive market.

In the late 1980s, telecommunications services in Australia were provided by various monopoly organizations. In 1988, the government restructured the regulatory environment by making reforms, namely *Telecommunications Act 1989* [51]**.** Reforms were applied to monopolies of Telecom Australia, OTC, and AUSSAT to design to foster an increased commercial focus and to provide greater operational freedom, management independence and accountability.

In 1990, the Australian government announced further reforms. In the first phase, a new approach of transition from monopoly to open competition in basic services was adopted. The second phase was implemented in the *Telecommunications Act of 1991* and related legislation. The most important components of the strategy were:

• Merging Telecom and OTC to become AOTC (later Telstra);
• Fixing the period for the facilities-based duopoly (ending in 1997);
• Licensing three public mobile operators (Telstra, Optus, and Vodafone);
• Creating an open competition in the resale of telecommunications capacity and public access cordless telecommunications services;
• Giving AUSTEL a stronger mandate to promote competition and protect consumers' interests.

To create more competitive environment and provide user choice, open competition was introduced into the entire market in July 1997, with the *Telecommunications Act 1997*. Self-regulation within the industry was encouraged, particularly in technical regulations and through codes of practice.

Currently, there is no restriction on entry into the telecommunications service market. As a result, any number of carrier licenses that can be issued. Any corporation or public body can apply for a license. However, to fulfill industry development plans, and to comply with the telecommunications access regime, government expects corporations to serve both in Australia's regional and remote areas. A carrier, especially the incumbent, is subject to criticism if it offers services in the urban areas that cannot be offered in the rural areas. This creates an incentive to wait a longer time before offering new services.

Liberalization affected the Australian telecommunications market significantly. One of these effects has been the increase in operators. There were three carriers in 1997, and in the beginning of 2001, there were sixty licensed carriers [51]. Liberalization has also made each division in the sector to be looked independently, this made it difficult to speak of a single telecommunication market. In terms of competition, mobile telecommunications services is very competitive in most regions in Australia and the competition is more intense where terrestrial coverage is available.

3.4.2.1 Telephony

The Australian telephony market is dominated by Telstra, also known as Telecom Australia. Telstra is 51% government-owned and 49% market controlled, as a result, the carrier has a lot of power in the telecommunications market. Other competitors in the market are Optus, which is owned by Singapore Telecommunications; AAPT, owned by Telecom New Zealand, Primus Telecom, Soul, Vodafone, and Powertel. In 2005, there were 11.46 million main lines in use and 18.42 million mobile telephony subscribers [50,52].

3.4.2.2 Mobile Telephony

There are four mobile service operators: Telstra (the incumbent), Optus, Vodafone, and Hutchison. As of 2004-2005, Telstra held 44% of the market, Optus held 35% of the market, Vodafone had 16%, and Hutchison held the remaining 5%.154 Currently, the mobile the telephony sector is a major contributor to the economy, offering more contribution than many industries, such as newspaper and publishing industry [52].

In 2000-2001, the number of mobile service subscribers surpassed the number of fixed services subscribers. Approximately 94% of the population in Australia is subscribed to mobile telephony service and the terrestrial mobile phone networks now reach over 98% of the population and cover 20% of the Australian landmass. In 2004-2005, the mobile penetration rate is reached to 81%. By the end of 2008, it is estimated that Australia will surpass a 100% penetration rate. This growth in the number of subscribers is due to the significant decrease in the price of mobile services.

When compared to other OECD countries, the Australian mobile telecommunication market offers a high degree of competition, which is ranked fifth among twenty-seven

countries in the level of pricing competitiveness for business mobile services and third for residential mobile services in 2002.

3.4.2.3 Convergence

In the Australian mobile market, convergence has been an important actor. In the past few years, there have been significant advances in mobile phones that allow users to have immediate access to news, sports information, stock prices, news and music radio broadcasts, and television broadcasts. For intance, Telstra's i-mode, which provides customers with the ability to bid on E-bay, view local news from the Australian Broadcasting Corporation, listen to music and new from radio station Triple-J, and access international news from CNN [51]. Another service, Vodafone Live allows customers to download, listen to, and watch over 500,000 music videos and also provides the capability of viewing live performances from the handset. Moreover, another interesting convergence example is that Telstra's new service, SMSenabled, it enables fixed-line telephones to send and receive SMS. Today, more than 80% of pay phones can now be used to send SMS in Australia.

3.4.2.4 3G

In 2003, Hutchison launched "3", The first commercial 3G network in Australia is launched in 2003 by Hutchison. It uses the Wideband CDMA standard which enables high speed delivery of multimedia services. The other competitors in Australia's 3G market include Optus, Vodafone, and Telstra. Optus and Vodafone have a 2.5G network with 3G-like services. In July 2005, Vodafone ran a trial for its 3G network, Telstra started selling its 3G handset in September 2005. Telstra operates jointly with Hutchison. Australia illustrates very important innovations of 3G: the sharing of networks and radio infrastructure by carriers. This sharing can significantly reduce

network costs and enable carriers to establish their services faster while providing efficiencies for all those carriers sharing the network.

Currently, there are more than 300 content providers in the Australian mobile telecommunications industry. With the partnership model between the operators and the content providers, customers access to the latest entertainment services. For instance, the content providers who work with Hutchison make various content available for the its customers, such as news supplied by ABC, Reuters, Sky News, and WeatherZone; sports provided by Fox Sports, Essendon, Cricket Australia, and Sportal; comedy made available by the Comedy Channel; music supplied by Sony, BMG, and Warner; and general entertainment information provided by HWW [51].

3.4.2.5 Mobile Television

With the advent of 3G services, telecommunications operators offer variety of services, and mobile television technology is one them. In 2005, Nokia and the Bridge Networks launched the first mobile TV trial in Australia. Moreover, Ericsson and Milia TV offers interactive mobile television and the first mobile soap opera which is sponsored by Vodafone. Ericsson and Milia TV's service allows viewers to interact with mobile television shows through voting or greeting (SMS or MMS-to-television) simply by pressing a response key. This service also allows viewers to access other services including shopping [51].

3.4.3 Internet

Currently, a majority of the users are accessing the Internet through large ISPs, who provide non-dial-up access. At the end of June 2006, non-dial-up subscribers represented 53% of all Internet subscribers in Australia [51,52].

The growth in the demand for Internet services has also led to an increase in the demand for content in wireless data access and data transfer capabilities in mobile telephony. This has resulted in convergence between Internet technology and mobile telephony. For intance, Telstra has invested in a network called “Telstra Hotspots” that allows certain customers to access localized Internet or broadband services at these hotspots.

Internet service and broadband are an area of high competition in Australia, while Telstra still controls a majority of the network. Currently, DSL is the predominant access technology used for broadband Internet services. Almost 76% of the broadband customers subscribe to this technology.

3.4.4 VoIP

In November 2005, Australian government announced the policy framework for the development of new kind of VoIP services. During the last election, the Australian Government committed to reviewing next generation services, including VoIP and, if necessary, to create legislation to remove barriers to entry in the market. Also, to make sure that consumers are aware of the choice VoIP offers and how VoIP is different from tradition telephony, public information will be developed with the help of the industry [51].

3.4.5 Summing Up / Conclusions

The mobile telecommunications market is where Australia has experienced success. Penetration rates are high in part because of the concentration of population in urban areas. Competition in the market is highly developed due to liberalization as well as a relatively small amount of regulation. Mobile operators have embraced convergence of services and technologies and offer a variety of value-added services. There is also an

issue regarding Telstra's market control. They are in all major telecommunications services. This situation hinders open competition and transparent market entry which Australia is striving for.

3.5 South Korea

3.5.1 e-Readiness

In the UN eGovernment Readiness Index for 2007 [44], South Korea is assigned a rank of 16 out of a total of 69 nations as seen in Table 4. It stands in second place after Australia (9), and front of Japan (18) and Turkey (42).

3.5.2 The Telecommunications Market & Telephony

The Korean government considered information and communications technologies (ICTs) as a way to overcome the financial crisis of 1997-98 and to build a more advanced economy. So, the Korean government began an information technology (IT) training program for its citizens [53].

Aim of this training program was to keep the unemployed occupied. Interestingly, the program proved more beneficial than anticipated. This was a free program, initially designed for 200,000 women but had to accommodate the three million women who registered. Later it was gradually expanded to accommodate men. As a result, totally ten million people were trained in IT. The results of this program made a majority of the citizen technology savvy and more likely to use IT and contribute to the information economy. Korean governments' policy has contributed to the success of communication technology deployment throughout the country. In the year 1999, the mobile phone penetration passed the fixed-line penetration. The country has a greater number of Internet and PC users than fixed telephone users.

In addition to these, there is very close relationship between the government, equipment manufacturers, and the mobile communication operators, in the context of agreement on standards, policies, and business models. Since, Koreans can not afford to purchase the handsets outright, the government regulates the prices the subscribers are charged and ensures all parties are sufficiently compensated (the mobile operator for its services and the equipment manufacturer for its equipment).

3.5.2.1 Telephony

South Korea's fixed-line penetration has been enhanced by the government's provision of the basic infrastructure to be used as a platform for the launch of various services. However, fixed-line penetration has reached saturation with very few subscribers joining the networks [54].

3.5.2.2 Mobile Telephony

Mobile communications began in South Korea in 1984. The service was provided by the Korean Mobile Telecommunications Service (NTT). KMTS was a monopoly in the provision of analogue cellular services for eleven years. SK group bought KMTS, as a result, it currently operates services under the name of SK Telecom. Digital voice service was launched in 1996 using CDMA (IS-95A) technology. With the introduction of the digital voice service,the three new operators entered to this market, Korea Telecom Freetel (KTF), LG Telecom, and Hansol (later merged with KTF), in addition to the two existing operators [54].

South Korea remains a world leader in CDMA technology, introducing it first with CDMA (IS-95A) and then continuing with CDMA 2000 and W-CDMA technologies. Afterwards, in May 2006, HSDPA, which is an enhancement to the W-CDMA 3G

technology that increases downlink speed commerical service, was lauched and now has 215,000 subscribers.

The country presently has a mobile penetration of approximately 80% [69]. Due to the saturation of th mobile market, Korean mobile operators are now concentrating on the development and provision of value-added services. Today, the mobile phone has become a fundamental part of Koreans everyday life. Koreans use mobile phone not only for voice communication but also for quick information searches, mobile commerce, mobile banking, video services, gaming and music.

3.5.3 Internet

There are seventy nine Internet service providers in South Korea. Some of these providers include KT (KORNET), Dacom (BORANET), and Hanaro Telecom (HANANET) [53].
Broadband became available in South Korea in 1998. It has become a very popular mode of Internet connection and there were 12.2 million subscriptions by the end of 2005. Korean operators offer some of the fastest and cheapest residential connections in the world. ADSL connections of 2Mbps are available for less than US$ 25 per month, while VDSL broadband connections of 20-40 Mbps are available for less than US$ 50 [54].

The success South Korea has achieved in broadband is the result of cooperation between the Korean government and the private sector investment. Private companies supported the broadband backbone, and at the same time, the government encouraged market entry by ligthening entry rules of registration and notification and by removing foreign ownership restrictions.

3.5.3.1 Wi-Bro

Wi-Bro is a Korean variant of the international Wi-Max standard. This technology is somewhat of a hybrid between the mobile phone and the wireless LAN (fixed wireless). It enables mobility to be achieved at 120 km/h with continuous access. Wi-Bro also has a same coverage area as the Wi-Max range which is about 1 km. The WiBro licenses were won by the fixed-line operators, KT and Hanaro, and by the mobile operator, SK Telecom [53].

3.5.3.3 Convergence

The broadband converged network (BcN) is an integrated network that allows secure seamless access anywhere, at any time to quality multimedia services, including fixed and mobile telecommunication services, broadcast services, and Internet services. It is scheduled for completion in 2010. Adopting IPv6 technology is is another next generation solution being looked at by South Korea due to shortage of IP addresses.

3.5.4 VoIP

There are many big private organizations that offer VoIP service for South Korea. For intance, Skype, the Internet telephone giant, has begun providing VoIP services in South Korea. Standard features of Skype services include instant messaging, SMS to mobile phones, calls terminating on regular phones (SkypeOut), the option of a personal phone number (SkypeIn), and conference calls [53].

3.5.5 Summing Up / Conclusions

South Korea's success can be attributed to the commitment of the government and of the private sector to the creation of necessary infrastructure for the provision of

converged services. This includes the creation and training of a technology savvy public.

3.6 Analysis of Country Results and Comparison

South Korea, and Japan, all share the characteristic of being first-movers in technology. While the remaining two, Australia and Turkey, have been reactionary in their responses to change within the telecommunication industry.

Primarly, let us review the countries e-Readiness scores. e-Readiness can be defined as *"state of play" of a country's information and communications technology (ICT) infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit*. e-Readiness ranking allows governments to gauge the success of their technology initiatives against those of other countries. It also provides companies that wish to invest in online operations with an overview of the world's most promising investment locations [44]. Comparison of e-Readiness scores can be seen in Table 4 below. Turkey (42) has the lowest score among the group.

Table 3. Comparison of e-Readiness scores [44]

Country	**Population (million)**	**2006 e-Readiness Rank (of 69)**	**2007 e-Readiness Rank (of 69)**	**2006 e-Readiness Score (out of 10)**	**2007 e-Readiness Score (out of 10)**
Australia	20	8	9	8.50	8.46
South Korea	48	18	16	7.90	8.08
Japan	128	21	18	7.77	8.01
Turkey	71	45	42	4.77	5.61

Using Figure 11 below, we examine a migration from fixed voice communication to mobile voice communication.

