UNIVERSITY OF NAIROBI

School of Computing and Informatics

E-VOTING READINESS IN KENYA: A CASE STUDY OF NAIROBI COUNTY

By

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P56/70398/2009

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A Project Submitted in Partial Fulfillment of the Regulations Governing the Award of the Degree of Masters of Science in Information Systems

May 2011

Declaration

I hereby declare that this project, as presented in this report, is my original work and has not been presented for any other university award.

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This project has been submitted in Partial Fulfillment of the Regulations Governing the Award of the Degree of Masters of Science in Information Systems of the University of Nairobi with my approval as supervisor.

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Abstract

Developing countries have established promising e-voting initiatives with the objective of enhancing the democracy for their citizens. However, governments tend to design and launch systems based on their understanding of what citizens need, surprisingly, without actually measuring the extent of readiness and what increases citizens' willingness to adopt the services. It is important that Governments must first understand variables that influence citizens' adoption of e-voting in order to take them into account when implementing e-voting systems.

This project addresses critical factors that influence adoption of e-voting with objective of developing a framework. The framework synthesizes, refines, and extends current approaches to understand adoption factors. The study started with a background research to identify factors that influence the adoption of innovation and e-voting.

A survey was thereafter carried out in eight constituencies in Nairobi County which had questions on voter readiness for e-voting. The study was conducted by surveying 203 voters from eight constituencies in Nairobi County. The project aimed at exploring the correlation between e-voter readiness and the diffusion rate of e-voting in Nairobi County. E-voting Readiness is achieved by determining the stage of readiness and comparing to the UN 2008 indices for developing countries. The findings indicated that there is a positive correlation between e-voting readiness and its diffusion.

The research is of more importance at this stage as Kenya is approaching election cycle period. Government and electoral stakeholders will comprehend voter readiness and diffusion of e-voting in Nairobi County in order to implement effective, acceptable and secure electoral process.

Acknowledgement

I am most grateful to my project supervisor at the University of Nairobi - Evans Miriti for valuable feedback on my work, his commitment to my progress and for academic critic to my research. I am indebted to him for providing me with the opportunity to carry out my research on Readiness for E-voting in Nairobi County. His constant encouragement, coupled with his availability and easily-approachable nature, gave me the confidence I needed to complete this work.

I would also like to sincerely thank the University panelists Dr. Wanjiku Ng'ang'a and Robert Oboko for their effort and valuable comments on my work during all the phases of the research. Further, I am indebted to the panel for evocable and timely contribution to all milestones towards the completion of the research.

Last and most importantly, I would like to recognize the Almighty, for granting me both mental and physical strength to undertake research.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

List of Abbreviations

APEC	:	Asian Pacific Economic Cooperation
CSPP	:	Computer System Policy Project
CID	:	Centre for International Development
CIDCM	:	Centre for International Development and Conflict Management
ICT	:	Information and Communication Technology
KENET	:	Kenya Education Network
NEPAD	:	New Partnership for African Development
TAM	:	Technology Acceptance Model
TRA	:	Theory of Reasoned Action
DOI	:	Diffusion of Innovation
TPB	:	Theory of Planned Behaviour
DRE	:	Direct Recording Electronic
NIST	:	National Institute of Standards and Technology
ECK	:	Electoral Commission of Kenya
IIEC	:	Interim Independent Electoral Commission of Kenya
IICDRC	:	Interim Independent Constitutional Dispute Resolution Court

CHAPTER ONE INTRODUCTION

This introductory chapter introduces the problem area, statement of the problem, objectives of the study and justification for conducting the research.

1.0 Background

Information has always played a vital role in our history. Over the ages, people have used it to gain a more accurate picture of their current situations, make better decisions for the future and improve the quality of their lives. But never has information been more accessible and more widespread that it is today. The recent developments in Information Technology (IT) have been phenomenal. Computers are progressively becoming smaller, more affordable and more powerful. They are linked together through telephone lines, satellites, and fibre optic cables that span across the world, allowing the ability to communicate and share information across borders. With this rapid advance of technology, IT has been revolutionizing the way we live our lives by eliminating digital divide. Democracy has been integrated into IT.

Kenya is a democratic state and has been holding elections after every five years using the ballot system for presidential, parliamentary and civic positions. Contention of 1997 and 2007 elections led to violence. Violence, which was mainly triggered by the perception that the election had been rigged, reduced trust and social capital among communities making violence more likely to reoccur (Dercon and Gutierrez-Romero, 2009).

Elections in Kenya are conducted manually using ballot and ballot boxes. As the whole system is manual so vote results compromised at polling stations (Kramon, 2010). Therefore, Kenya was in need of such a system where people can vote and feel secure, ensuring results cannot be manipulated (Kramon, 2010). Such environment may be achieved through electronic voting system, in which results may not be forged, manipulated or delayed by any one.

Switching from paper-based to electronic elections is a challenging task, in which the technological aspect (e.g., the type of systems used to vote electronically) is just a part of a larger problem that includes sociological, political, normative and organizational aspects. Other works – as for instance Ghapanchi et al. (2008) advocate the need to adopt a more general, integrated, 'holistic' view on electronic government (e-government) processes as a key factor for success.

With the specter of the growing digital divide looming large, the significance of 'citizens' readiness for e-voting' assumes paramount position in the roadmap towards e-government because in an environment that is more 'e-ready', people are in general more comfortable with the new technologies. Further, e-government initiatives are easily accepted and adopted. Hence, before a country embarks on a journey towards adoption of e-voting, it has to assess its state of 'e-readiness'.

In May 2010, IIEC introduced electronic registration of voters in eighteen constituencies as a pilot in preparation to adopt e-voting in Kenya. IIEC plans to extend the service to all constituencies, and automate the entire electoral process including voter registration, national electoral register, register analysis and validation, data processing, electronic voting, automated counting and tallying, electronic delivery and analysis and dissemination of results.

Despite the potential benefits of the introduction of e-voting, it should be noted that modernizing how people vote will not, per se, improve democratic participation. Failure to do so, however, is likely to weaken the credibility and legitimacy of democratic institutions (Carter and Belanger, 2005). Only e-enabled voting systems which are efficient, secure, technically robust and readily accessible and acceptable to all voters will build the public trust to such an extent as to make it feasible to hold large-scale e-enabled elections.

While the use of ICT promises to facilitate the role of e-democracy in Kenya, little is known of how ready citizens are for the actual implementation of e-voting.

1.1 Research Problem and Context

1.1.1 Statement of the Problem

The increased interest in use of ICT in enhancing governance and democracy may point to the growing role of e-voting in democratizing Kenya and the counties. IIEC was allocated Kshs. 40 billion to automate the voting system during the financial year 2010/2011 (IFC 2008).

It can be argued that common standards on e-voting, reflecting and applying the principles of democratic elections and referendums to the specificities of e-voting, are key to guaranteeing the respect of all the principles of democratic elections and referenda when using e-voting, and thus building trust and confidence in domestic e-voting schemes.

Studies on e-voter readiness have focused on developed countries. The need to adopt e-democracy practice suggests an immeasurable chance of success. E-voting readiness index (Krimmer and Schuster, 2009) analyzed and compared the environment for the introduction of E-voting in thirty one countries including all EU member states. The index does not tell us how ready we are given our circumstances in Kenya. So a need exists to establish if voters are ready to adopt the technology ahead of 2012 general elections.

To address this gap, this study will establish the extent of diffusion of e-voting and the significance of various influences on the uptake of e-voting among the citizens in Nairobi County.

1.1.2 Research Hypothesis

Null Hypothesis, H_0. There exists no correlation between readiness for e-voting status and adoption of e-voting in Kenya.

Alternative Hypothesis, H_1. There exist a positive correlation between readiness for e-voting and adoption of e-voting in Kenya.

1.1.3 Objectives of the Study

The aim of the study was to investigate readiness of citizens in order to shed light on the factors that may influence the adoption and diffusion of e-voting in Kenya. The research explores the readiness of citizens in adopting e-voting system in Nairobi County. The specific objectives of the study are to:

i. Determine the critical success factors for the adoption e-voting systems
ii. Investigate how e-voting readiness affects diffusion of e-voting systems.
iii. Establish e-voting readiness status in Nairobi County.
iv. Suggest appropriate framework for e-voting readiness for Kenya.

1.1.4 Research Questions

i. What critical success factors affect the adoption of e-voting system?
ii. How does E-voting readiness compare with UN Index of 2008?
iii. What is the extent of voter readiness for e-voting in Nairobi County?

1.1.5 Significance of the Study

The study was significant for various reasons, including:

i. The findings will be useful to management of elections in Kenya. The management of IIEC may find information on factors enhancing or inhibiting the use of e-voting important in their adoption of the technology.
ii. The government and IIEC will find the results important in that they will get a better understanding of factors affecting the adoption and diffusion of e-voting technology in Kenya. With this added information, they may factor in significant improvements designing and recommending intervention strategies.
iii. The study will also add to the growing body of literature on e-voting readiness in Kenya. It will also identify gaps for further research.

1.2 Definition of Terminologies

1.2.1 E-voting readiness

Electronic voting (e-voting) is any voting method where the voter's intention is expressed or collected by electronic means. According to Krimmer and Schuster (2008) the e-voting readiness defines how prepared an individual or a country is for the adoption of electronic voting. It's the readiness to incorporate ICT in e-democracy. The e-voting readiness index offers insights into different strategies, clear patterns and common themes in development patterns among regions and across them.

1.2.2 E-voting adoption

Adoption is the decision by a voter to become a regular user of electronic voting innovation (Kotler and Armstrong, 2002).

1.2.3 E-voting diffusion

For Rogers (2003), adoption is a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation". Rogers defines diffusion as "the process in which an innovation

is communicated thorough certain channels over time among the members of a social system". Kotler and Armstrong (2002) define adoption as a decision by an individual to become a regular user of the product. Hence adoption process is defined as the mental process through which an individual passes from first learning about an innovation to final Adoption. As expressed in this definition, innovation, communication channels, time, and social system are the four key components of the diffusion of innovations. "An *innovation* is an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003). An innovation may have been invented a long time ago, but if individuals perceive it as new, then it may still be an innovation for them. The newness characteristic of an adoption is more related to the three steps (knowledge, persuasion, and decision) of the innovation-decision process. E-voting diffusion is the process by a voter is made aware, develops interest, evaluates, tries and adopters electronic voting as way of determining winners to various positions in the society.

1.3 Outline of the project

This project consists of six sections. In chapter one, a relatively broad description is given, providing the reader with a background and discussion of the issues related to the problem area. Chapter two presents the literature review with theories relevant for the problem area. Also the research problem and research questions are described. Chapter three details the methodology used to undertake the research. Chapter four describes Data collection and Analysis for the research undertaken. Further findings will be analyzed against the conceptual framework in chapter Five. Chapter six describes the recommendation and conclusion from the research undertaken. The document there after provides references and appendices.

Chapter Two Literature Review

This chapter describes literature review about Nairobi County, IT Development and citizens' readiness for e-voting, e-voting adoption in Kenya. Citizens' readiness for E-voting adoption can be attributed to several effective factors: Personal, social or level of technology. Though the current literature provides valuable lessons about E-voting readiness, a drawback of many approaches is a tendency to presuppose the empirical puzzle; taking as given the effect that e-voting will have on democracy and focusing the attention on explaining why the relationship exists. Yet empirical support for the notion that e-voting has a casual effect on democracy is limited and mixed, particularly in the African context.

2.0 Introduction

The use of information and communication technology (ICT) in the electoral process is on the rise around the world. While most of the applications emerge back-office, ICT is finally reaching the arena of the voters (Krimmer and Schuster, 2008). E-voting is one of the most basic uses of technology in e-democracy. It offers considerable scope for faster, more efficient and more accurate elections and referenda, not to mention the possibility of more frequent public consultation. However, it is also deeply controversial and has been subject to criticism on a number of fronts, not least from people in the computer industry and citizens concerned about the potential for widespread electoral error or fraud (Barrister and Connolly, 2007). In Ireland, these factors contributed to the government having to abandon plans to introduce electronic voting for the European and local elections in June 2004 (Bannister, 2007). The use of E-voting machines has been undertaken in many developed countries. However, the use of E-voting in remote elections mostly in developing nations is still (Krimmer and Schuster, 2008). These underpin the need for citizens' readiness for e-voting.

2.1 Elections in Kenya

Kenya gained independence from Great Britain in 1963 and from then up until 2002 was ruled out by the political party Kenya African National Union (KANU). KANU's dominance was achieved by banning opposition parties in 1969 leaving Kenya a de facto one-party state to a de jure one-party state when a constitutional amendment in 1978 ruled that no other party was able to contest in the elections. In 1991 after much pressure from Kenyan activists and the international community multi-party elections were re-introduced. Several opposition parties emerged (FORD Kenya, FORD Asili, Democratic Party, Social Democratic Party, National Development Party of Kenya and other smaller parties). Nonetheless KANU remained in power winning the general elections of 1992 and 1997 amid violence and allegations of electoral irregularities (Dercon and Gutiérrez-Romero, 2008). Analysts though, argued that politicians instigated the violence as a tool for winning the elections. The KANU elite aiming to suppress opposition political parties also recruited and sponsored 'tribal militias' and gangs for them to terrorize and instigate ethnic violence in the same vein as other African countries have done such as Cameroon, Malawi, Nigeria, South Africa and Sudan (Kagwanja, 2003). These underpin the need for consistent citizens' readiness for election process.

2.1.1 2002 General Elections

In the general elections of 2002, all the opposition parties for the first time united under the National Rainbow Coalition (NARC) and behind a single presidential candidate, Mwai Kibaki. Kibaki won the presidential elections

by defeating KANU's presidential candidate Uhuru Kenyatta. Mwai Kibaki's Presidential election success in 2002 - declared free, fair and the most peaceful elections that Kenya has had in recent years by international observers - was hailed at the time as a step forward for Kenyan democracy. The democratic achievement was much owed for having formed a multi-tribal NARC coalition, unlike the previous multi-party elections where political parties formed seeking to target a specific ethnic group (Oyugi, 1997). The results were counted in the polling station for the first time and the introduction of form 16-A, as authentic verification and validity check, ensured credibility of elections.

2.1.2 2007 General Elections

On 27th December 2007, the fourth multi-party general elections were held. There was no outright winner for presidential elections. The political crisis exposed the extent of their shortcomings. The failure by the commission to guarantee free and fair elections left its mark, not so much on the institution's credibility, which is already at its lowest ebb, but on the understanding of the democratic process itself by citizens. Democracy is undoubtedly in its infancy in Kenya. The disappointment over the scale of electoral fraud, whose proof becomes more evident with the release of various reports, comes with real mistrust of the political class by citizens and a questioning, which should be taken very seriously, of the usefulness of the ballot. Added to this is the meaning of democracy and the ability of politics to solve the most urgent problems, be they economic or social. The expectations of citizens in Kenya have risen highly "Will the political class be able to promptly respond" (Lafargue, 2008)?

The election of 2007 was characterized by flaws in vote tallying process where auditability of votes was lacking either due to slackness or intended fraud (Lafargue, 2008). These require tamp proof election system to regain the lost trust, credibility and management fear of unknown, hence the need for electronic voting system based on citizens' requirements.

The table below lists the important factors studied by various researchers on Kenya Elections illustrating the existence of a research gap in electronic voting.

Author	Factors Studied
Kramon (2009)	Vote Buying and Turnout in Kenya's 2002
Dercon and Gutierrez-Romero (2008)	Triggers and Characteristics of the 2007 Kenyan Electoral Violence
Gibson and Long (2008)	Flaws in the Vote Tally Process and Credibility of ECK officials
Tsuda (2010)	Trust in Government and ECK (1997, 2002 and 2007 elections)
Lafargue Jérôme (2008)	Results and Expectation Management in 2007 Elections
Kagwanja, P. M. (2003)	Election Machination and Politics of Moi Succession in Kenya

Table 1: Previous studies of Kenyan Elections

2.2 E-Voting System

2.2.1 Concept of E-voting

E-voting terms

This section gives the explanations of the term "e-voting". The term "e-voting" is used, in variety of different ways mainly and it encompasses all voting techniques involving electronic voting equipment, including voting over the internet, using booths in polling stations and sometimes even counting of paper ballots.

Electronic voting (e-voting) is any voting method where the voter's intention is expressed or collected by electronic means. There are considered the following electronic voting ways.

Kiosk voting means the use of dedicated voting machines in polling stations or other controlled locations. Voters mark their choice electronically (perhaps on touch sensitive screen) rather than on paper ballot. The votes are counted on individual machines, known as Direct Recording Electronic (DRE) machines, and the votes cast are transferred to the central tallying point by unspecified means. A ballot paper can be printed and retained in confidence in a ballot box as an additional check.

Remote electronic voting is the preferred term for voting that takes place by electronic means from any location. This could include the use of the Internet, text message, interactive digital TV or touch tone telephone.

Internet voting (i-voting) is a specific case of remote electronic voting, whereby the vote takes place over the Internet such as via a web site or voting applet. Sometimes also used synonymously with Remote Electronic Voting. That usage is however deprecated and it will be used instead as a strict subset of remote electronic voting.

In this study, we use the term e-voting with the specific meaning of Internet voting where specific components of voting process are automated. If we use it as a general term, then we specify the meaning.