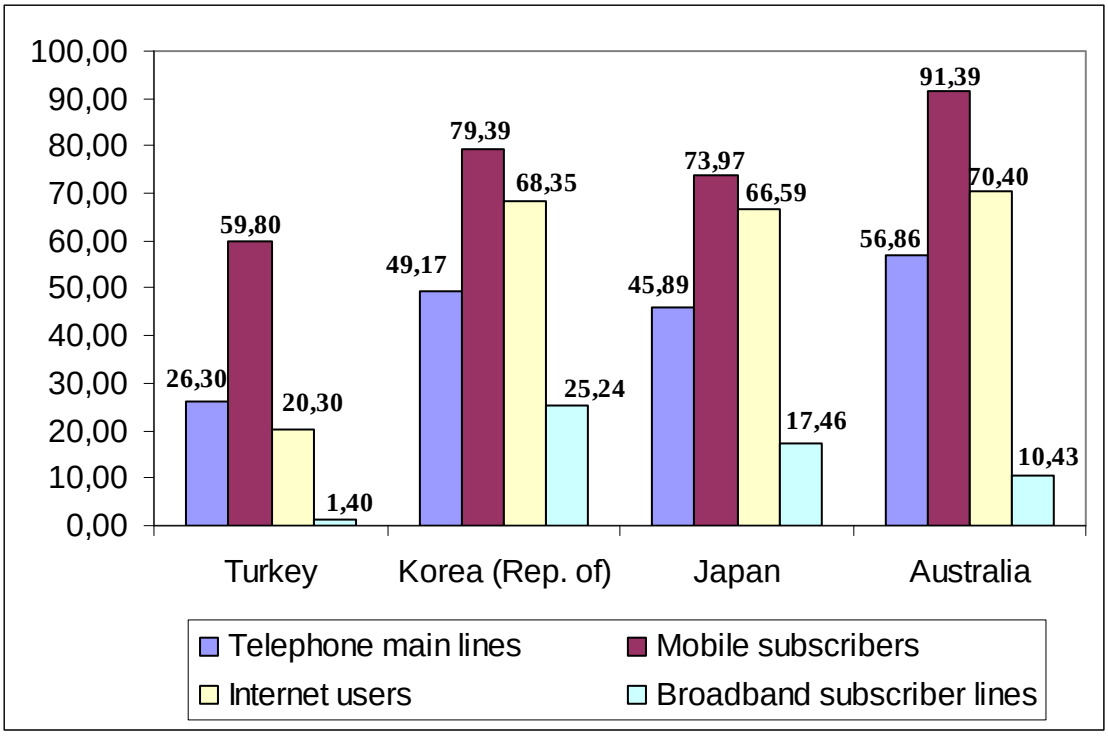

Figure 11. ICT Market Indicators (Subscribers per 100 Inhabitants), 2005

In all four countries, mobile communication has overtaken fixed communication in terms of number of subscribers, as the number of mobile subscribers is greater than the number of fixed subscribers. This may be result of low cost of mobile communication, rise in the broadband subscriptions, and previous achievement of fixed-line saturation. Countries do not share similar demographics, due to this, mobile penetrations show differences among countries. For instance, Australia has a mobile penetration rate of 92% because of the concentration of the population within the urban areas. However, Turkey's cellular market is not as fully penetrated as Asia Pasific region. Turkish citizens often own more than one SIM card, thus distorting true penetration statistics.

Tables 5 and Table 6 provide a comparison of countries for voice communications and data communications respectively. The use of data services as alternative means of communication is widespread in many parts of the Asia Pacific region.

More than half of Turkey's population is under the age of 24, therefore young population of Turkey, increases the number of SMS messages. In South Korea, the move to data services has been fueled by the country's advancements in communication technology. The availability of 3G network services and their upgrade with HSDPA to provide a high speed connection makes data communication relatively easy to deploy. Mobile gaming, music, video, mobile banking and commerce are but a few of the services embraced by consumers. In South Korea, as in Turkey, SMS is not the preferred means of communication. However, it is popular amongst the teenage groups.

Table 4. Analysis - Comparison of Voice Communications

Country	Fixed-Line	Mobile
Turkey	• Demand has been declining since 2002.	• No 3G licenses. • 3G licences are on the Turkey's 2007 agenda.
Japan	• Demand has been declining since 2000.	• Digital mobile communication; • Using 3G and PHS across various interfaces.
Australia	• Close to saturation; • Universal service obligation; • Market is dominated by Telstra which was 51.8% government owned until November 2006	• Close to saturation; • Expected to surpass 100% by 2008; • Major contributor to the economy.
South Korea	• At a saturation point; •	• 2G and 3G available; • Home to global giants in handset manufacturing; • Operators' strategy relies on content provision.

Internet subscribers are prefering broadband over dial-up. Among the four countries examined, South Korea, and Japan are all in a good position to supply the infrastructure necessary to support these services. Turkey still needs to work on its infrastructure and regulations. Australia has plans to for a upgrade to its network which will facilitate in the provision of broadband and its related services. In addition to this, Australia is unique among the countries examined in that it is in a position where the incumbent, Telstra, controls the infrastructure necessary for the provision of

services. This means other operators must have access to Telstra's network in order to provide competing service.

Table 5. Analysis - Comparison of Data Communications

Country	SMS	Broadband	VoIP
Turkey	• High usage, especially young aged users prefer SMS messaging.	• Available over ADSL, however still very low compared to other countries.	• Twelve companies have obtained licenses from Turk Telekom. • There is need for regulation.
Japan	• Low usage; • Preference for other data applications	• Available over ADSL, CATV, W-LAN and FTTH; • FTTH experiencing a steady rise as the infrastructure of the future.	• Three types in existence according to quality of service; • 13 operators who provide the best quality service.
Australia	• A major source of growth within the telecommunications market; • Initially linked to media such as TV programming.	• $3 billion network upgrade planned; • Telstra controls the network; • Dial-up customers exceeded broadband customers until 2006.	• Government feels that no regulation change need to accommodate VoIP; • Legislation may be created to remove barriers from market entry.
South Korea	• Common with teenagers; • Inexpensive.	• Available over various technologies • ADSL, VDSL, CATV, FTTH; • Fast and inexpensive.	• Recognizes three types of VoIP services; • Separate numbering plan.

Among these four countries, all have opened their market to VoIP in some manner, although in Turkey, firms are only permitted to do VoIP within their company structure, despite their location in Turkey. Japan categorizes and regulates services based on their quality. South Korea, adopts a similar approach like Japan. Australia, on the other hand, views VoIP not much differently than traditional telephony and has chosen to focus on developing a regulatory framework based in consumer protection and emergency.

Table 6. Analysis - Comparison of Strategies and Consumer Demands

Country	Government Strategy	Operator Strategy	Consumer Demand
Turkey	• Centralised approach; • Goal of transforming	• Operators such as Turkcell aims to become	• Willing to adopt new technologies, due to

Table 6. (Cont.)

	• into an information society and closing the digital divide; • Full liberalization and effective regulation of the market are expected to attract foreign investments into the sector; • As a part of the EU convergence, e-Transformation Turkey in 2003 and e-gov projects are being implemented.	• a regional player and established partnerships; • GSM operators are waiting for the 3G licence tender. • Vodafone and AVEA, aims to expand their market share, and to create a more competive market by reducing prices and launching new services.	• young and dynamic population. • More than half of the population is under the age of 24.
Japan	• The u-Japan program which is move towards the convergence of communication broadcasting and consumer electronics into a single network.	• Expand market power or move into new markets by merging with or acquiring another operator(s).	• Technology savvy; • Willing to adopt new technologies.
Australia	• Slow regulatory reaction; • Attempting to apply existing regulatory framework and only making changes as deemed necessary; • Emphasis on industry self-regulation.	• Access to Telstra's fixed network is key; • Value-added services. •	• Willing to adopt new technologies if they are cost effective.
South Korea	• Broadband Converged Network (BCN), executed in three phases, to be completed in 2010; • First mover in the creation of infrastructure.	• Operators positioned to provide more than voice services as total solutions providers; • Pilot project for IPTV allowed by KBC and MIC.	• Very technology savvy; • Willing to adopt new technologies.

3.7 Discussions and Justifications

We already analyzed Turkey's current position in terms of m-gov. In this section, we will try to determine the critical success factors from our comparison of country cases, and try to find answer to the question: *What are the odds for Turkey's success in m-gov?*

In the world, there are 41 different manufacturers that produce 355 different 3G model mobile phones. On the other side, there are 19 different types of 3G mobile phones, and at least 750 thousand 3G device users. According to GSM operators in Turkey, this number is expected to be increase in time. Most importantly, 3G technology is full compatible with GSM, in other words, all 3G mobile phones support GSM.

Currently, Turkey's mobile penetration rate is officially at 70 per cent. However Turkish citizens have the habit of switching SIM cards quite often and owning more than one, thus distorting true penetration statistics. On that basis, it is possible to say that the official penetration rate of 70 per cent, is actually lower. When Turkey's cellular market compared to Japan, South Korea, Australia and other Western Europe countries, penetration rates are low and not fully saturated.

Turkey is the only country that doesn't have 3G licences among the European member or candidate countries. Mobile operators in Turkey are aware of the upcoming 3G market. However it seems that Turkcell is the only one of the three whose network is anywhere near ready to launch 3G services. It is for sure that, 3G will bring innovative services to subsribers, such as the provision of e-gov services by mobile phones. With access to high speed Internet via mobile handsets, the subscriber base is expected to be grow. This is possible because third generation technologies will be offered at cheaper rates than GPRS. For customers in rural areas who cannot access ADSL lines, mobile services means a gateway to knowledge. Turkey's traditional digital divide could soon be closed.

Recently, Turkey's one of most successful projects in 2006 has been 'Turkcell-im', which brings together more than 100 services available online or via SMS. For instance, in 1999, Japan's NTT DoCoMo launched its famous Internet connection service for mobile phones, 'i-mode'. This was the most popular service among other services in Japan, and attracted millions of new subscribers. This made mobile Internet, the most popular Internet access technology in Japan. The factors that

contribute to the success of this service of mobile networks for Internet access in Japan increases the chance that Turkey would be successful with a similar approach. Let us examine these factors: low PC and Internet penetration, but high mobile penetration, which is similar to Turkey. Another factor is that there is large number of long-distance commuters using public transport. This pushes citizens to use mobile devices in public transport due to long distances. In Turkey, major of the citizens in big cities are using public transportation vehicles to reach their homes. In Istanbul and Ankara, citizens use metro and public bus to reach their homes in long distances. Mobile devices can be great alternative way to ensure pleasant time to citizens. Lastly, young users compose the largest proportion of 'i-mode' in Japan. Similarly, Turkey has a young and dynamic population that easily adapts to new technologies. More than half of Turkey's population is under the age of 24. These factors show us that mobile phone may be very popular internet access technology as like Japan, and 'Turkcell-im' may play a major role in achieving this approach.

3.8 Defining Critical Success Factors and Strategies for Turkey

Japanese government implemented "e-Japan Strategy" in 2001. Main objective of this strategy was making Japan the most advanced IT country in the world within five years. Accordingly, the government foster the private sector through mechanisms such as effective IT policies, tax incentives and deregulation. This created an innovative and efficient environment for operators in Japan. Right regulatory environment, made operators to invest hugely in infrastructure deployment and have made strategic moves using mergers and acquisitions. With the support of the government, operators made mobile Internet services an integral part of mobile phone ownership. This let phenomenal growth in usage and subscribers. Now, in long term, they're aiming to create "ubiquitous network society", achievement is also known as "Ubiquitous Net Japan (u-Japan)". This society will enable to connect to the network "anytime" (24 hours day or night), "anywhere" (at work, at home, in the city, in the country, or on the

move), with “anything” (home appliances, individual items, cars, food products), and by “anyone” (adults or children, elderly or handicapped).

The South Korean government strategy was launching an information technology (IT) training program for its citizens. Program success was more than anticipated. The results of this program made a majority of the citizen technology savvy and more likely to use IT and contribute to the information economy. Besides, government kept intimate relationship with equipment manufacturers, and the mobile communication operators. Combining this relationship with strategies standards, policies, and business models was another success of South Korea government. Government also promote the purchase of the mobile devices, by regulating the prices. Moreover, connection speed for broadband is a priority for the Korean government which believes it is important for the deployment of converged services. The government has set out policies to facilitate the efficient use of existing infrastructure and the innovation of new infrastructure.

The Australian government strategy was to create open competion. In July 1997, with the *Telecommunications Act 1997,* self-regulation within the industry was encouraged. As a result of liberalization and small amount of regulation, competition in the market is highly developed. Australia followed similar policy that Japan and South Korea applied regarding relationships with private industry.

Turkey launched e-Transformation Turkey 2005 Action Plan. Twenty three (23) e-gov action items were contained in the plan’s e-gov section. The third item of this plan explicitly states the importance of mobile technologies. The item reads, “*The strategy, which will support administrative, economic and technical steps, necessary to provide the latest generation mobile technology services will be determined*” [12]. This should be a stimulative act for government to implement further strategies regarding m-gov.

Therefore, from now on, Turkish government should mention the e-gov concept along with m-gov as they complement each other.

When evaluated together with data provided from country cases analysis earlier in this chapter, and information derived from the literature survey, for the success of m-gov in Turkey, government should implement actions described below:

- Firstly, the infrastructure should be improved to sufficient level for the highest levels of data transmission possible.
- Mobile Government technologies such as, Wi-Fi, Wi-Max, and RFID technologies should be deployed in Turkey for users to reach the information 'anytime' and 'anywhere' and minimize costs.
- Citizens technology readiness should be improved. This could be established with the training programs such South Korea did for its citizens. Government can adopt this model for the success.
- Organizations/governments should evaluate technology readiness of their employees and accordingly, educate and train them. South Korea case can contribute toward this end. Also IT partners could also help in training and education.
- Organizations/governments should encourage employees' use of mobile/wireless devices, through incentives, both for work and personel use.
- Governments should implement the right strategies:
    - Create open environment for the competition ;
    - Create innovative atmospher for operators and organizations to do R&D;
    - Decrease regulations if possible;
    - Keep intimate relationship with equipment manufacturers, and the mobile communication operators;
    - Build balance between citizens, operators and manufacturers;

    - Foster the private sector through mechanisms such as effective IT policies and tax incentives;
    - Develop policies to make mobile Internet services an significant of citizens' lives.
    - Educate and train their employees;
    - Educate citizens.
- Specify barriers and act accordingly. For instance, make mobile communication more secure and reliable;
- Integrate e-gov projects with mobile devices if possible, for instance integrate e-gov Portal (e-Devlet Kapisi) with mobile devices;
- Improve research and development regarding mobile technology;
- Implement actions according to *Prescriptive Matrix* which is described earlier.

3.9 Designing a Strategical Plan Model for M-Government

Sandy and McMillan [61] developed a Success Factors Model to assist those in planning and implementing m-gov services. This model included the factors that ensure the benefits claimed for m-gov will be realized. We modified this model with the support of comprehensive review of the literature, including government sites worldwide.

In the previous section, we defined the critical success factors for Turkey in the light of the four country case studies and based on our literature review. In addition to CSF (Critical Success Factors), we added Drivers and Barriers component to our model. In the literature, Kuscu, Kushchu and Yu [20] defined Drivers and Barriers in the transition from e-gov to m-gov. Archer [62] described the Drivers and Barriers of mobile e-health applications. Moreover, Pagani and Pasinetti [55] discussed Drivers and Barriers in the development of t-government (Transformational Government) services.

Taking into consideration of these components, we designed an enhanced m-gov plan (See Figure 12) to assist those in planning and implementing m-gov services.

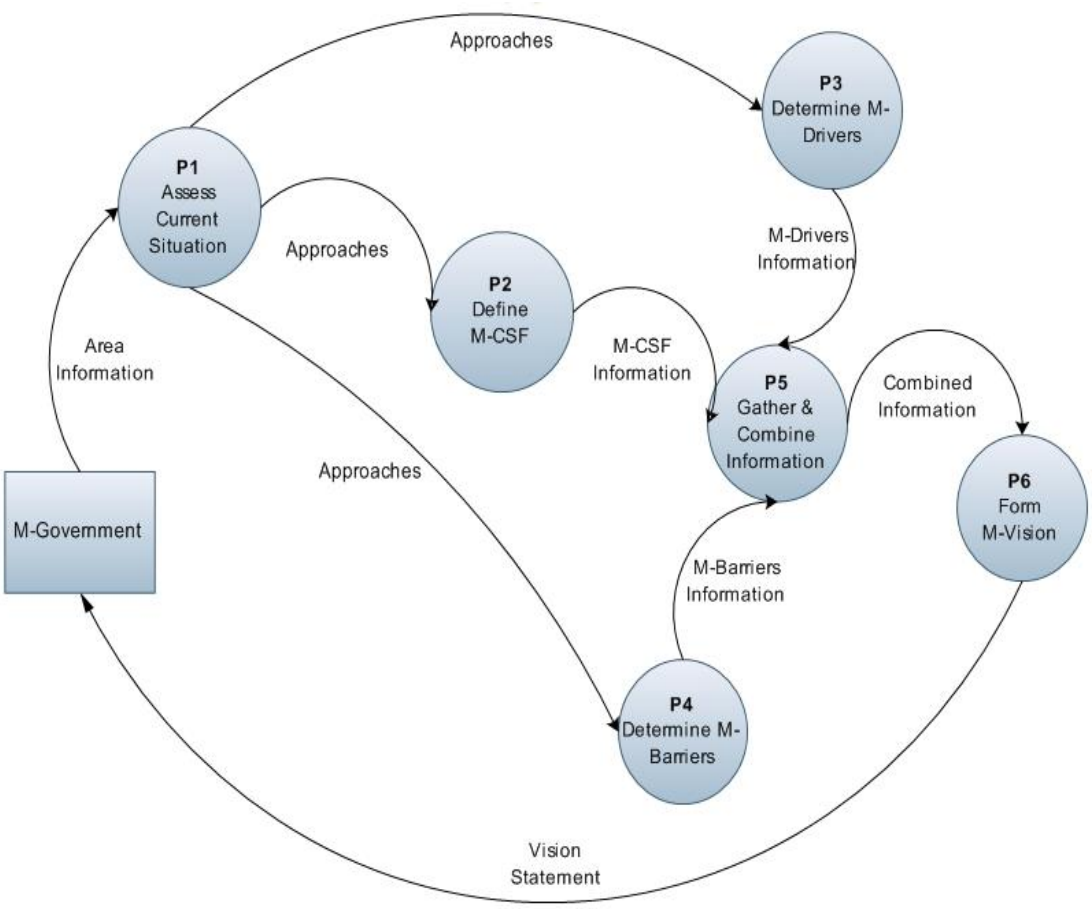

Figure 12. DFD of a Strategical Plan Model for M-Government

3.9.1 Defining Components of the Strategical Mobile Government Model

In Figure 12, *Government* is the source and destination of information (the entity), respectively *P1, P 2, P3, P4, P5* and *P6* are the processes in the model. In the context of processes 'M' stands for m-government. Definition of processes in this model is defined below:

P1:Assess Current Situation: Understanding their *current situation assessment* is vital for government to identify the approaches needed to drive success. In this process, governments should consider areas presented below:

- Citizens/Mobile Subscribers: Citizens' current and future needs, their adoption of the wireless/mobile technology, their perceptions toward governments/operators performance and services.
- Government workers: Their adoption of the wireless/mobile technology, their perception of the government, measurement of wireless/mobile technology over their effectiveness.
- Telecommunication industry trends: Recent developments and shifts in the industry, forecasting future industry shifts.
- Countries: Comparison with other countries, their recent and anticipated initiatives.
- Operator performance trends: Operators performance in the market, marketing and R&D.
- Recent goals and initiatives: Government assessment of their recent initiatives, implementations and projects.

P2:Define M-Critical Success Factors: Government approach toward *Critical Success Factors* is significant to achieve the goals. These conditions include strategies, regulations, policies, standarts, business models, and relationships with private operators/organizations/citizens.

P3:Determine M-Drivers: Government approach toward *M-Drivers* is significant in the development of m-gov infrastructure, mobile convergence, and emergence of new services and applications.

P3:Determine M-Barriers: On the other side, government approach toward *M-Barriers* is crucial in addressing series of challenges. Governments must overcome those challenges to achieve its strategic direction. *M-Drivers* and *M-Barriers* will be discussed in particular in the next chapter.

P5: Gather and Combine Information: All the information from P2, P3 and P4 is *Gathered and Combined* to form *M-Vision*.

P6: Form M-Vision: The information gathered from P5 is combined with the understanding of future trends to develop the *vision statement*. M-*Vision* is the government's preferred picture of the future in the context of m-government. *Vision* phase includes the *mission* and *goals* statement. While the *mission* defines as "what the government does, for whom, and the benefit", the *vision* displays what the future will look like if the government achieves its mission.

- *Mission:* the overall purpose of the government (i.e., what the government does, for whom it does it, and the benefit)
- *Goals:* the long-term aims that define accomplishment of the mission.

3.9.2 Conclusion

So far, we have determined the Critical Success Factors in the model for Turkey. In the next chapter, we'll identify the most significant M-Drivers and M-Barriers in Turkey.

CHAPTER 4

A CASE STUDY: DETERMINING M-DRIVERS AND M-BARRIERS FOR TURKEY

4.1 Introduction

Main purpose of this survey is to identify the most significant m-drivers and m-barriers in order to provide some guiding lines in the design of a successful strategic action plan model for mobile government in Turkey. Besides, we investigate the impact of demographic factors on selected drivers and barriers.

To achieve our purpose, we conducted a quantitative analysis through a total of 238 completed survey questionnaires. The respondents were IT professionals from major government and private sector organizations who were the attendees of the meeting on issues in the use of IT in organizations, organized by the Informatics Associations of Turkey (IAT). The sample was chosen intentionally for a reason. IT-oriented people are more likely to be part of the "lead-user" segment of wireless device users, and it was important to establish the relationships at their level rather than citizens level [35].

Before our analysis and discussions, let us review the literature regarding the definitions of our driver and barrier factors.

Figure 13 details the guiding framework adopted in this study:

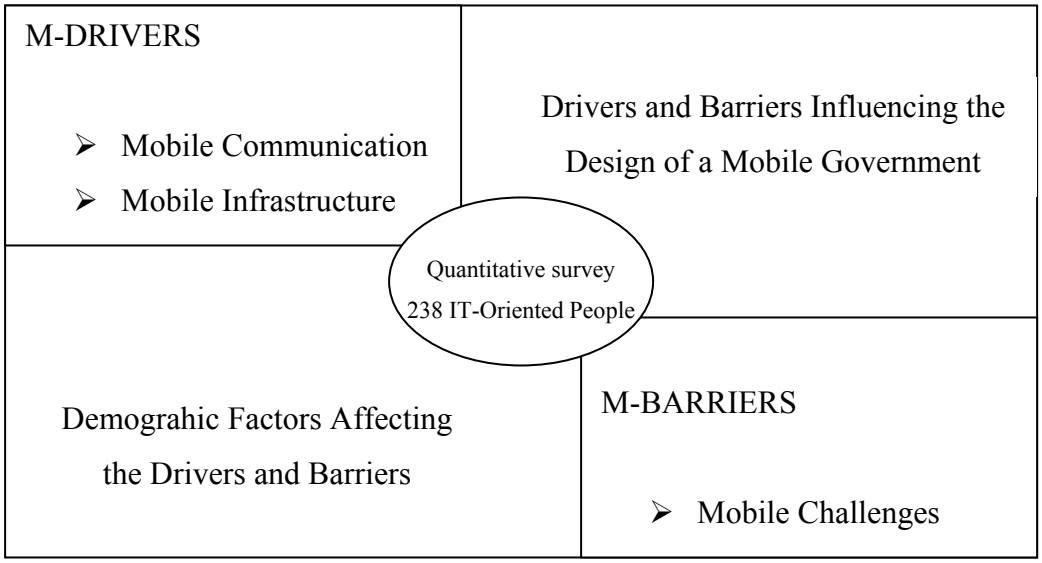

Figure 13. Guiding framework

4.2 Review and Definitions

Reviews and definitions of dependent factors can be seen below (See A-Table 1 in Appendix-A):

The dependent variables were categorized into two divisions as follows:

M-Drivers

- Mobile device penetration and increasing mobile/wireless communication device usage
- Increasing mobile infrastructure
- Move towards 3G service applications

M-Barriers

- Mobile Government Challenges

Mobile device penetration and increasing mobile/wireless communication device usage

The high mobile phone penetration rate will put serious pressure on mobile government implementations. Today, mobile phones are not only used only for voice communication purposes but also used to connect to the Internet for transferring data, exchanging e-mails, and doing small scale business transactions [6].

Increasing mobile infrastructure

Infrastructure can be both "physical" and "soft". Technology, equipment (mobile devices), and network (wired/wireless) required to implement m-gov are considered as the physical infrastructure. On the other side, soft infrastructures refers to the institutional arrangements, and software that make m-gov transactions possible. Increasing mobile infrastructure will influence the new and existing e-gov efforts and support in adopting mobile applications and services [55].

Move towards 3G Service Applications

The services include personalisation, location based services and context aware applications. With reference to the potential field of application we consider nine main areas of content :

- *Local taxation:* Information channel for local residents, payment of house taxes, income taxes, etc.
- *Personal Data:* Request/renewal of documents, certificates, change of place of residence.
- *Postal Services:* Postal notification service, etc.

- *Education:* Application forms, payment of school taxes, test results, academic status, courses.
- *Banking and Finance:* Stock exchange, fund exchange, banking services
- *Security:* Crisis information channel, emergency services
- *Health:* Reservation of hospital visits, monitoring vital parameters.
- *Tourism:* Information channel for tourists, hotel reservations
- *Social Security:* Pension information systems

Challenges for M-Government

At the implementation phase of mobile government, there will be a series of challenges. As we discussed in previous chapters that mobile government applications will be complementary to the e-gov activities. Therefore, some of the typical challenges encountered by e-gov are naturally shared by the m-gov efforts. The challenges and their definitions can be seen below [6]:

- *Lack of technological infrastructure*: Increasing mobile infrastructure can be considered as a force in adopting mobile government activities, however lack of an essential infrastructure refers to be a challenge for mobile government.
- *Low credit card penetration*: In developing countries, the number of persons with credit cards is too small when compared to the number of potential users for m-gov transactions.
- *Security and privacy gaps*: Citizens have concerns about sending their credit card information over the mobile and wireless devices. Also they do not want their mobile phone numbers to be traced by the government.