2.2.2 Security properties of e-voting

High security is essential to elections. Democracy relies on broad confidence in the integrity of elections. There has been a lot of attention to an electronic voting by cryptographers. Many scientific researchers have been done in order to achieve security, privacy and correctness in electronic voting systems by improving cryptographic protocols of e-voting systems. The main interest has been the practical security in e-voting systems (Mägi, 2007). Hence, e-voting should be uniform, confidential, secure and verifiable. According to Mägi (2007), the most important requirements of e-voting include:

i. Eligible voters are capable to cast ballots that participate in the computation of the final tally.
ii. Non-eligible voters are disfranchised.
iii. Eligible voters are not capable to cast two ballots that both participate in the computation of the final tally.
iv. Votes are secret. This is the property of privacy. This property is apparently contradicting property with correctness. On the one hand voting must be private and the votes that are counted anonymous. On the other hand, voters must be identified in order to guarantee that only the eligible voters are capable to vote.

v. It is possible for auditors to check whether all correct cast ballots participated in the computation of the final tally.

vi. This requirement says that a group of dedicated auditors or Electoral Committee can check the correctness of voting.

vii. The result of an election must be secret until the end of an election. The third party must not be capable to reveal the results of the election. Additionally, the system should guarantee that official votes' counting office cannot reveal the final tally before the end of voting. Otherwise, the result of voting could affect voters' decisions during the voting.

viii. All valid votes are counted correctly and the system outputs the final tally.

ix. It must be possible to repeat the computation of the final tally.

2.2.3 Description of e-voting systems

Generally, e-voting systems consist of six main phases: voters' registration; authentication; voting and votes' saving; votes' managing; votes' counting and Auditing.

The voters' registration is a phase to define voters for the e-voting system and give them authentication data to log into the e-voting system. The authentication is a phase to verify that the voters have access rights and franchise. The voting and vote's saving is a phase where eligible voters cast votes and e-voting system saves the received votes from voters. The votes' managing is a phase in which votes are managed, sorted and prepared for counting. The votes' counting is the phase to decrypt and count the votes and to output the final tally. The auditing is a phase to check that eligible voters were capable to vote and their votes participate in the computation of final tally. Additionally there are some other e-voting specific rules verified in this phase.

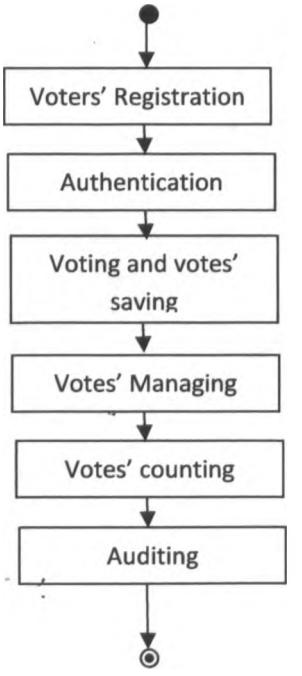

Figure 1: Phases of E-voting

According to Mägi (2007), it is possible to divide the e-voting system into three main components of infrastructure:

- Voter Applications;
- Network Sever;
- Back-office.

Voter Application is a web application or an application in voters' personal computers for casting votes. Voter application connects to Network Server. Usually, encryptions and authentications methods secure the communication between these components. Network Server is an online server that provides voters a necessary interface for casting votes. Network Server connects to Back–office server and transfers the received votes to it. Back–office consists of servers to save and maintain votes and to count a final tally.

In e-voting systems there are many Voter Applications, Network Servers and Back-office servers as illustrated in figure (Mägi, 2007).

2.2.4 Process of E-voting

According to Mägi (2007) E-voting starts with a voter connection to Network Server. Next, the voter provides his personal data for authentication. An authenticated voter makes one's choice by using the list of candidates transferred from Network Server. Next, the voter generates a random number r, concatenates it to the vote and encrypts created ballot by using a public key PK of the e-voting system. It guarantees that without knowing r the voter's choice is hidden. Without a randomized component in the plaintext, it would be possible for an adversary to create ballots for all possible votes, because the encryption key PK is public. Therefore, the voter's signature on the cipher text of ballot Enc(v, r, PK), is optional in the model of the system. In e-voting general model we consider that voters sign encrypted ballots by using their signature private keys.

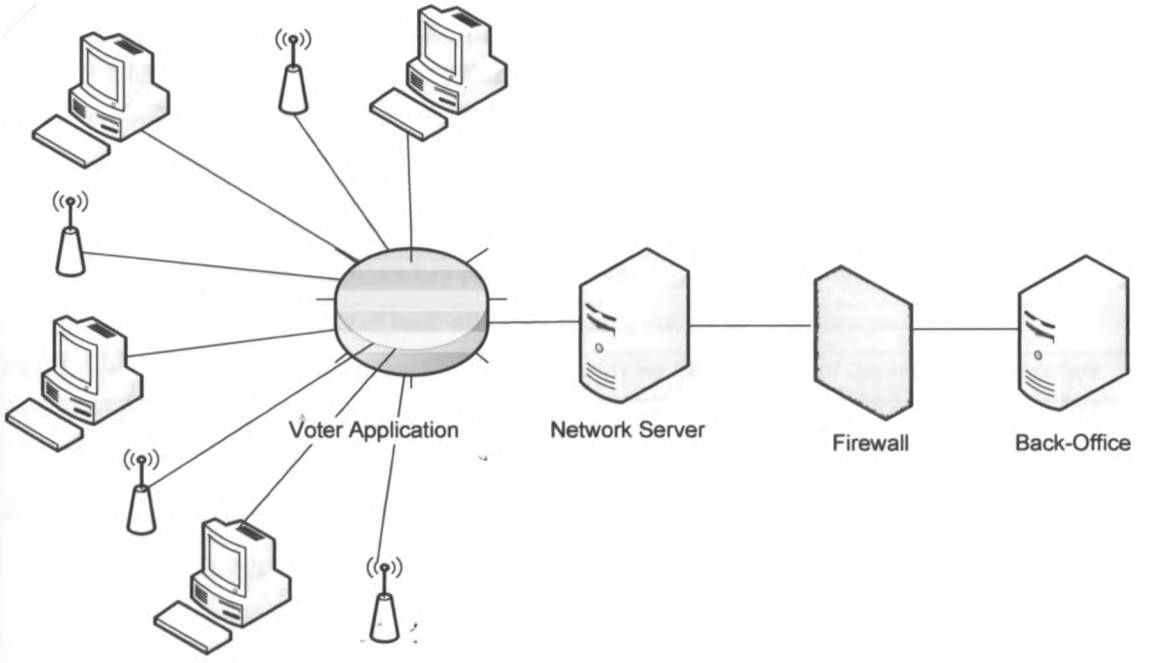

Figure 2: The Components of E-Voting

(Source: Mägi, 2007)

Network Server receives signed encrypted ballot Sign(Enc(v, r, PK), SK[i]) and transfers the accepted signature to Back-office. In order to guarantee that only eligible voters can vote, the processes of Back-office checks the signatures of the ballots and verifies whether voters already voted. If a voter had already voted the systems sends to the voter a signed receipt of voting Sign(ID, SK[0]). Votes' managing process saves every cast vote v and voter's personal data ID in Back–office servers. Back–office process replies to each correctly cast vote with a signed receipt Sign(ID, SK[0]), which is a confirmation of the voting system that the vote of the i-th voter has been correctly cast. Receipts do not contain any information about the corresponding votes. The voter can verify the signature Sign(ID, SK[0]) with public key PK[0] that corresponds to SK[0].

When the voting period is ended, Back–office's votes' counting process computes the final tally. Back-office outputs the signed final tally and the signed list of voters. Figure 3 depicts the process of e-voting systems. The activities and their abridgements in the model are given in Table 2 and Table 3.

Authentication	process for authentication
Cast	process to cast a vote
Random	function for generate random number
Enc	function for encrypting
Sign	function for digitally signing encrypted ballots
Save	function for saving data to following transmission
Count	function for counting the final tally

Table 2: The functions of general e-voting model

Table 2.3 Data items and their abridgements of general e-voting model

PK	the public key of the e-voting system which is used to encrypt ballot
SK	the secret key of the e-voting system, which is used to decrypt encrypted ballot in the back-office server
SK[i]	the private signature key of eligible voter
PK[i]	the public signature key of eligible voter
SK[0]	the private key of back-office for signing the voting confirmation
PK[0]	the public key of back – office for verifying the signature of the voting confirmation
v	a voter's choice, vote
r	randomly generated number
ID	voter's personal data file

Table 3: Data Items and their abridgements of general e-voting model

2.2.5 Estonian e-voting system

The Estonian e-voting system is implemented from the sixth day up to the fourth day before the Election Day. There are following principles in the Estonian e-voting system:

- Each eligible voter is able to revote. In this case the older votes are deleted.
- Classical voting in polling box cancels the voters' electronic votes.
- If considerable attacks against e-voting have been detected, Electoral Committee might stop e-voting and cancel the result of voting.