- *Insufficient number of its users*: Citizen participation depending on socio-economic factors will play an important role in the success of mobile government.
- *Citizen adaptation process*: Especially in the rural areas of developing countries, citizens adaptation to the mobile and wireless aplications and services is an another important factor to be successfull in mobile government.
- *Problems with laws and political process*: There is no clear legal status for mobile applications, no regulations and laws for online fillings, online signings, and on online taxable transactions. In some countries, slow bureaucratic process is also a challenge in implementation processes.
- *Compatibility of the mobile systems with the existing e-gov systems*: It may not be easy to integrate both systems in terms of functionalities and data administration.

4.3 Hypotheses

We use a systematic and exploratory analysis approach to investigate the impact of demographic factors on selected mobile government driver and barrier factors. The demographic factors refer as independent variables and the selected drivers and barriers refer as depependent variables. Each empirical factor were extracted based on prior literature, and the corresponding hypotheses were made according to similar researches on demographic factors.

4.3.1 Personal attitudes towards Mobile Government Drivers

The attitudes and behaviors of individuals are influenced by factors such as gender, age, type of education, occupation and experience. Mobile/wireless devices and

technlogy take a significant place in our daily and business life. Their usage may differ according to demographic factors [56]. There are many studies related to communication device usage and acceptance of mobile technology. Literature provides some studies including different respondent groups. For instance, Hung, Yang, Hsiao and Yang [57] used students in their study on acceptance and use of mobile services, while in an another study, Han [58] has examined physicians' acceptance of mobile technology . In our case, we analyze IT-oriented people. Moreover, impact of demographic factors on adoption decisions and willingness to adopt technologies in general is very little known [58-60]. Also, recent literatures [60] emphasize that consumers' factors that influence adoption decisions and value perceptions relating to m-Technology are not well researched. Following this line of reasoning, the present study explores the impact of demographic factors in relation to attitudes towards the m-gov. The present study therefore proposes the following hypothesis.

H1. Demographic parameters have impact on the "mobile penetration and communication device usage."

To be successful in mobile government, one of the requirements is to have the essential information technology infrastructure. The impact of demographic factors on the effect of the type of infrastructure is an area which has not been studied yet and our second hypothesis is therefore:

H2. Demographic parameters have impact on the "Types of mobile infrastructure".

Another driving force of mobile government is the attitude towards 3G Service applications. Based on prior literature, we consider nine main areas of the potential field of applications. Besides, the literature provides some evidences for the relationship between demographic factors and applications. Further, m-gov applications and services are in a competition with alternative applications, services,

and channels. Consequently, the existence of alternative applications and services, put consumers in a multiple-choice situation, and this needs to be considered [37]. So, we propose the following hypothesis:

H3. Demographic parameters have impact on the "mobile government applications".

4.3.2 Personal attitudes towards Mobile Government Barriers

Besides driving forces, there are also key barriers to mobile government deployment. The impact of demographic factors on the mobile government challenges is an another area which has not been studied yet, however there is a empirical evidence indicating that perceived barriers are more significant determinants of adoption decisions than the users' perceptions of the benefits associated with the technology [60] and our last hypothesis is therefore:

H4. Demographic parameters have impact on the "mobile government challenges".

4.3.3 Research Design

In terms of the composition of the respondents, our sample is biased toward the more educated and more IT-oriented people. The sample was chosen intentionally for a reason. IT-oriented people are more likely to be part of the "lead-user" segment of wireless device users, and it was important to establish the relationships at their level rather than citizens level [3].

Each respondent was asked to evaluate the importance of each attribute through a five point Likert scale. According to this, all items were measured on a 5-point scale ranging from strongly agree (5) to strongly disagree (1), with (3) being neutral. The items were developed based on related literature studies. The reliability of the multiple-item scales is high as coefficient alpha value accepted as 0.95. The survey

instrument included information on whether the respondent owned wireless devices such as cellular phones, laptops, PDAs, wired, and wireless access to the Internet. Gender, age, education information, and work experience (years) along with career information were also examined as they are excepted as independent variables [3]. In the survey instrument, we included items that measured (Please see A-Table 1 in Appendix-A):

(1) current usage of mobile/wireless/wired Technologies;
(2) respondent perceptions of Turkey's current infrastructure;
(3) their willingness toward potential m-gov applications;
(4) their attitudes toward challenges for m-gov.

In this study, SPSS software system was used for statistical analyses. It allowed us for in-depth data access and preparation. First of all, we compare the mean of one or more groups based on one independent variable (or factor) by using the One-Way ANOVA as you can see in Table 2-3-4-5 in Appendix-B. In the discussion section, important findings will be supported by the Pearson Chi-Square test. This test suggest that whether two variables are independent or not. Suggestions are made according to the significance of the Pearson Chi-Square test. If it is above our usual cut-off point of 0.05, then two variables are not related.

4.4 Results

4.4.1 Descriptive Results

4.4.1.1 Respondent Information

In all, 238 IT-oriented people, half of whom were IT employee from different departments of governments, about 39 percent were IT managers and 9 percent were

IT-oriented academicians participated in the survey. Based on the DELAYs to the demographic questions, approximately 71 percent of the respondents were male and 29 percent were female. About 16 percent were between the ages of 18 and 33, 70 percent between 34 and 49, and 14 percent were higher than 50. In terms of education, 10 percent had postgraduate degrees, 32 percent had graduate degrees, 58 percent had undergraduate degrees. Consequently, in terms of work experience, 15 percent of the respondents had worked 1 to 10 years, 69 percent had worked 11 to 20 years, and 16 percent had worked more than 20 years. Respondent information may be followed from Figure 13.

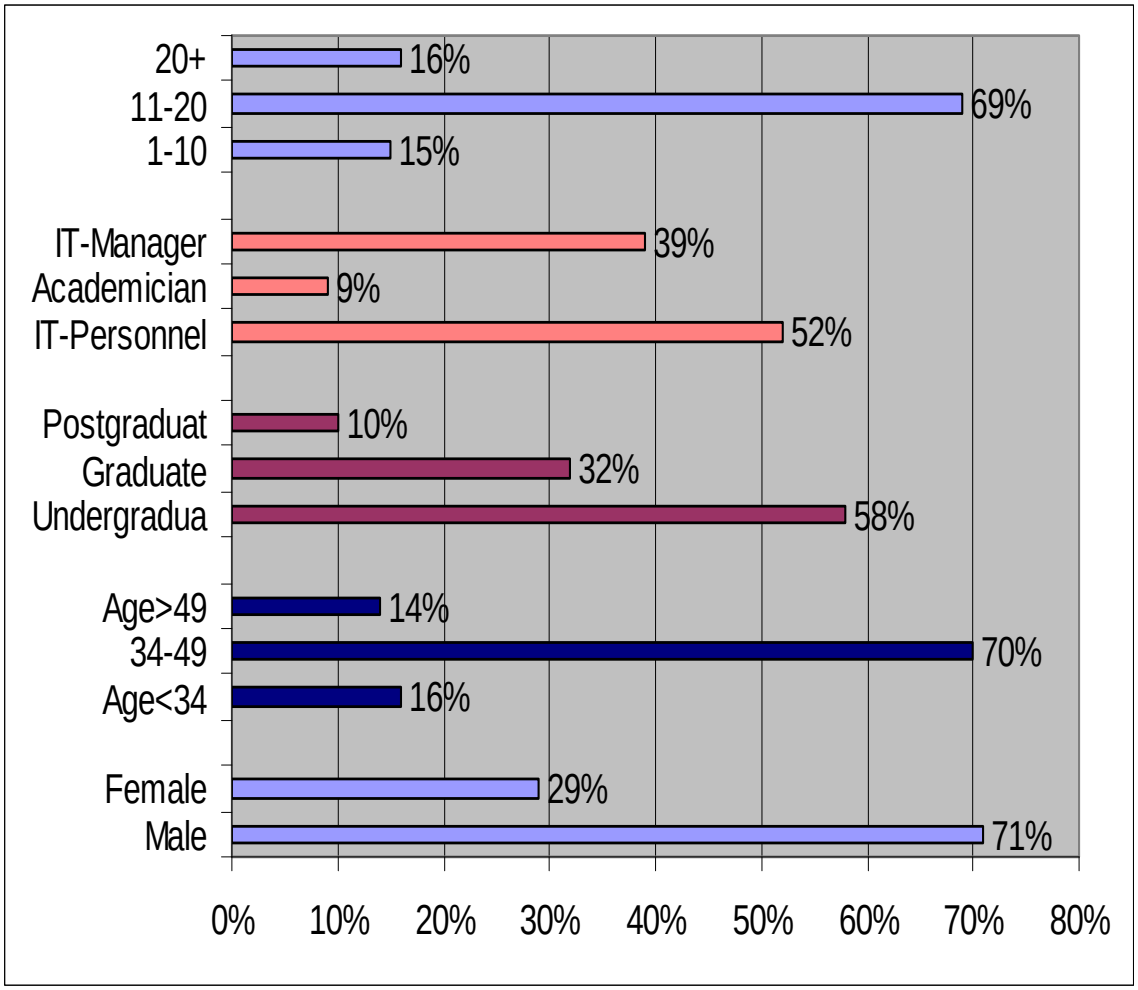

Figure 14. Demographic Factors

4.4.1.2 Mobile device penetration and increasing communication device usage

Communication device easiness

Most of the respondents (%58) say mobile phones are easy to use rather than other communication devices.

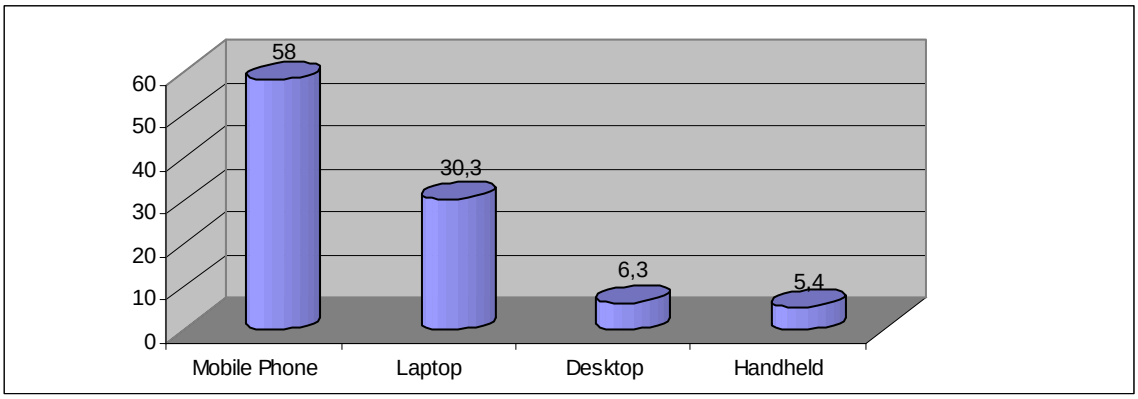

Figure 15. Communication Devices-1

This result is very normal due to mobile phones having a unique and simple interface, and less functionalities compared to computer.

Preferred mobile communication channel

Majority prefers e-mail rather than SMS in the terms of communication channel. This result is due to SMS giving the possibility to receive and send text messages with maximum volume of 160 digital alphabetic symbols. In spite of this poor attribute, SMS still have some advantages; unlike an e-mail, SMS is much more likely to be read by a person at any one time, since the majority of people have their mobile phones at arms reach 24 hours a day.

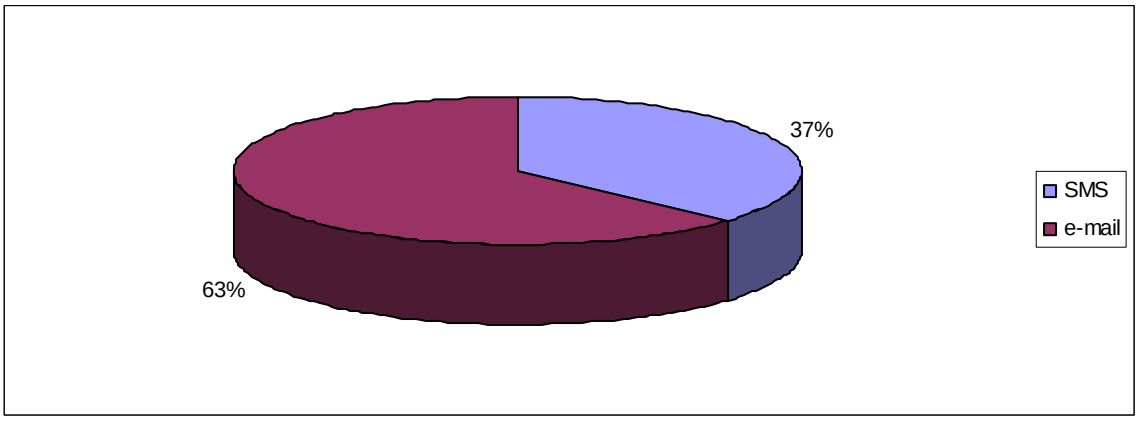

Figure 16. Mobile Communication Channel

Preferred mobile/wireless communication device for connecting internet

Generality of participants (%51), prefer laptop computers for connecting internet. Mobile phones and handheld computers seem not to be an altenative communication device for connecting internet but seem to be a complementary device to laptop computers.