The main components of the Estonian e-voting systems are Voter Application, Network Server; and Back-office is divided into two Votes Storing Server and Votes Counting Server. These components have following described processes (Mägi, 2007).

Voter Application is a web application. The encryption and authentication built into the Secure Socket Layer (SSL) protocol protect the communication between voters and Network Server. The Estonian e-voting system is able to run on Windows, Linux and MacOS operation systems. In the Windows operation system it is required to use Microsoft Internet Explorer. The public key PK of e-voting is integrated into Voting Application. Voter Application uses signed ActiveX application.

The processes of Network Server are authentication, the checking of franchise, sending a candidates' list to voters, receiving signed and encrypted ballots. Network Server immediately transfers the received encrypted ballots to Votes Storing Server and transposes the acknowledgements of receipt from Votes Storing Server to voters.

Network Server completes the work at the moment when the period of e-voting finishes. Votes Storing Server receives encrypted ballots from Network Server and stores them until the end of voting period. One of the specific properties of the Estonian e-voting system is an option to cast a vote more than once. The last vote is taken into account.

Votes Storing Server has a responsibility of votes' managing and canceling. Votes Counting Server is an offline server, which summarizes all encrypted ballots. The encrypted ballots are transferred from Votes Storing Server to Votes Counting Server by using data carriers. Votes Counting Server does not get voters' digital signatures and it does not know voters' personal data.

Additionally, e-voting system delivers independent log files, which consist of trace of the received encrypted ballots from Network Server, all annulled encrypted ballots, all encrypted ballots sent to Votes Counting Server and all counted encrypted ballots. All the records in the log files are linked by using cryptographic protocol. The electoral committee has the right to use the log files for resolving disputes. The process of auditing uses the independent log files of e-voting system. There are the following logs:

LOG1: received signed encrypted ballots;

LOG2: cancelled signed encrypted ballots with reasons of cancellation;

LOG3: signed encrypted ballots which are transferred to Votes Counting Server;

LOG4: invalid encrypted ballots;

LOG5: counted encrypted ballots.

In the process of auditing, there is possibility to verify the integrity of log files. The intersection of LOG2 and LOG3 must give LOG1. The intersection of LOG4 and LOG5 must give the content of LOG3. Hence, there is the independent audit trail to verify e–voting process and to help solve problems in the Estonian e-voting system.

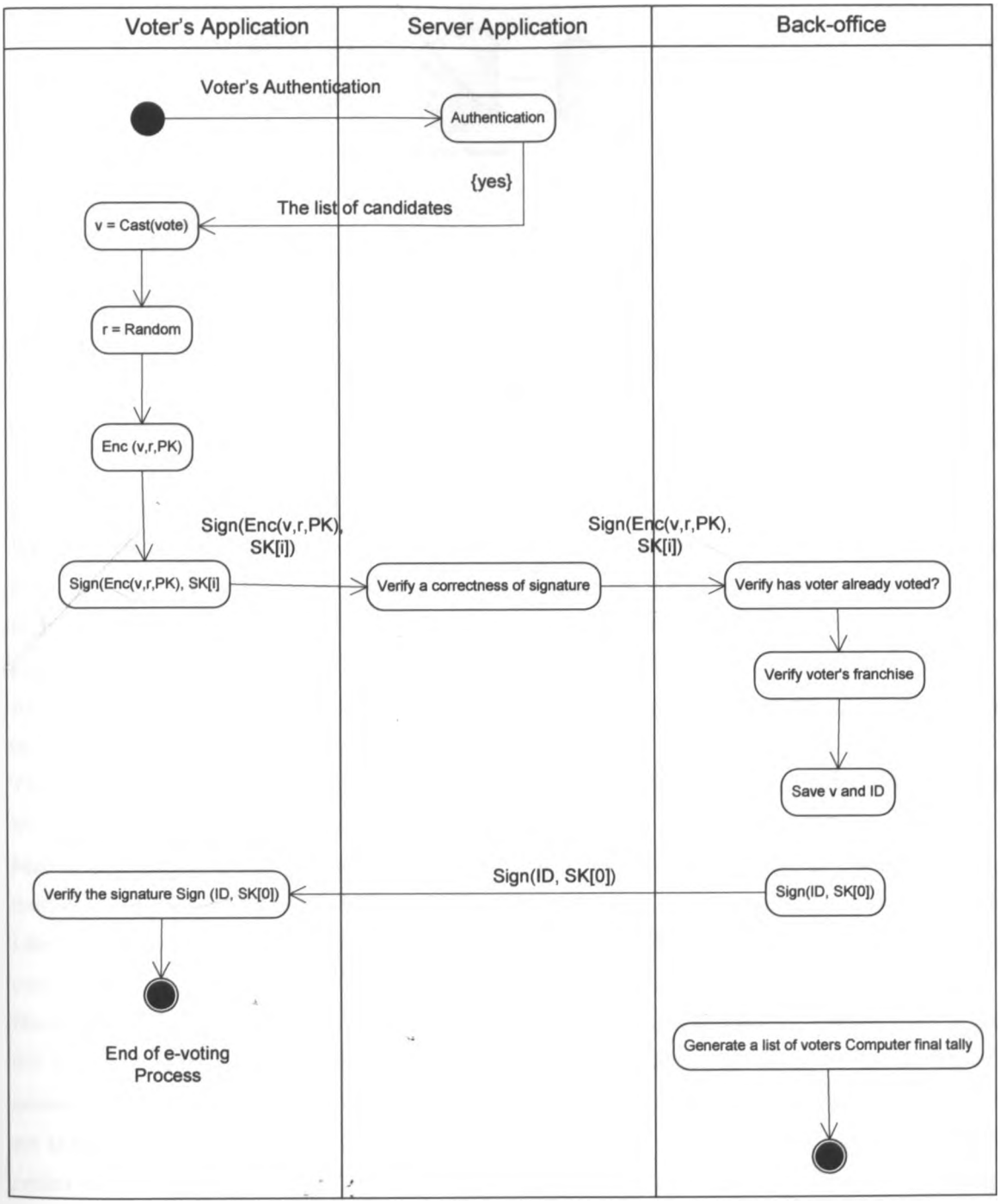

Figure 3: Description of E-Voting

(Source: Mägi, 2007)

Figure 4 depicts the components of e-voting system

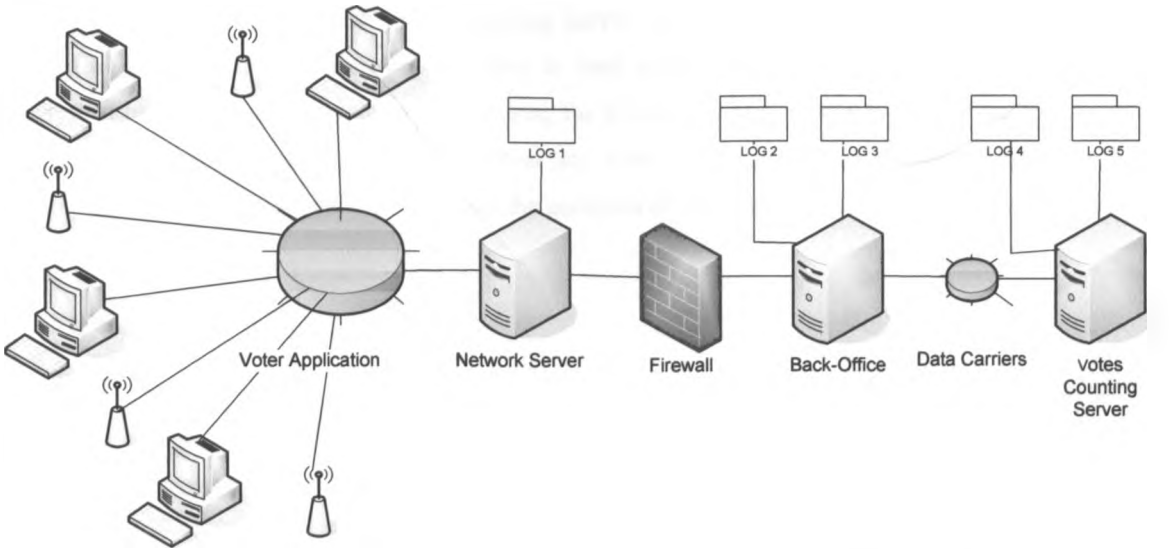

Figure 4: Components of Estonian E-voting System

(Source: Mägi, 2007)

2.2.6 SERVE e-voting system

We refer to the SERVE e-voting system as the SERVE system and as the SERVE project. On the one hand, it is an e-voting system, but due to the case that the United States didn't use it in elections, we may appoint it like a project. In the SERVE system, it is possible to vote any time within 30 days before the Election Day until the closing time of polls on the Election Day. Every eligible voter can cast a vote only once. There are no Public Key Infrastructure and ID-cards used in SERVE. If Electoral Committee is informed of considerable attacks against the e-voting system, the e-voting might be terminated and the result cancelled.