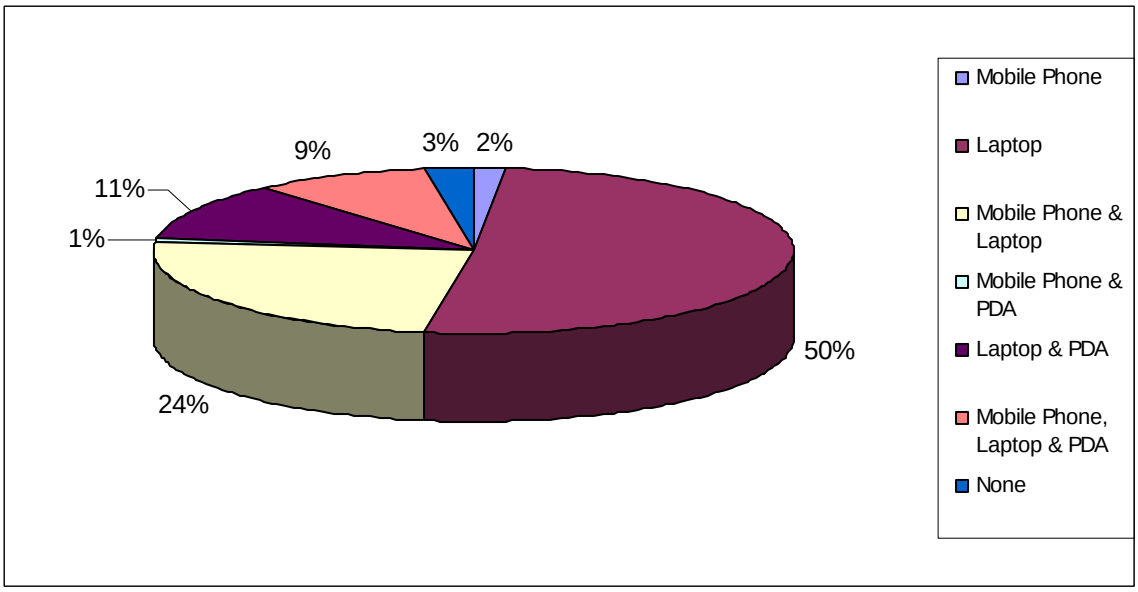

Figure 17. Communication Devices-2

People are unwilling to use these devices to connect to internet because of their limitations in display size, information processing capabilities and information transmission capabilities [35]. According to the results of Turkey's State Institute of Statistics (TUIK) ICT Usage Survey on Households and Individuals carried out in June 2005, availability of mobile phone devices in households is 73 percent, however only 37 percent of households prefer mobile phone over narrowband (WAP, GPRS, etc.) access to the Internet at home [8]. This implies, usage of WAP services are not positively correlated with mobil penetration, due to high communication charges and low communication speeds.

Communication type at home

Half of the respondents (%49) prefer wired connections at home. Wireless connection (%20) seems to be a complementary connection (%28) to wired connection. According to the results of ICT Usage Survey on Households and Individual [8], proportion of people having internet connection at home is 28 percent, which is low when compared with connection at place of work with 43 percent.

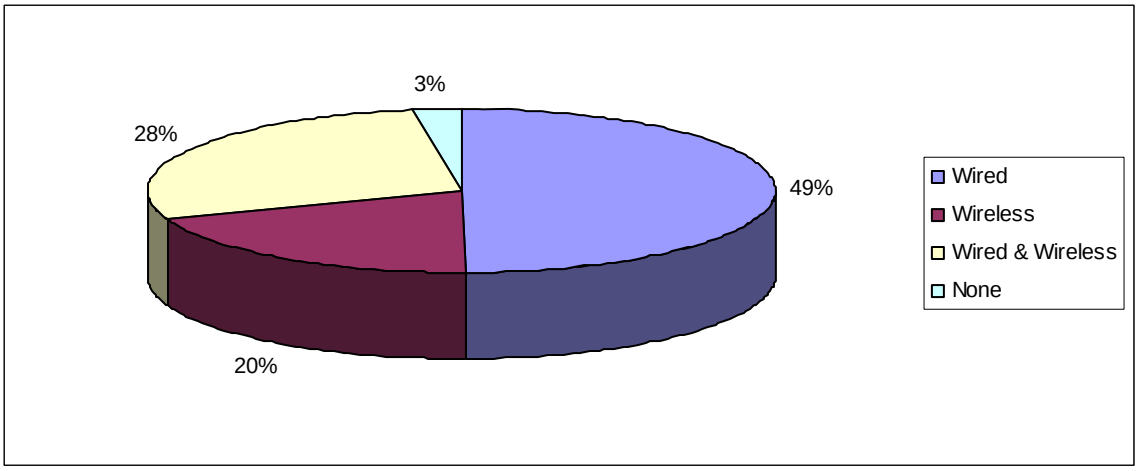

Figure 18. Communication Type

4.4.1.3 Mobile Government Infrastructure Types

This part of the survey tests which part of the Turkey's mobile government infrastructure is strong in the development of m-gov services. As seen in Figure 18, the respondents scored significantly high on the *technology infrastructure* (mean = 4.25) and high on the *software* (mean = 3.89). As we discussed in country cases, Turkey's GSM operators seem to have the essential technologic infrastructure to implement and deploy mobile government applications, therefore this score (mean = 4.25) supports this opinion.

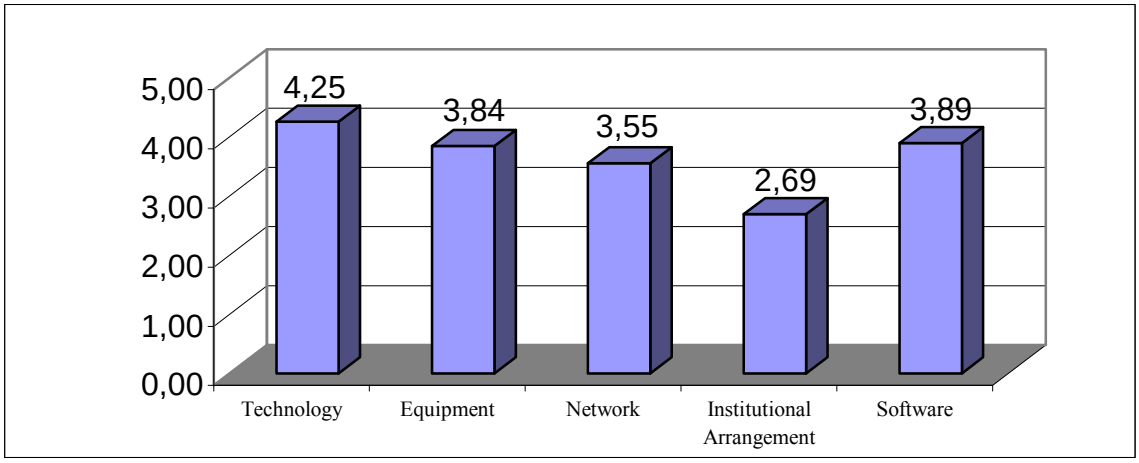

Figure 19. Infrastructure Types

Respondents as a group agree Turkey's infrastructure (general mean: 3.64) generally is ready for the mobile applications and 3G services, however interestingly they scored low on the *institutional arragements*. According to these scores, respondents think that Turkey have to improve its soft infrastructure which refer to its *institutional arrangements* (mean = 2.69). This result is usual due to mistrust to goverment institutions in collaborating with private institutions. With reference to the developments of e-gov in Turkey, respondents think that m-gov developments will be slow as e-gov developments.

4.4.1.4 Willingness to use M-Government services

Respondents were asked to indicate most preferred services to recognize in the future. The most preferred mobile government services are *Health* (mean: 4.65), *Personal Data* (mean: 4.37), *Security* (mean: 4.28) and *Social Security* (mean: 4,27) as seen in Figure 19.

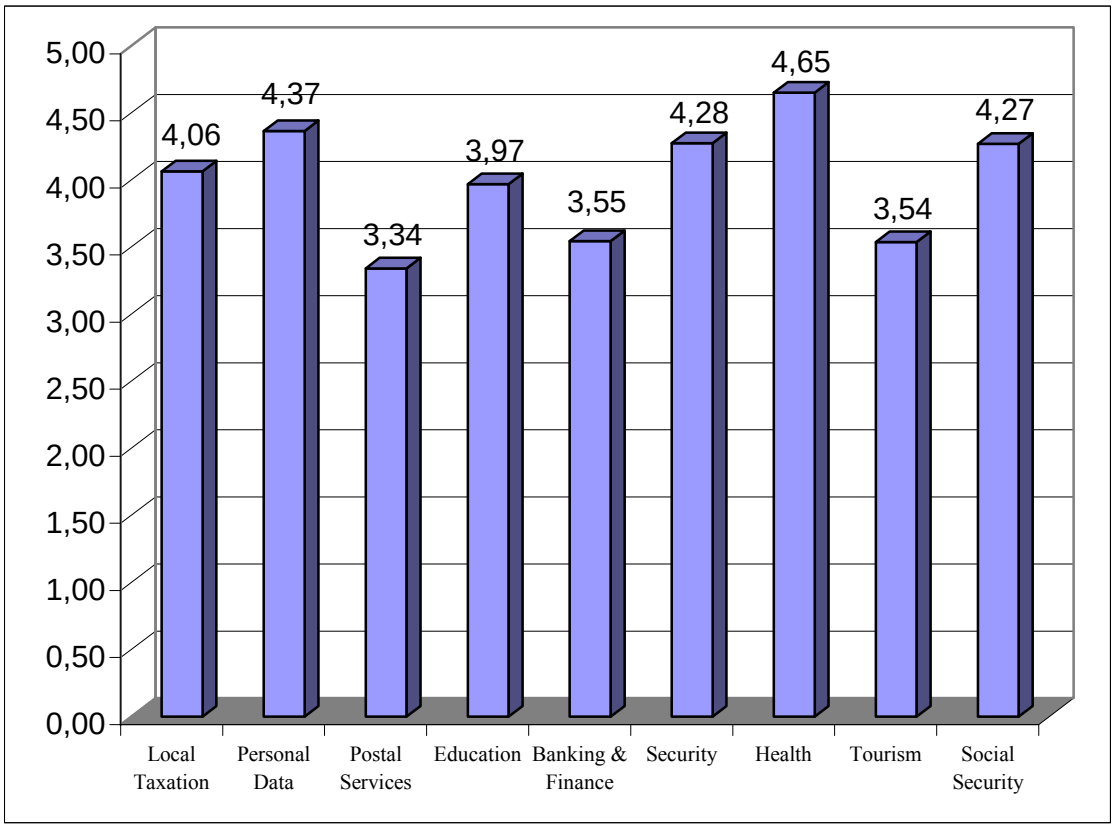

Figure 20. Preferred Mobile Government Services

A deeper analysis which considers also the age of respondents will be made in further discussions. Preferred services by age of respondents may also be seen in A-Figure 4 in Appendix-C.

4.4.1.5 Challenges for M-Government

Respondents were asked to indicate the most important challenges that stand in the front of mobile government development in Turkey. As seen in Figure 20, respondents evaluated *Problems with laws and political process* (POLITICS) with the highest score (mean: 4.10) and *Security and privacy gaps* (SECURITY) with the second highest score (mean: 4.03). According to these scores, respondents do not trust the Turkish politics and bureaucratic system. Also, they do not consider it safe giving out a credit cart number on a wireless/mobile device due to wireless/mobile devives having significant security risks as compared with using wired devices [35].

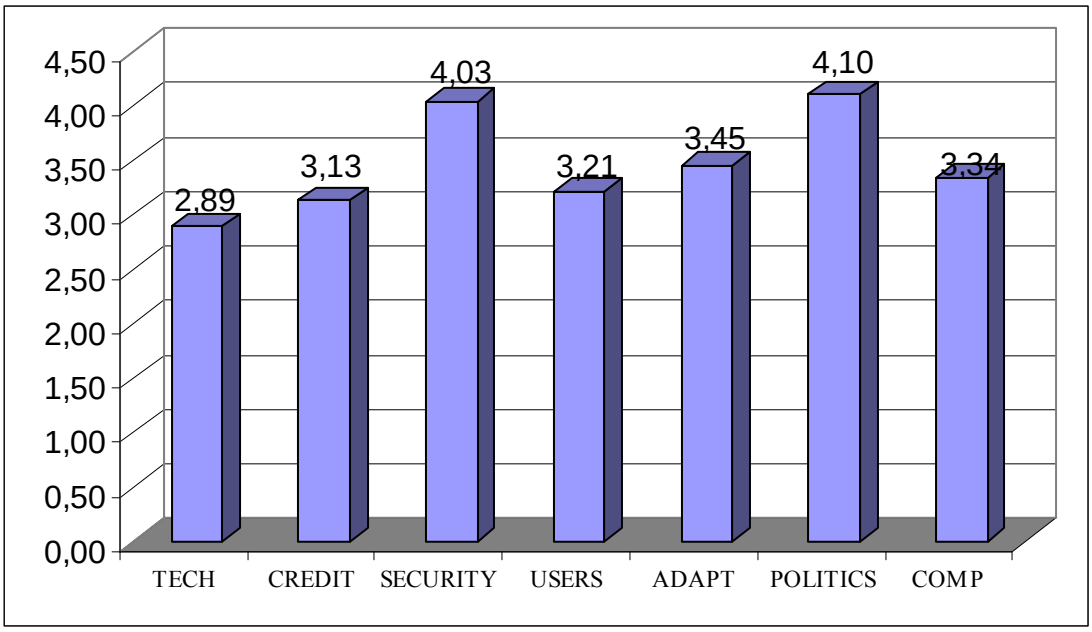

Figure 21. Mobile Government Challenges

Respondents do not consider *Lack of technological infrastructure* (TECH) as a threat (mean: 2.89) in the development of mobile government. This result makes sense due to the respondents attitude towards Technology infrastructure (upper section, mean: 4.29).