The main participants in SERVE are Voter Application, Network Server and Back-office that is divided into Votes Storing Server and Votes Counting Server. Voter Application is a web application. Voters' computers must run a Microsoft Windows operating system and either the Internet Explorer or the Netscape web browser. The browser must be configured to enable JavaScript and either Java or ActiveX scripting and it must permit session cookies. Like the Estonian e-voting system, the encryption and authentication built into the SSL protocol, protects the communication between the user's web browser and the voting application on Network Server.

Network Server is an online server. Network Server receives ballots and personal information from voters, encrypts this data, and transmits cipher texts to Votes Storing Server. Votes Storing Server verifies the voters' rights of access and franchise. But the most important is that the server decrypts the received cipher texts. Hence, the ballots are in the server in non-encrypted way within a little period until the server encrypts the ballots again. The server retains encrypted ballots and the list of voters' personal data, even after a copy has been sent to Votes Counting Server. The aim to store the list of voters is to verify whether the voter has already cast a vote.

The SERVE system has many Votes Counting Servers named Local Election Office. Every voting district that participates in SERVE has online Votes Counting Server. Every Votes Counting Server generates an e-voting key pair. The Votes Counting Server's public key is used to encrypt the ballots voters from that certain district. Encrypted ballots can be read exclusively by using the private key known only to Votes Counting Server. There are direct interactions between Votes Storing Server and Votes Counting Servers for downloading the list of voters' personal data and encrypted ballots. To model the activities of system we focus on one Votes Counting Server only.

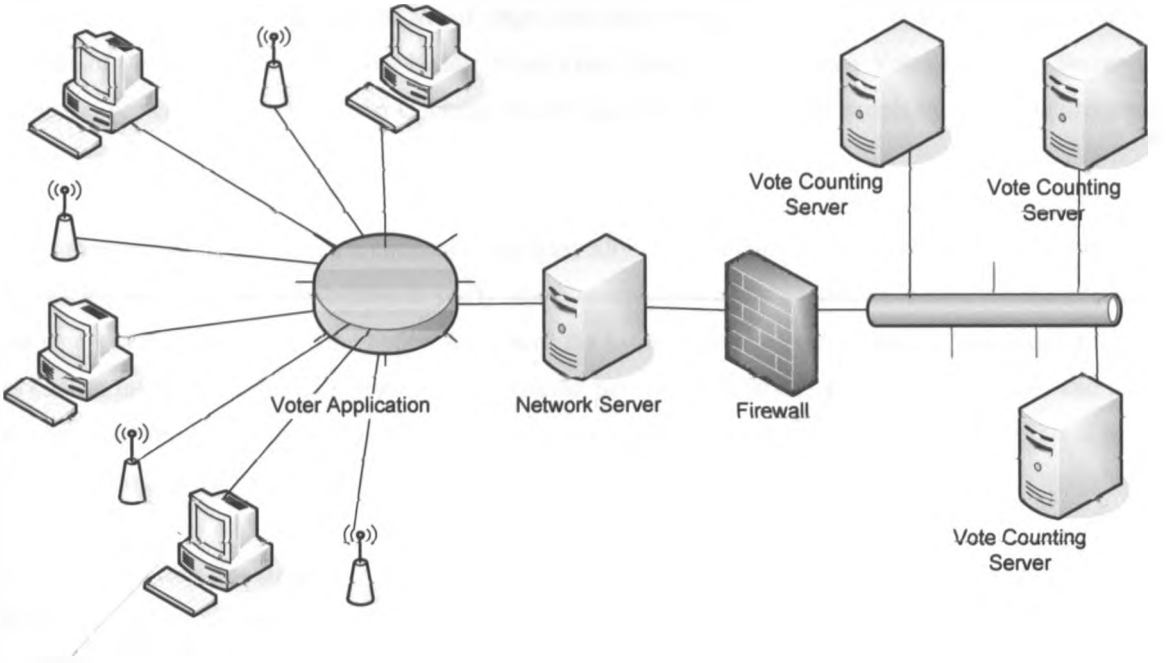

Figure 5: The Infrastructure of SERVE Project

(Source: Mägi, 2007)

We describe the processes of the SERVE e-voting system by using the information from D. Jefferson, A.D. Rubin, B. Simons, D. Wagner paper "A Security Analysis of the Secure Electronic Registration and Voting Experiment".

To participate in the e-voting process, an eligible voter must firstly enroll for the SERVE program. After the enrolment, the voter will be able to register oneself as a voter. The authentication of the SERVE system uses password-based service. To authenticate oneself, the voter connects over https protocol to Network Server and inserts the login data. Additionally, Network Server verifies the voter's franchise. Once the connection is established, a trusted ActiveX control is downloaded into the voter's computer when voter uses Internet Explorer browser, or for Netscape users-a Java applet runs are downloaded.

Next, Network Server reveals the list of candidates and the voter makes one's choice. The application encrypts a vote v and a generated random number r by using SERVE's public key PK[S]. Voter Application casts the encrypted ballot Enc_ball = Enc(v, r, PK[S]) and voter's personal data ID to Network Server. After the verification of correctness of message the encrypted ballot and voter's personal data are transferred from Network Server to Votes Storing Server.

In the votes' managing phase, the Votes Storing Server verifies that a voter is registered and has not yet voted. The server generates a Response for each accepted vote. In case the voter has already voted the receipt Response with corresponding answer is generated and voting process terminates. Accepted encrypted ballots follow the process in Votes Storing Server. The server decrypts cipher text of votes using the private key of SERVE and separates the ballots and the voters' personal data. Afterwards, Votes Storing Server encrypts ballots without the voters' personal data using the public key of Votes Counting Server. Votes Storing Server retains the encrypted ballots Enc_bal2 = Enc(v, r, PK) = Enc(bal, PK) and the list of voters who have already cast a vote. Votes Counting Server downloads the list of voters and the encrypted ballots from Votes Storing Server when Votes Counting Server updates its database. For counting votes, Votes Counting Server decrypts the encrypted ballots by using the private key SK of Votes Counting Server.

Only accepted format of votes are counted to the final tally. The computation of the votes is repeatable.
In SERVE there are two possibilities to verify which components of the system have received the information about the voters or the ballots. The first option is to check the list of voters in Votes Counting Server and another option is to make a query to the list of voters in Votes Storing Server. Both servers retain the voters' list and the encrypted ballots separately. It is not possible to verify whether a voter's vote participated in the calculation of the final tally. To summarize, there is no independent audit trail of votes to verify the e-voting process.

2.3 E-Voting Examples

Electronic voting has been a hot issue in many states worldwide and lately some of these states implemented e-voting as a replacement for their conventional electoral systems in practice.

2.3.1 Brazil

Brazil is a world leader in electronic elections, having conducted them since 1990. The elections in October, 1998, was one of the largest electronic elections in history with over sixty million voters casting ballots by computer for local and national candidates. 57% of the voting population voted electronically in elections for local, state and national offices. In accordance with Brazilian law, an initial election involving all candidates was held in October and a run-off election between top two vote-getters for each office was held in November. When the results were tabulated, Brazil had elected its President, 27 Senators, 27 Governors and over 2000 state and local officials (Krimmer and Schuster, 2008; Avgerou, C. et.al., 2006).

2.3.2 United Kingdom

The expansion of new Information and communication Technologies into every sphere of people's lives offer opportunity to progressively overhaul electoral processes and to realize the benefits that new technologies can offer this component of democracy. Most people routinely undertake electronic transactions as part of their everyday activities. Millions of people regularly cast electronic votes in private elections, particularly for television and radio

contests. Soon, voting in public elections (both locally and general elections) may be one other activity which can be achieved electronically (Krimmer and Schuster, 2008).

The vision of e-voting is not one of a sudden switch over to a simple technology. Rather the vision is one of a phased move to multi-channel elections in which voters are offered a range of means by which to cast their vote and choose the mechanism that most suits them. Some of the 2002 local election pilots were experimented with multi-channel approach. The process of piloting, testing and then introducing became an increasing feature of electoral practice. By the 2008 General elections most counties tried this approach and it showed significant improvements. By 2011, much of the ground should have been prepared for an e-enabled election, offering various vote casting alternatives (Mercuri, 2001).

2.3.3 New Zealand

Most of the developments are providing electronic voting facilities in polling places particularly replacing paper and ballot s in jurisdictions with complicated ballots and multiple languages as in the case in Belgium, the Netherland and the United States. There were ambitious remote e-voting trials that took place in 2007 that were monitored closely. In particular, registered overseas New Zealand voters voted online at the parliamentary elections.

2.3.4 How Best to Introduce E-Voting

Buchsbaum (2004) in work offered suggestions on how best to introduce (remote) e-voting.

- suggest e-voting as additional, optional voting channel;
- start with identifiable group(s) of persons who wish / need e-voting, e.g. persons away from polling stations on election day(s), handicapped and bedridden persons incapable of going to polling stations, and mobile and busy people unwilling to go to polling stations but interested in participating in elections;
- go for added-value schemes which may be different in individual countries, with respect to existing voting channels and procedures;
- full understanding and trust by voters and lawmakers - including of the opposition - are absolutely necessary;
- only a step-by-step approach leads to success: election tests separate from or parallel to, elections are to be held before valid test elections (pilots) can be, and small before big numbers of electors should be involved;
- in countries where postal voting is practiced, extending postal voting to remote e-voting eases the introduction of e-voting;
- the best, as most reliable way, is identification with the help of electronic signatures / smart cards (not PINS);
- In order to avoid risks through postal transmissions, any transmission related to e-voting shall be possible / offered by electronic channels.

The above underpins the need for dedicated communication channel that is reliable, efficient and always available. Hence citizens' readiness is vital in order to establish e-voting system.

Various researches have been undertaken in the field of e-voting. The table below lists the important factors studied by researchers in order to facilitate the introduction of e-voting system.

Author	Factors Studied
Lopresti, Nagy and Smith (2008)	Constraints in Processing Ballots; including: Undetected failures in machine reading Ballots, System errors, Cost of Manual recount, human errors and human bias in performing audit and recount; need for anonymity.
Fischer (2003)	Threats; Vulnerabilities (technical and social), Defense mechanism including trade-offs; and Response and Recovery Procedures
Prosser and Krimmer (2004)	Dimension of E-voting and E-voting model
Buschsbaum (2004)	How best to introduce e-voting: Citizen awareness, understanding and Trust by voters and Law makers; Security Enhancement, and Transmission through Electronic channels.
Schaupp and Carter (2005)	Factors that influence the adoption of e-voting by citizens between ages 18 – 20 years.
Braun (2008)	E-voting Legal Framework
Meißner, Hartmann and Richter (2005)	Verifiability of E-voting System

Table 4: Summary of E-voting Literature

2.3.5 Benchmarking E-voting

The UN Global E-Government Survey 2003 highlighted that there was a wide disparity between Member States in their e-government readiness. The 2004 report goes deeper into the issues and challenges of the disparities in 'access to the opportunity for development' offered by ICTs. It discusses the various aspects of the digital divide and presents the thesis that the digital divide is not only a disparity between those who are connected and those who are not but that it encompasses a wide range of issues which cause disparities in access to proper utilization of ICTs. It identifies the boundaries of what constitutes lack of access to ICT. In its data analysis it presents a picture of where the countries are placed in providing access to all.

2.4 E-Voting Readiness Index

According to Krimmer and Schuster (2008),the e-voting readiness index incorporates the access characteristics, such as the infrastructure and educational levels, to reflect how a country is using the ICT opportunity for national, economic, social and cultural empowerment of its people.

The e-voting readiness index offers insights into different strategies, clear patterns and common themes in development patterns among regions and across them. By tracking the progress of Kenya over time it seeks a better understanding of the challenges to the nation: the challenge of encouraging greater use of e-democracy and ICT while ensuring the opportunity for access is available to all; the challenge of finding resources to integrate new

technologies into traditional development patterns at a pace that allows for exploitation of those opportunities; the challenge of devising appropriate e-democracy strategies and policies which would overcome the inept leadership and resource management.

The e-voting index will also signals broad trends counties in Kenya and across regions. It contributes to the discussion of the centrality of ICT to development by gaining a better understanding of the emerging patterns of country performance across the world.

By constructing a comparative index the e-voting readiness index ranks government's efforts while taking into account their size; infrastructure availability and ICT penetration; and the level of education and skill development, the index provides a valuable input for policy making and agenda setting for the future. The relative rankings will assess a county within its economic and social development context.

The e-voting readiness indices are useful for government officials, policy makers, researchers, and the representatives of civil society and the private sector to gain a deeper understanding of the comparative benchmarking of the relative position of a county in utilizing e-voting for the citizen vis a vis the rest of the country. The Survey aims to inform and improve the understanding of policy makers' choices to shape their e-voting programs in the service of development. The Survey rankings – which serve as a snapshot – hope to shape further consolidation of ICT programs which contribute to a more participatory public policy model of development for all.

2.4.1 E-voting Assessment Framework

For the development of the E-voting Framework, Krimmer and Schuster (2008) identified four dimensions: Political, legal, technology and social dimensions. These factors constitute the national level in contrast to the process level for the concrete application under investigation. The core institutions of the political system available in the digital world provide the systematic context within which individual citizen have an opportunities to participate online. It is determined by the particular citizen, his or her resources (time, money and skills) and his or her motivation to take advantage of these opportunities.

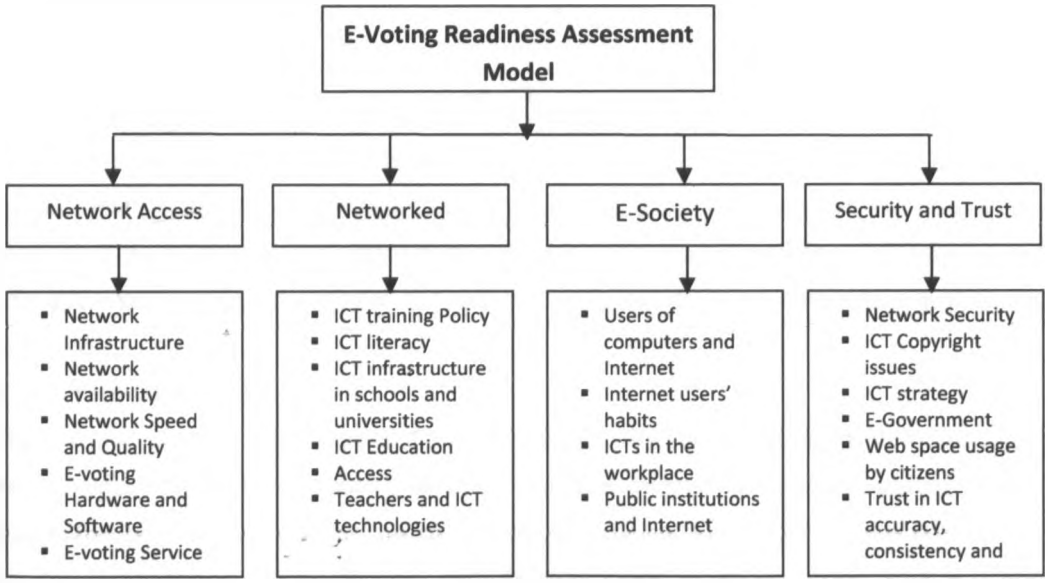

Figure 6: The Bulgerian Readiness Assessment Model

Regarding E-democracy, the dimensions of the national level that can be considered include:

- Information Society Context
- Political Context
- Legal Context

Information society context measures computer and internet penetration. Political Context considers the democratization of a country based on political stability and type of government. A stable democracy is necessary for the introduction of e-voting system. Legal Context measures the basics of democratic elections using election system or supplementary protocol for human rights.

2.4.2 Origin of the concept of E-voting Readiness

The rapid rate of Internet penetration throughout the world and the dramatic advances in the use of information technology in business and industry has occasioned a growing interest and literature on e-readiness not only in developed countries but also in developing countries as well. The concept of e-readiness was developed as a result of the need to provide a unified framework to evaluate the breadth and depth of the digital divide at macro level between most and least developed countries during the later part of the 1990s. This was followed by the emergence of various e-readiness assessment tools which were developed by different companies, organizations or groups with each group claiming its tool to offer better results. The Computer Systems Policy Project - a public policy advocacy group that comprises of the United States information technology companies, was the first to use the concept of e-readiness when it developed in 1998 an e-readiness assessment tool known as the "Readiness Guide for Living in the Networked World". From this first model by CSPP, other models have evolved (www.cssp.org). These have been applied to democracy, particularly in analyzing citizens' readiness for e-voting.

2.4.3 E-Readiness Attributes

(a) Network Access

The minimum necessary condition for e-readiness is access to adequate network infrastructure. Without access to global communications networks, no organization can participate in the Networked World. Access is determined by a combination of the availability and affordability of the network itself, as well as of the hardware and software needed for network interface. The quality and speed of the network are also important in determining how the network is used.

(i) Network Infrastructure

This refers to the physical hardware used to interconnect computers and users. Infrastructure includes the transmission media, telephone lines, routers, repeaters, and other devices that control transmission paths.

The infrastructure provides the necessary backbone that connects institutions to the global network infrastructure is important for realization of quality services. Infrastructure development consumes large amounts of financial

resources in ICT projects and it is important that management attention be directed to this component right from project initiation,

(ii) Network Availability

This affects the rate at which results are relayed to the commission headquarters and tallying centre. The range of services offered, the number of dial-up lines and the transmission capacity all influence an ISP's usefulness. The availability of wireless network is particularly important in evaluating citizens' e-voting readiness.