4.4.2 Test Results

Appendix-B presents the summary of the ANOVA test results alternately in A-Table 2, A-Table 3, A-Table 4, and A-Table 5.

4.4.2.1 Personal attitudes towards Mobile Government Drivers

The examination of p-values in A-Table 3 indicated that there is no sufficient evidence to accept $H2_{ij}$ (i=1,2,…,5) (j=1,2,…,5). This means that demographic factors do not have any impact on *Mobile Government Infrastructure Types*. Besides, it can also be observed from the A-Table 2 that, except for hypotheses $H1_{12}$ (*p*-value: 0,018) and $H1_{32}$ (*p*-value: 0,023), all the remaining ones were not supported by the survey results. In other words, *Age* has significant impact on the *Communication Device Easiness* and *Mobile/wireless communication device for connecting internet*. Moreover, the first column of A-Table 4 shows that, $H3_{11}$ (*p*-value: 0,039) and $H3_{51}$ (*p*-value: 0,033) were found to be significant at 5 percent significance level in this category. This means that gender has significant impact on *Local Taxation* and *Banking & Finance*. On the other hand, the second column in A-Table 4 indicates that, $H3_{42}$ (*p*-value: 0,040), $H3_{72}$ (*p*-value: 0,028) and $H3_{92}$ (*p*-value: 0,034) are found to be significant. This may also interpreted as age having significant impact on the *Education*, *Health* and *Social Security*.

4.4.2.2 Personal attitudes towards Mobile Government Barriers

The inspection of the A-Table 5 indicated that there is sufficient evidence to accept $H4_{31}$ (*p*-value: 0,017) and $H4_{64}$ (*p*-value: 0,028) This concludes that gender factor has significant impact on the *Security and Privacy Gap*, and occupation factor has significant impact on *Problems with Laws and Political Process*.

4.5 Discussions

4.5.1 Gender

Present study results indicate that gender has significant impact on some of the driving factors as seen on A-Table 2-3-4-5. From the tables, we see that gender has significant impact on "*communication device easiness"* (A-Table 2: $H1_{11}$). However this difference between genders was not found to be statistically significant in terms of "*communication device easiness"* ($\chi^2 = 1.74$, df = 1, p-value = 0.184).

Our study also indicates that, gender has significant impact on the some of the preferred mobile government services to be seen in future. Male respondents are more likely to prefer *"local taxation"* (mean: 4.17) (A-Table 4: $H3_{11}$) and, "*banking & finance"* (mean: 3.69) (A-Table 4: $H3_{51}$) services than female respondents (mean: 3.80 and mean: 3.17) as seen in Figure 11. Our explanation of this result may be that, majority workers in these fields are men in Turkey. This finding was also supported by the χ^2 test results ($\chi^2 = 20.862$, df = 4, p-value = 0.041 / $\chi^2 = 14.083$, df = 4, p-value = 0.007) that there is significant relationship between gender and *"local taxation"* and, "*banking & finance"* 3G service applications services.

Another implication is that gender also affects "*security and privacy"* (A-Table 5: $H4_{31}$) challenge. Female respondents (mean: 4.27) are more fragile in this issue as well than male respondents (mean: 3.93). However, this finding is not supported by the χ^2 test results ($\chi^2 = 7.59$, df = 3, p-value = 0.055), that there is not significant relationship between gender and "*security and privacy"* challenge.

For in-depth analysis graphics of gender, see A-Figure 1 and A-Figure 2 in Appendix-C.

4.5.2 Age

The test results indicated that age has significant impact on specific factors as seen in Anova Tables. Younger people find mobile phone easier than older people that in general, the percentage of the younger group of IT professionals that finds mobile phones easy to use (19%) is higher than the older ones (11%). Also younger group mostly prefers mobile phones and PDAs to connect internet (%38) than older group (%22). The $\chi 2$ test results (χ^2 = 20.862, df = 4, p-value = 0.041 / = 14.083, df = 4, p-value = 0.007) also showed that the *"communication device easiness"* and *"mobile/wireless communication device for connecting internet"* variables changes significantly with the age of respondents.

In the terms of 3G mobile application services, age has impact on *"education"* (A-Table 4: $H3_{42}$) and *"social security"* (A-Table 4: $H3_{92}$) as seen in Anova Tables. Younger aged group of respondents (mean: 4.28) are more willing to see *"education"* services than older aged group (mean: 3.42) as seen in Figure 13. This finding was also supported by the χ^2 test results (χ^2 = 20.830, df = 4, p-value = 0.008) that there is significant relationship between age and *"education"*. Secondly, age has impact on *"social security"* as seen in Figure 13, however, it is interesting to note that the relationship between age and the reason for *"social security"* was not found to be significant (χ^2 = 11.643, df = 8, p-value = 0.168). For in-depth analysis graphics of age, see A-Figure 2 and A-Figure 3 in Appendix-C.

4.5.3 Education

Surprisingly, we have investigated that education has no significant impact on none of our dependent factors as seen in Anova Tables (See the tables in Appendix-B). We did not find a strong relationship between these factors. For our finding explanation may be that most of the respondents included in the survey have similar educational level.

4.5.4 Occupation

In the terms of their perceptions of driving forces, our test results indicated that occupation has significant impact on type of infrastructures: *"Institutional Arrangements"* (A-Table 3: $H2_{44}$). Mostly IT managers (mean: 2.42) perceive "*Institutional Arrangements"* as weak property of Turkish mobile infrastructure rather than other respondent groups (mean. 2.90). Cause of this outcome may be of managers being more directly related with arrangement phases of projects in institutions. This finding was also supported by the χ^2 test results ($\chi^2 = 15.244$, df = 6, p-value = 0.048) that there is significant relationship between occupation and the "*Institutional Arrangements"*.

Another important finding is that, occupation has significant impact on one of the mobile government challenges: *"Problems with law and political process"* (A-Table 5: $H4_{64}$). IT managers (mean: 4.28) perceive political process as more challenging factor while other group of respondents (mean: 3.85) perceive it less challenging. Our explanation of this result is similarly to prior outcome that IT managers being more directly related with political processes in an organization. χ^2 test results ($\chi^2 = 30.365$, df = 6, p-value = 0.000) also support our finding.

4.5.5 Years of Experience

We observed that years of experience have affect on *"Compatibility of the mobile systems with the existing e-gov systems"* (A-Table 5: $H4_{75}$) and *"Social Security"* (A-Table 4: $H3_{95}$) as seen in Anova Tables, however according to $\chi 2$ test results ($\chi^2 = 12.908$, df = 8, p-value = 0.115 / $\chi^2 = 14.290$, df = 8, p-value = 0.058) there were no significant association for mobile government driver and barrier factors in this category.

4.6 Conclusions

Purpose of this survey was to examine most significant drivers and barriers of the mobile government and impact of demographic factors on these driving and challenging factors among IT-oriented respondents in Turkey.

The analysis revealed that, in terms of infrastructure, respondents as a group generally recognize feel very positively about the mobile government infrastructure (general mean = 3.64), however they evaluated *"Institutional Arrangements"* factor as weakest infrastructure (mean: 2.69) and they recognize *"Technology"* (mean: 4.25) factor as strongest infrastructure. Secondly, it emerges from this study that "*Health"* (mean: 4.65), *"Personal Data"* (mean:4.37), *"Security"* (mean: 4.28) and *"Social Security"* (mean: 4.27) fields of m-gov are critical fields that should be primarily developed in Turkey. Lastly, we observed that the most significant barriers to the adoption of m-gov services will be the "*Problems with laws and political process"* (mean: 4.10) and *"Security and privacy gaps"* (mean: 4.03).

On the other side, we observed that gender and age were the key factors for the tendency towards selected mobile government drivers and barrier factors. Besides this, occupation and experience were found to have an impact on some of the factors. Interesting implication of this study was that education were not found to have an impact on any driving and challenging factors [56].

A limitation of this study is the sample adopted in the survey of respondents refers only to IT-oriented people, specific segments of population may be added to explore mobile government in different prospects. For instance, questions may be modified and GSM operators may be added as respondents to get results from different perspectives. In the next future, this survey could be realised considering more

meetings in different places and may be different countries in order to compare the impact of cultural attitude.

Mobile government driving factors such as “Technology Readiness Index” (TRI) and “Attitudes toward Wireless Technology Adoption” were not included in this survey. For for further research, these factors should be attached to present factors for more in-depth analysis [35].

Finally, we propose to use larger samples which may lead to more accurate findings for mobile government factor attitudes among IT-oriented people. Also demographic factors such as income can be added to current factors. In addition to this, education factor may be modified to type of university department to get different and better results. Thus, adding sector factor such as government and private may contribute a lot to this research for to acquire significant findings about disparity about private and government sector and this will interest the reader in this direction [56].

CHAPTER 5

CONCLUSION & LIMITATIONS

Four research questions are tried to be answered in thesis as described below:

- What are the odds for Turkey's success in m-gov?
- What are the critical success factors and other components to develop a strategical plan model?
- What are the drivers/barriers for mobile government in Turkey?
- What are the affects of the demographic factors in the context of drivers/barriers?

5.1 Summary

Mobile and wireless technology represents a great new transformation of the 21st century. Governments find themselves at the center of this great transformation that promises to deliver new technology solutions. As mobile phone penetration increases, its application in the public sector is increasingly being viewed as inevitable. The convergence of mobile and wireless technology has brought a whole new range of alternative government service delivery options.

Another issue is also important to emphasise that m-gov affects on organizations/governments. M-gov iniatives increase efficiency in public sector operations and help to reduce the perceived gap between government and the public. However, it is necessary to underline that m-gov is not a replacement for, but a complement to, e-gov.

5.2 Contribution

Primarly, to comprehend m-gov and its concepts, we made an extensive literature review. When the concepts regarding m-gov are better understood, we made a comparison of four country cases, including Turkey's case. Selection reason of these specific Asia Pacific region countries was that countries had different characateristics as they differ in demographic factors, government regulations and business strategies. At the start, we analyzed countries personally based on some indicators. After presenting indicator anaysis results, we specified each finding of that particular country. Moreover, we accomplished a comparative country analysis, and we extracted each comprative results into different tables to be explained compherensively. Taking into consideration of the findings that gathered from the analysis and recent developments in Turkey, we discussed the odds for Turkey's success in the context m-gov, with justifications. With the results gained from this explanation and in the light of the literature, we identified critical success factors for Turkey. Afterwards, we designed a strategic plan model considering developing countries, and with regards, we clarified all the concepts alternately.

In the next section, we analyzed drivers and barriers concept, in a detailed way. This concept was one of the components of the strategic action plan model we developed in prior section. To analyze drivers and barriers of m-gov, we conduct a quantitative analysis, through a total of 238 completed survey questionnaires, to IT professionals from major government and private sector organizations. According to the literature

study, affects of the demographic factors was very little known, therefore we investigate the impact of the demographic factors. To do the analysis, we implement One-Way ANOVA to compare the mean of one or more group variables and we support the findings with Pearson Chi-Square test.

Within our scope, the country comparison results showed that mobile technologies in Turkey have the potential to bridge digital divide. Recent developments, market peculiarities, and also having young population and high mobile penetration are some of the characteristics of Turkey that justifies the possibility of its sucess in m-gov. However, not only these characteristics are sufficient for the success, but also there are lots of duties that Turkish government must accomplish, in order to gain success in the development and deployment of m-gov services and application.

In brief, survey results revealed that, primarly, respondents as a group generally feel very positively about the mobile government infrastructure (general mean of infrastructure variables: 3.64), however they sense negatively about bureaucracy in Turkey as they evaluated *"Institutional Arrangements"* factor as weakest infrastructure (mean: 2.69). Secondly, respondents mostly prefer "*Health"* (mean: 4.65) services to recognize in the future as mobile service. Thirdly, very interestingly, respondents perceive "*Problems with laws and political process"* (mean: 4,10) as more challenging issue than "*Security"* (mean: 4,03) issue. Moreover, *gender* and *age* were found to be the key factors for the tendency towards selected mobile government drivers and barrier factors. Interesting implication of the survey was that *education* demographic factor were not found to have an impact on any driving and challenging factors.

5.3 Limitations

- Number of the country cases are limited to four countries;

- Country cases only cover, Asian Pacific region countries, except Turkey;
- In the survey of respondents refers only to IT-oriented people;
- The survey sample size is limited with number of 238 respondents. Sample size needs to increased in order to get more accurate results;
- Demographic factors of the survey that affect drivers and barriers are limited.

5.4. Future Work

Recommendations for future research in this area are closely connected to the limitations mentioned above.

- Thesis generally focuses m-gov from the government perspective, for more depth analysis different perspectives can be added such as citizens' and operators' perspective.
- In the context of country cases, European or other regions countries can be examined as well.
- Specific segments of population may be added to survey to explore mobile government in different prospects.
- Survey could be realised considering more meetings in different places and may be in different countries in order to compare the impact of cultural attitude
- For further study, mobile government driving factors such as "Technology Readiness Index" (TRI) and "Attitudes toward Wireless Technology Adoption" issues can be included in the survey.
- Some adjustments can be done to demographic factors, for instance, income can be added to current factors. Education factor may be modified to type of university department to get different and better results. In addition to this, sector type factor can be added, this may contribute a lot to this research for to acquire significant findings about disparity about private and government sector.

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APPENDICES

APPENDIX – A: M-GOVERNMENT SURVEY QUESTIONNAIRE ITEMS

A-Table 1. Items Related to Mobile Government

DRIVERS		
Mobile Penetration & Communication Device Usage		
1.	Communication device easiness	1. Mobile phones 2. Laptop 3. Desktop 4. Handheld (PDA/IPAQ)
2.	Preferred mobile communication channel	5. SMS 6. e-mail
3.	Preferred mobile/wireless communication device for connecting internet	7. Mobile phones 8. Laptop 9. Handheld (PDA/IPAQ) 10.None
4.	Communication type at home	11.Wired 12.Wireless 13.None
Mobile Infrastructure		
5.	Infrastructure/Physical	1. Technology 2. Equipment 3. Network
6.	Infrastructure/Soft	4. Institutional Arrangements 5. Software
Mobile Government Applications		

A-Table 1 (cont.)

7.	Potential fields of application	1. Local taxation 2. Personal data 3. Postal services 4. Education 5. Banking & Finance 6. Security 7. Health 8. Tourism 9. Social Security
BARRIERS		
Mobile Government Challenges		
8.	Infrastructure development	1. Lack of technological infrastructure (TECH). 2. Low credit card penetration (CREDIT). 3. Security and privacy gaps (SECURITY). 4. Insufficient number of its users (USERS). 5. Citizen adaptation process (ADAPT). 6. Problems with laws and political process (POLITICS). 7. Compatibility of the mobile systems with the existing e-gov systems (COMP).

APPENDIX – B: ONE-WAY ANOVA TEST RESULTS

A-Table 2. Summary of Test Results Part-1 (Anova Results)

Independent variables→ / *Dependent variables ↓*	**Gender**	**Age**	**Education**	**Occupation**	**Year of Experience**
Communication device easiness	Hyp: $H1_{11}$ χ^2: 4.52 d.f.: 1 *p*-val: 0.035[a]	Hyp: $H1_{12}$ χ^2: 4.06 d.f.: 2 *p*-val: 0.018[a]	Hyp: $H1_{13}$ χ^2: 0.05 d.f.: 2 *p*-val: 0.951	Hyp: $H1_{14}$ χ^2: 1.46 d.f.: 2 *p*-val: 0.233	Hyp: $H1_{15}$ χ^2: 1.33 d.f.: 2 *p*-val: 0.266
Preferred mobile communication channel	Hyp: $H1_{21}$ χ^2: 0.03 d.f.: 1 *p*-val: 0.866	Hyp: $H1_{22}$ χ^2: 1.39 d.f.: 2 *p*-val: 0.252	Hyp: $H1_{23}$ χ^2: 0.75 d.f.: 2 *p*-val: 0.476	Hyp: $H1_{24}$ χ^2: 1.04 d.f.: 2 *p*-val: 0.356	Hyp: $H1_{25}$ χ^2: 1.08 d.f.: 2 *p*-val: 0.343
Mobile/wireless communication device for connecting internet	Hyp: $H1_{31}$ χ^2: 2.95 d.f.: 1 *p*-val: 0.087	Hyp: $H1_{32}$ χ^2: 3.85 d.f.: 2 *p*-val: 0.023[a]	Hyp: $H1_{33}$ χ^2: 0.62 d.f.: 2 *p*-val: 0.538	Hyp: $H1_{34}$ χ^2: 1.60 d.f.: 2 *p*-val: 0.203	Hyp: $H1_{35}$ χ^2: 1.82 d.f.: 2 *p*-val: 0.191
Communication type at home	Hyp: $H1_{41}$ χ^2: 1.25 d.f.: 1 *p*-val: 0.265	Hyp: $H1_{42}$ χ^2: 2.23 d.f.: 2 *p*-val: 0.109	Hyp: $H1_{43}$ χ^2: 1.04 d.f.: 2 *p*-val: 0.356	Hyp: $H1_{44}$ χ^2: 0.13 d.f.: 2 *p*-val: 0.876	Hyp: $H1_{45}$ χ^2: 0.74 d.f.: 2 *p*-val: 0.479

[a] Indicates statistically significant at 5 per cent significance level.

A-Table 3. Summary of Test Results Part-2 (Anova Results)

Independent variables→ / *Dependent variables ↓*	**Gender**	**Age**	**Education**	**Occupation**	**Year of Experience**

A-Table 3 (cont.)

Technology	Hyp: $H2_{11}$ χ^2: 3.41 d.f.: 1 *p*-val: 0.066	Hyp: $H2_{12}$ χ^2: 0.87 d.f.: 2 *p*-val: 0.420	Hyp: $H2_{13}$ χ^2: 0.99 d.f.: 2 *p*-val: 0.374	Hyp: $H2_{14}$ χ^2: 0.12 d.f.: 2 *p*-val: 0.885	Hyp: $H2_{15}$ χ^2: 1.72 d.f.: 2 *p*-val: 0.181
Equipment	Hyp: $H2_{21}$ χ^2: 0.13 d.f.: 1 *p*-val: 0.720	Hyp: $H2_{22}$ χ^2: 0.68 d.f.: 2 *p*-val: 0.507	Hyp: $H2_{23}$ χ^2: 2.21 d.f.: 2 *p*-val: 0.112	Hyp: $H2_{24}$ χ^2: 1.59 d.f.: 2 *p*-val: 0.206	Hyp: $H2_{25}$ χ^2: 2.24 d.f.: 2 *p*-val: 0.108
Network	Hyp: $H2_{31}$ χ^2: 0.22 d.f.: 1 *p*-val: 0.638	Hyp: $H2_{32}$ χ^2: 1.03 d.f.: 2 *p*-val: 0.358	Hyp: $H2_{33}$ χ^2: 2.37 d.f.: 2 *p*-val: 0.096	Hyp: $H2_{34}$ χ^2: 0.01 d.f.: 2 *p*-val: 0.988	Hyp: $H2_{35}$ χ^2: 1.97 d.f.: 2 *p*-val: 0.142
Institutional Arrangements	Hyp: $H2_{41}$ χ^2: 1.76 d.f.: 1 *p*-val: 0.186	Hyp: $H2_{42}$ χ^2: 2.66 d.f.: 2 *p*-val: 0.072	Hyp: $H2_{43}$ χ^2: 1.15 d.f.: 2 *p*-val: 0.319	Hyp: $H2_{44}$ χ^2: 3.42 d.f.: 2 *p*-val: 0.036[a]	Hyp: $H2_{45}$ χ^2: 1.95 d.f.: 2 *p*-val: 0.145
Software	Hyp: $H2_{51}$ χ^2: 0.16 d.f.: 1 *p*-val: 0.688	Hyp: $H2_{52}$ χ^2: 1.07 d.f.: 2 *p*-val: 0.352	Hyp: $H2_{53}$ χ^2: 1.52 d.f.: 2 *p*-val: 0.221	Hyp: $H2_{54}$ χ^2: 2.86 d.f.: 2 *p*-val: 0.059	Hyp: $H2_{55}$ χ^2: 0.50 d.f.: 2 *p*-val: 0.604

[a] Indicates statistically significant at 5 per cent significance level.

A-Table 4. Summary of Test Results Part-3 (Anova Results)

Independent variables→ *Dependent variables* ↓	**Gender**	**Age**	**Education**	**Occupation**	**Year of Experience**

A-Table 4 (cont.)

Local taxation	Hyp: $H3_{11}$ χ^2: 4.32 d.f.: 1 *p*-val: 0.039[a]	Hyp: $H3_{12}$ χ^2: 0.698 d.f.: 2 *p*-val: 0.499	Hyp: $H3_{13}$ χ^2: 0.72 d.f.: 2 *p*-val: 0.488	Hyp: $H3_{14}$ χ^2: 1.65 d.f.: 2 *p*-val: 0.196	Hyp: $H3_{15}$ χ^2: 1.70 d.f.: 2 *p*-val: 0.187
Personal data	Hyp: $H3_{21}$ χ^2: 0.46 d.f.: 1 *p*-val: 0.498	Hyp: $H3_{22}$ χ^2: 0.15 d.f.: 2 *p*-val: 0.861	Hyp: $H3_{23}$ χ^2: 1.60 d.f.: 2 *p*-val: 0.203	Hyp: $H3_{24}$ χ^2: 1.37 d.f.: 2 *p*-val: 0.256	Hyp: $H3_{25}$ χ^2: 1.40 d.f.: 2 *p*-val: 0.249
Postal services	Hyp: $H3_{31}$ χ^2: 2.93 d.f.: 1 *p*-val: 0.089	Hyp: $H3_{32}$ χ^2: 1.09 d.f.: 2 *p*-val: 0.340	Hyp: $H3_{33}$ χ^2: 2.25 d.f.: 2 *p*-val: 0.110	Hyp: $H3_{34}$ χ^2: 1.48 d.f.: 2 *p*-val: 0.231	Hyp: $H3_{35}$ χ^2: 0.85 d.f.: 2 *p*-val: 0.431
Education	Hyp: $H3_{41}$ χ^2: 0.01 d.f.: 1 *p*-val: 0.981	Hyp: $H3_{42}$ χ^2: 3.28 d.f.: 2 *p*-val: 0.040[a]	Hyp: $H3_{43}$ χ^2: 1.18 d.f.: 2 *p*-val: 0.311	Hyp: $H3_{44}$ χ^2: 0.35 d.f.: 2 *p*-val: 0.709	Hyp: $H3_{45}$ χ^2: 1.79 d.f.: 2 *p*-val: 0.170
Banking & Finance	Hyp: $H3_{51}$ χ^2: 4.63 d.f.: 1 *p*-val: 0.033[a]	Hyp: $H3_{52}$ χ^2: 0.39 d.f.: 2 *p*-val: 0.678	Hyp: $H3_{53}$ χ^2: 0.63 d.f.: 2 *p*-val: 0.535	Hyp: $H3_{54}$ χ^2: 0.51 d.f.: 2 *p*-val: 0.605	Hyp: $H3_{55}$ χ^2: 0.18 d.f.: 2 *p*-val: 0.837
Security	Hyp: $H3_{61}$ χ^2: 2.86 d.f.: 1 *p*-val: 0.103	Hyp: $H3_{62}$ χ^2: 2.26 d.f.: 2 *p*-val: 0.108	Hyp: $H3_{63}$ χ^2: 1.60 d.f.: 2 *p*-val: 0.205	Hyp: $H3_{64}$ χ^2: 2.24 d.f.: 2 *p*-val: 0.110	Hyp: $H3_{65}$ χ^2: 0.29 d.f.: 2 *p*-val: 0.749

Health	Hyp: $H3_{71}$ χ^2: 0.07 d.f.: 1 *p*-val: 0.788	Hyp: $H3_{72}$ χ^2: 3.63 d.f.: 2 *p*-val: 0.028[a]	Hyp: $H3_{73}$ χ^2: 0.39 d.f.: 2 *p*-val: 0.678	Hyp: $H3_{74}$ χ^2: 1.26 d.f.: 2 *p*-val: 0.288	Hyp: $H3_{75}$ χ^2: 2.56 d.f.: 2 *p*-val: 0.080
Tourism	Hyp: $H3_{81}$ χ^2: 0.24 d.f.: 1 *p*-val: 0.624	Hyp: $H3_{82}$ χ^2: 0.120 d.f.: 2 *p*-val: 0.887	Hyp: $H3_{83}$ χ^2: 1.14 d.f.: 2 *p*-val: 0.326	Hyp: $H3_{84}$ χ^2: 1.99 d.f.: 2 *p*-val: 0.143	Hyp: $H3_{85}$ χ^2: 0.21 d.f.: 2 *p*-val: 0.813
Social Security	Hyp: $H3_{91}$ χ^2: 0.64 d.f.: 1 *p*-val: 0.424	Hyp: $H3_{92}$ χ^2: 3.46 d.f.: 2 *p*-val: 0.034[a]	Hyp: $H3_{93}$ χ^2: 0.51 d.f.: 2 *p*-val: 0.601	Hyp: $H3_{94}$ χ^2: 2.15 d.f.: 2 *p*-val: 0.120	Hyp: $H3_{95}$ χ^2: 1.99 d.f.: 2 *p*-val: 0.190

[a] Indicates statistically significant at 5 per cent significance level.