(iii) Network Speed and Quality

The available bandwidth determines the number of users and types of online activities the network can support. Bandwidth-intensive activities, such as large file transfers or video streaming, may be unavailable to organizations with constrained access to the network. The quality of the network, including servers, also determines its usage. High numbers of network faults, poor connections, dropped connections and packet loss can render any network useless or operationally sub-optimal, thus discouraging use of and investment in new technologies.

(iv) E-voting Hardware and Software

According to CID (2000), a vibrant market with numerous hardware and software options can encourage more specialized usage of the network, including ICT solutions that are tailored to organizational needs. The availability of open source software is important. The usability and complexity of hardware and software are particularly important if most of the citizens are to become ICT compliant.

(v) E-voting Service and Support

A strong citizen service orientation is important in determining the success of e-voting deployment. The quality and number of technical support professionals are essential in maintaining the network and providing service. The hand-on expertise is fundamental to the evaluation of e-voting readiness in Kenya.

(b) Networked Learning

(i) Access to Information and Communication Technologies

Institutions must integrate ICT tools into their processes if they are to be part of the Networked World, Programs that give voters and general public at large access to information and communication technologies anywhere, anytime and using any device; providing an important step to e-voting adoption. According to CID (2000), an organization's e-readiness in terms of access can be broken down into six broad areas: number of computers, physical access to the technology, types of computers, diffusion of the network, access to and organization of electronic content, and quality and speed of connectivity in the school.

(ii) ICT Literacy

While putting ICTs into institutions is an important step to e-voting readiness; the technologies need to be properly harnessed to improve the voting process. Hands-on and practical must be encourage.

(iii) ICT Infrastructure

It is essential that there exist opportunities within the institutions to offer ICT workers essential skills such as software programming, hardware engineering and World Wide Web design. These opportunities are fundamental to creating a sustainable ICT industry and support the integration of ICTs into the institutions.

(c) NETWORKED SOCIETY

According to CID (2000), e-voting readiness depends upon the community's incorporation of information and communication technologies into the fabric of its activities in order to maximize the gains of joining in the Networked World. ICTs in society at large can have a profound effect upon people's professional and personal lives by providing easier access to information, more efficient ways to communicate and powerful organizational tools. In order to understand how a community is using ICTs, it is important to assess not only how many members of the community have access to the technologies, but also how they are using them.

(i) Users of computers and Internet

According to CID (2000), one of the hardest indicators to track is the actual number of online users, particularly in the developing world, where multiple users share many electronic mail accounts and other online tools, there are few reliable indicators that accurately map how many people are online. The exponential growth in online usage also makes tracking current use difficult. This is nevertheless an important indicator. According to CID (2000), as more people access the Internet regularly and networks of users grow, there is greater demand and opportunity for online interaction, as well as better meshing with the Networked World at- large. As more organizations gain an online presence, it becomes more likely that the community will use information and communication technologies to augment or carry out its activities and needs.

(ii) Internet Users' habits

Community members find the Internet medium more useful and relevant to their own lives when online content reflects their own interests and needs. Locally relevant content is a major driver of growth of Internet usage. Interactions such as chat rooms, online interest groups, special interest software, bulletin boards and websites all drive the community to use ICTs more widely in their lives: Similarly, online content is more relevant when it is available in local languages.

(iii) Information and Communication Technologies in Everyday Life

According to CID (2000), communities participate more directly in the Networked World when information devices, such as radios, faxes, televisions, telephones, pagers and computers are culturally accepted and widely incorporated into daily life. It is important to examine both penetration of ICT devices into a community and their applications. In communities where either income levels or the network infrastructure cannot support high levels of individual access, public shared facilities provide a needed alternative. Such venues may include tele-centres, cyber cafés and community information centres. Strategies for drawing people in to use these facilities are essential.

(iv) Information and Communication Technologies in the Workplace

According to CID (2000), the more, that business and government offices are already using information and communication technologies, the better prepared they are to participate in the global networked economy. CID (2000) further notes that in order to realize important efficiency gains from ICTs, businesses and governments need

to not only make technologies available to their employees, but also effectively incorporate them into their core processes.

(d) NETWORK POLICY, SECURITY AND ICT STRATEGY

(i) Network security

The terms Network Security and Information Security are often used interchangeably. Network Security is generally taken as providing network protection against unauthorized people. Information Security, however, explicitly focuses on protecting data resources from malware attack or simple mistakes by people within an organization.

(ii) ICT Copyright issues

Copyright is a form of intellectual property that gives the author of an original work exclusive right for a certain time period in relation to that work, including its publication, distribution and adaptation, after which time the work is said to enter the public domain.

Copyright applies to any expressible form of an idea or information that is substantive and discrete and fixed in a medium. Some jurisdictions also recognize "moral rights" of the creator of a work, such as the right to be credited for the work.

(iii) ICT Strategy

The information and Communication Technology (ICT) Strategy defines the technical direction and framework for institutional developments, services and risk management.

It is envisaged that this strategy will act as a guide for the development and management of ICT for a predefined period of time. The aims of the ICT Strategy are to:

- Define the technical direction and framework for developments in the infrastructure and administrative and academic applications that involve use of information technology.
- Define the principles and standards that permit data sharing, integration and devolvement of systems that will lead to efficient and coherent working.
- Cover issues such as security and disaster recovery

(iv) Web space usage by citizen

This determines the number of citizens currently on social networks and possibility of fraud, hacking and cybercrime to occur.

(v) Trust in ICT accuracy, consistency and timeliness

The infamous "computer error" while releasing Kenya Certificate of Secondary Education, raise an issue of trust in ICT. Citizens' readiness often is influenced by public opinion. It is often worthwhile to establish standards.

2.5 Discussion of Previously used E-Readiness Assessment Tools

Various e-readiness assessment tools have been used over the past few years. Each tool gauges how ready a society or economy is to benefit from information and communication technology. The range of tools uses varying definitions for e-readiness and different methods for measurement.

For each assessment tool, the following questions are answered in this discussion: What is the goal of the tool? What is measured? Who created the tool? How is 'e-readiness' defined? How is assessment carried out? What is produced?

The range of available tools is broken down into different categories.

2.5.1 READY-TO-USE TOOLS - QUESTIONA1RES

2.5.1.1 CSPP's readiness guide for living in the networked world

Who created the tool?

The Computer Systems Policy Project (CSPP) developed this tool. It was published in 1998, and is available at www.cspp.org. CSPP is a "public policy advocacy group comprised of the Chairmen and Chief Executive Officers" of US information technology companies.

What is the tool's goal?

This self-assessment tool is designed to help individuals and communities determine how prepared they are to participate in the "networked world".

What does it measure?

The guide measures the prevalence and integration of ICTs in homes, schools, businesses, heath care facilities, and government offices, with additional focus on competition among access providers, speed of access, and government policy. Measurements are divided into five categories:

- Infrastructure;
- Access
- Applications and services;
- Economy; and
- Enablers" (policy, privacy, security, ubiquity).

How does it define 'e-readiness'?

An e'-ready' community has high-speed access in a competitive market; with constant access and application of ICTs in schools, government offices, businesses, healthcare facilities and homes; user privacy and online security; and government policies which are "favorable to promoting connectedness and use of the Network."

How the assessment carried out?

The CSPP Readiness Guide provides a series of 23 questions, for community members to ask ho the community itself for each question, the users choose from a set of answers, which represent four progressive "stages" of development. The 23 questions are divided into the five categories listed above.

What result does it produce?

The assessment produces a rating that indicates which of four progressive stages of development the community is at for each of the five categories listed above. "An overall 'score' for the community can be estimated by simply averaging the scores across the criteria.

2.5.1.2 CID's Readiness for the Networked World: A Guide for Developing Countries

Who created the tool?

The center for International Development at Harvard University developed this guide. It was published in 2000, and is available at www.readinessguide.org. It draws from the CSPP guide, described earlier.

What is the tool's goal?

"The guide systematically organizes the assessment of numerous factors that determine the Networked Readiness of a community in the developing world." This assessment is meant to serve as a basis for further analysis and planning.

What does it measure?

This guide measures 19 different variables classified as follows:

i. Network access (Information Infrastructure, Internet Availability. Internet Affordability, Network Speed and Quality, Hardware and Software, Service and Support).
ii. Networked learning (Schools' Access to Information and Communication Technologies, Enhancing Education with ICTs, Developing the ICT Workforce)
iii. Networked society (People and Organizations Online, Locally Relevant Content, information and Communication Technologies in Everyday Life, Information and Communication Technologies in the Workplace).
iv. Networked economy (ICT Employment Opportunities, Business-to-Consumer (B2C) Electronic Commerce, Business-to-Business (B2B) Electronic Commerce, E-Government).
v. Network policy (Telecommunications Regulation, ICT Trade Policy).