A-Table 5. Summary of Test Results Part-4 (Anova Results)

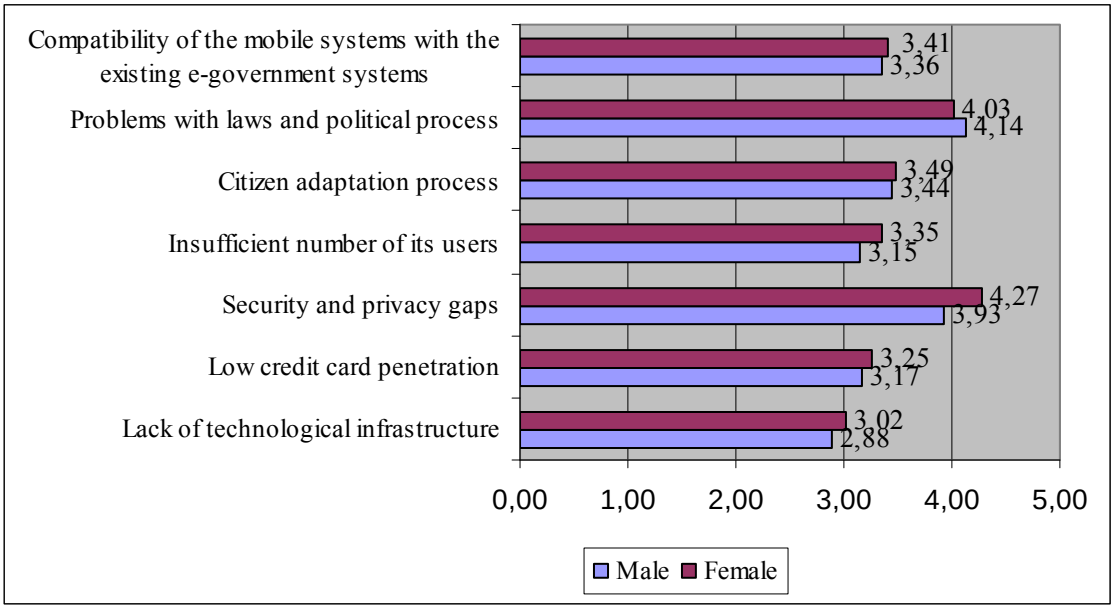
Independent variables→ *Dependent variables ↓*	**Gender**	**Age**	**Education**	**Occupation**	**Year of Experience**
Lack of technological infrastructure	Hyp: $H4_{11}$ χ^2: 3.41 d.f.: 1 *p*-val: 0.066	Hyp: $H4_{12}$ χ^2: 1.83 d.f.: 2 *p*-val: 0.162	Hyp: $H4_{13}$ χ^2: 0.67 d.f.: 2 *p*-val: 0.515	Hyp: $H4_{14}$ χ^2: 1.27 d.f.: 2 *p*-val: 0.283	Hyp: $H4_{15}$ χ^2: 1.50 d.f.: 2 *p*-val: 0.226
Low credit card penetration	Hyp: $H4_{21}$ χ^2: 0.56 d.f.: 1 *p*-val: 0.456	Hyp: $H4_{22}$ χ^2: 0.68 d.f.: 2 *p*-val: 0.508	Hyp: $H4_{23}$ χ^2: 1.80 d.f.: 2 *p*-val: 0.168	Hyp: $H4_{24}$ χ^2: 0.98 d.f.: 2 *p*-val: 0.376	Hyp: $H4_{25}$ χ^2: 0.07 d.f.: 2 *p*-val: 0.937

A-Table 5 (cont.)

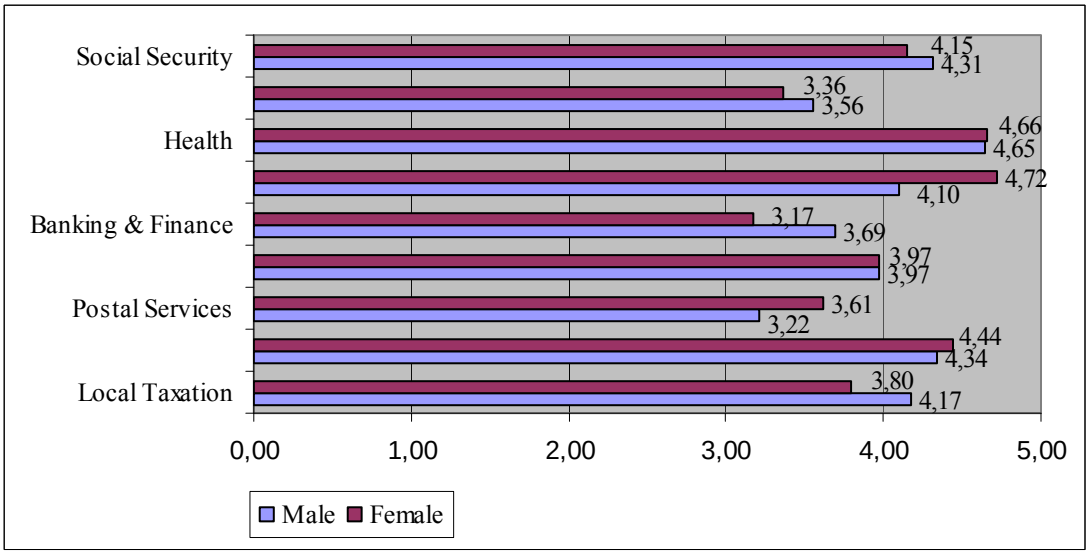
Security and privacy gaps	Hyp: $H4_{31}$ χ^2: 5.78 d.f.: 1 *p*-val: 0.017[a]	Hyp: $H4_{32}$ χ^2: 2.22 d.f.: 2 *p*-val: 0.108	Hyp: $H4_{33}$ χ^2: 1.07 d.f.: 2 *p*-val: 0.346	Hyp: $H4_{34}$ χ^2: 0.54 d.f.: 2 *p*-val: 0.585	Hyp: $H4_{35}$ χ^2: 0.99 d.f.: 2 *p*-val: 0.374
Insufficient number of its users	Hyp: $H4_{41}$ χ^2: 1.52 d.f.: 1 *p*-val: 0.219	Hyp: $H4_{42}$ χ^2: 0.503 d.f.: 2 *p*-val: 0.605	Hyp: $H4_{43}$ χ^2: 1.72 d.f.: 2 *p*-val: 0.181	Hyp: $H4_{44}$ χ^2: 0.08 d.f.: 2 *p*-val: 0.920	Hyp: $H4_{45}$ χ^2: 1.18 d.f.: 2 *p*-val: 0.310
Citizen adaptation process	Hyp: $H4_{51}$ χ^2: 0.11 d.f.: 1 *p*-val: 0.739	Hyp: $H4_{52}$ χ^2: 0.801 d.f.: 2 *p*-val: 0.450	Hyp: $H4_{53}$ χ^2: 1.06 d.f.: 2 *p*-val: 0.349	Hyp: $H4_{54}$ χ^2: 0.56 d.f.: 2 *p*-val: 0.572	Hyp: $H4_{55}$ χ^2: 0.19 d.f.: 2 *p*-val: 0.821
Problems with laws and political process	Hyp: $H4_{61}$ χ^2: 0.60 d.f.: 1 *p*-val: 0.440	Hyp: $H4_{62}$ χ^2: 1.12 d.f.: 2 *p*-val: 0.329	Hyp: $H4_{63}$ χ^2: 1.95 d.f.: 2 *p*-val: 0.145	Hyp: $H4_{64}$ χ^2: 3.63 d.f.: 2 *p*-val: 0.028[a]	Hyp: $H4_{65}$ χ^2: 0.85 d.f.: 2 *p*-val: 0.427
Compatibility of the mobile systems with the existing e-gov systems	Hyp: $H4_{71}$ χ^2: 3.45 d.f.: 1 *p*-val: 0.064	Hyp: $H4_{72}$ χ^2: 2.03 d.f.: 2 *p*-val: 0.133	Hyp: $H4_{73}$ χ^2: 2.58 d.f.: 2 *p*-val: 0.078	Hyp: $H4_{74}$ χ^2: 2.65 d.f.: 2 *p*-val: 0.073	Hyp: $H4_{75}$ χ^2: 0.24 d.f.: 2 *p*-val: 0.798

[a] Indicates statistically significant at 5 per cent significance level.

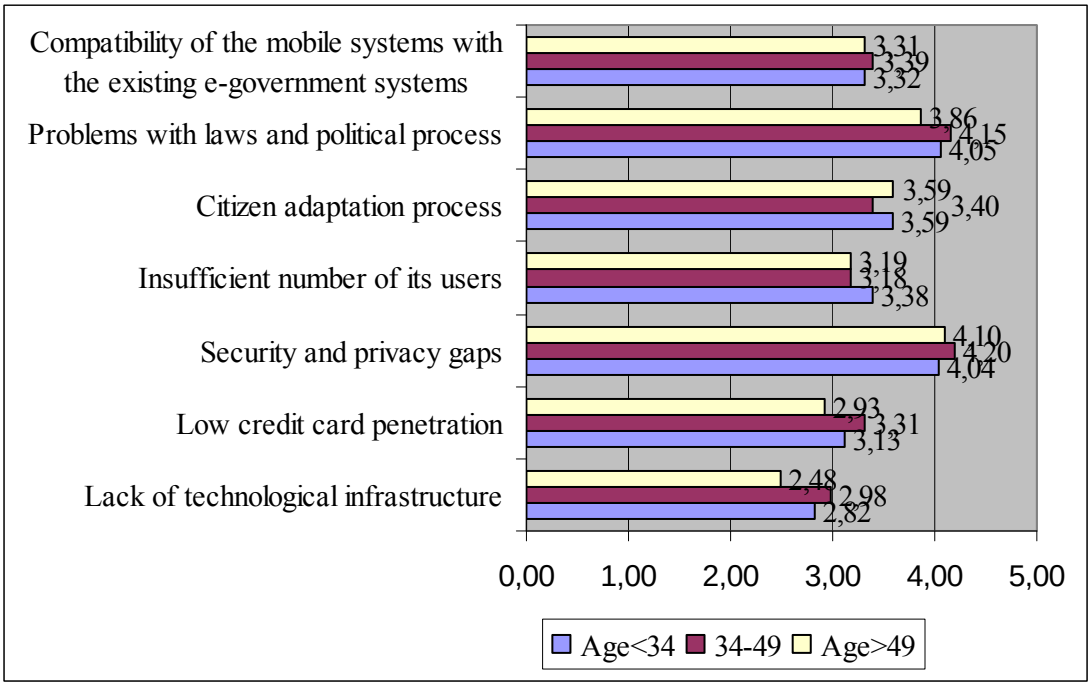
APPENDIX – C: DEMOGRAPHIC FACTOR FIGURES



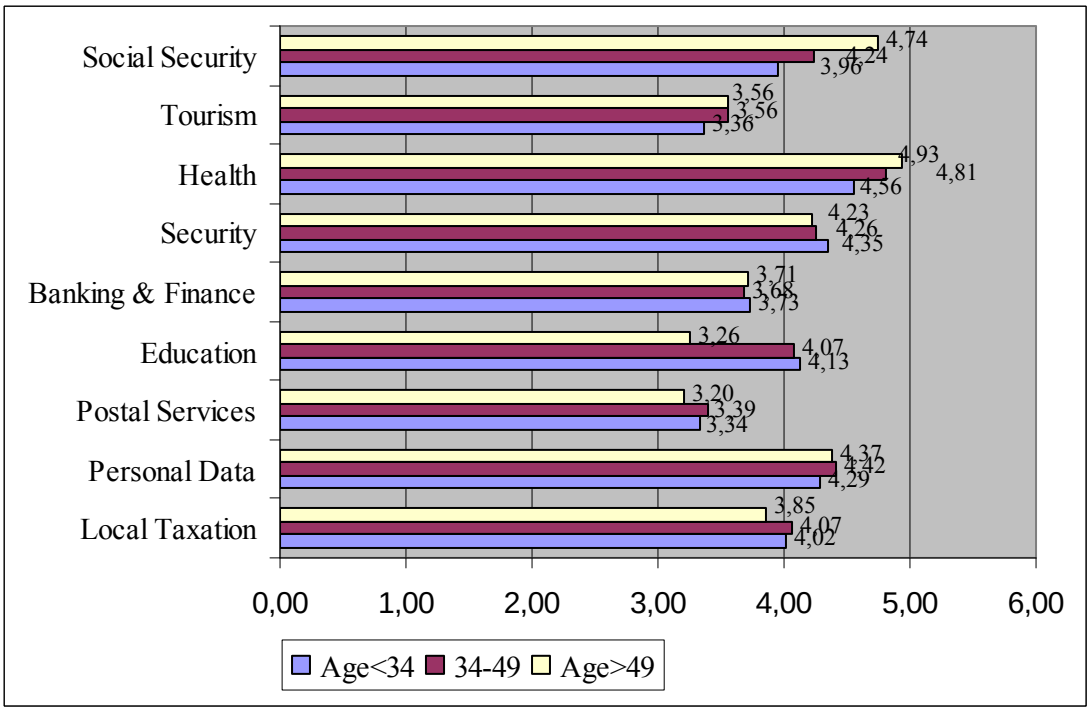
A-Figure 1. Perceived challanges by gender of respondent



A-Figure 2. Preferred services by gender of respondents



A-Figure 3. Perceived challanges by age of respondents



A-Figure 4. Preferred services by age of respondents

APPENDIX – D: OTHER TABLES

A-Table 6. A sampling of Wi-Fi network management and cracking tools [25]

Tool	Description
AirMagnet	▪ used for Wi-Fi administration, installation surveying, security assessment, connection troubleshooting and performance management functions ▪ runs on pocket PC
Airsnort	▪ passively monitors transmission ▪ 5 to 10 million encrypted packets required to be collected before computing the WEP key
Fluke Waverunner	▪ detects rogue access points ▪ Linux powered HP iPAQ PDA
Kismet	▪ Wi-Fi detector, sniffer, and intrusion detection system ▪ used for rogue access point detection, war-driving and site survey ▪ passively collects packets
NetStumbler	▪ Windows utility for war-driving ▪ sniff rogue access points and detect Wi-Fi networks ▪ ministumbler (pocket PC version)
Sniffer Pro	▪ network analyzer with a built-in traffic generator ▪ real-time and historical traffic display ▪ used to maintain, troubleshoot and fine-tune Wi-Fi networks
Sniffer Wireless	▪ network analyzer ▪ detects rogue access points and mobile devices ▪ software-based (runs on laptop)
WEPCrack	▪ an open source tool for breaking WEP key ▪ software-based in Perl language
Yellow Jacket	▪ real-time spectrum analyzer ▪ measures packet error rate, multi-path, RSSI ▪ works with Compaq iPAQ PDA
YBT-250	▪ handheld interference analyzer ▪ measures power and verifies signals of GSM/GPRS, EDGE, W-CDMA/UMTS, cdmaOne, CDMA2000 1xRTT, CDMA2000 1xEV-DO, TDMA and analog base stations