How does it define 'e-readiness'?

An 'e-ready' society is one that has the necessary physical infrastructure (high bandwidth, reliability and affordable prices); integrated current ICTs throughout businesses (e-commerce, local ICT sector), communities (local content, many organizations online, ICTs used in everyday life, ICTs taught in schools), and the government (e-government); strong telecommunications competition; independent regulation with a commitment to universal access, and no limits on trade or foreign investment.

How is the assessment carried out?

Tb guide provides a grid (See appendix B) with descriptions of four stages of advancement in each of 19 categories (placed into five groups). Communities estimate their current stage of development in each category. No prescription is given on how that estimate should be made.

What results does it produce?

The guide rates the 'stage' a community is in for each of the 19 categories, and descriptions are given of what is required to be in a particular stage. "The Guide does not offer prescriptions for improved Readiness."

2.5.1.3 APEC's E-Commerce Readiness Assessment

Who created the tool?

The Asian Pacific Economic Co-operation (APEC) Electronic Commerce Steering Group developed this guide. It was published in 2000, and is available at http://www.ecommerce.gov/apec.

'Who is the tool's goal?

"To help governments develop their own focused policies, adapted to their specific environment, for healthy development of c-commerce."

What does it measure?

Six categories are measured for "readiness for e-commerce:"

i. Basic infrastructure and technology (speed, pricing, access, market competition, industry standards, foreign investments),
ii. Access to network services (bandwidth, industry diversity, export controls, credit card regulation),
iii. Use of the internet (use in business, government, homes),
iv. Promotion and facilitation (industry led standards),
v. Skills and human resources (ICT education, workforce), and
vi. Positioning for the digital economy (taxes and tariffs, industry self-regulation, government regulations, citizens' trust).

How does it define 'e-readiness'?

A country that is 'ready' for e-commerce has free trade, ease of exports, and compliance with international standards and trade agreements.

How is the assessment carried out?

Participants are asked 100 multiple-choice questions grouped into six categories listed above. The possible answers indicate progressive levels of e-readiness for a country. No overall scoring occurs.

What result does it produce?

The product of the assessment is the answer to the 100'questions. Countries are supposed to work areas with less than optimal answers, since they are "impediments... to the deployment e-commerce."

2.5.2 Third Party Surveys and Reports

2.5.2.1 McConnell International's Risk E-Business: Seizing the Opportunity of Global E-Readiness

Who created the tool?

McConnell International prepared this report in collaboration with World information Technology and Services Alliance (WITSA), and it was released in August 2000. It is available at http://www.mcconnellinternational.com.

What is the tool's goal?

The goal is to assess a national economy's e-readiness or "capacity to participate in the global digital economy."

What does it measure?

The report measures five areas:

i. Connectivity (infrastructure, access and pricing),
ii. E-leadership (government policies and regulations),
iii. Information security (intellectual property, privacy, electronic signatures),
iv. Human capital (ICT education, available skilled workforce), and
v. E-business climate (competition, political and financial stability, foreign investment, financial infrastructure).

How does it define 'e-readiness'?

An 'e-ready' country has extensive usage of computers in schools, businesses, government and homes; affordable reliable access in a competitive market; free trade; skilled workforces and taming schools; a culture of creativity; government-business partnerships; transparency and stability in government and an evenly enforced legal system; secure networks and personal privacy; and regulations allowing digital signatures and encryption.

How is the assessment carried out?

For each country and each category, the report performs a "dynamic evaluation of the relevance and accuracy of available quantitative data with an understanding of myriad cultural, institutional, and historical factors." These general ratings and their narratives can be used as a starting point for further planning.

What results does it produce?

Countries are rated in the five categories listed above on a scale of one to three ('blue,' amber, red'), and extensive analysis and recommendations are given.

2.5.2.2 CIDCM's negotiating the Net Model

Who created the Tool? The Leland Initiative Telematics for Africa project at the Centre for international Development and Conflict Management (CIDCM) at the University of Maryland developed tin tool and was published in 2001.

What is the tool's goal?

To help advance the diffusion of ICTs in developing countries, especially Africa, by helping decision-makers improve the processes of negotiating through which ICTs are diffused by governments, NOOs and the private sector.

What does it measure?

The framework measures four categories of information for each country:

1. Background and history — structural context (economy, education levels, existing infrastructure), political structure and culture (type of government, policy making style), cultural norms (religion, etc).
2. Key players in Internet development — responsibilities and objectives of relevant players in government, local and foreign businesses, universities, NOOs, international financial institutions, research groups.
3. Internet development and ICT policy over time — access, regulation, competition.
4. Negotiations between players in developing the country's Internet — each aspect of Internet development and ICT policy is categorized into one of four stages (pre-commercial, commercial, competitive, and consolidated). 'Negotiation' between players is the focus of the framework — the rest is supporting information.

How does it define 'e-readiness'?

An 'e-ready' society has an ISP market that has passed through three phases of development: (1) pre-commercial (access limited to a pioneer community), (2) commercial (access is sold s) and (3) competitive (the ISP market has multiple competing actors). The negotiations between actors should be transparent, conclusive, speedy and inclusive of the major players in public, private and NGO sectors.

How is the assessment carried out?

The assessment is conducted through interviews with key actors in the relevant institutions draws upon a range of background statistics and information as outlined above.

What result does it produce?

The result will be detailed narrative that describes the processes and outcomes of negotiations between key players over the phases of development, identifying major contentious issues likely to remain problematic in the future.

2.6 Overview of E-Voting Readiness at Global Level

Many countries and organizations across the world have realized the enormous potential Information and Communication Technology plays in accelerating their development. As such these countries and organizations have found it important to take stock of the state of the e-voting readiness by appraising the status of the underlying infrastructure, human resources, policies and investment climate at regular interval using e-voting readiness index (Krimmer, 2008). This is based on four dimensions, namely: Political, Social, Technology and Legal. The underlying principle behind the ranking is that digital business is crucial to national economy and for digital transactions to be widely adopted and efficient, they have to thrive in all supportive environment (Economic Group 2005), and hence the potential for the introduction of e-voting in Kenya.

2.7 Over View of E-Voting Readiness in Africa

In Africa, e-readiness initiatives are being driven by the World Economic Forum and the e-Africa Commission ICT Task Team responsible for developing NEPAD ICT program and implementing its projects. The World Economic Forum-NEPAD E-readiness Policy has the goal of helping African countries to develop e-readiness policies and to reduce the policy obstacles that limit the use of ICTs throughout the region. These can be adopted for e-voting readiness.

According to Bridges.org (2003), some of the activities that have so far been undertaken by the World Economic Forum-NEPAD E-readiness Policy Programme include:

- Establishing collaboration with the e-Africa Commission;
- Identifying key actors and mechanisms to engage them;
- Collecting information on basic c-readiness in African countries;
- Creating a framework for examining the issues, and proposing country; groupings according to e- readiness levels.

According to Bridges.org (2003), key findings about e-readiness in Africa undertaken by the World Economic Forum- NEPAD E-readiness Policy Programme show that there is unanimous agreement among Africa's leaders and pan-African structures on the benefits that ICT could bring and the impact it could have on a wide range of development issues. This underpin the need for need for e-voting readiness.

2.8 Overview of E-Readiness by KENET

KENET an organization providing Internet connection to public and private universities in Kenya recently carried out a study whose objective was to assess the level of preparedness of Higher Education (HE) institutions in Kenya to use Information and Communication Technologies in teaching, learning, research, and management.

The study included 17 universities, eight middle-level colleges (including polytechnics), and five research institutions that are members of the body. The assessment was conducted using a diagnostic tool derived from the Center for International Development at Harvard University. The study concluded that the higher education community, especially the university community in Kenya, was ready to use ICT for learning, teaching, research and management but observed that the institutional leadership did not yet consider ICT as strategic way for their institutions. The study noted that the institutions were allocating low operational budgets to ICT, were not investing

adequately in campus networks and they were not giving attention to the use of ICT to enhance education and research (KENET, 2007).

This was the first e-readiness assessment to be carried, out in Kenya. The study made several recommendations one of which was to carry a similar assessment to cover e-voting readiness in Kenya.

2.9 National ICT Strategy for Education and Training

The Ministry of Information, sector partners and stakeholders have developed the National ICT Strategy (2006) aimed at guiding the education sector in the adoption of ICTs across all levels of education and training. The strategy was developed by taking into consideration the policy environment captured in the National ICT Policy of 2006. The strategy was been developed in line with the E-Government Strategy of 2004 and wider Economic Recovery Strategy Paper for Wealth and Employment Creation (ERSWEC). The strategy identifies the following strategic pillars for education sector ICT implementation:

- Establishment of a policy framework Digital equipment
- Connectivity and network infrastructure
- Technical support
- Harnessing emerging technologies
- Digital content development
- Integration of ICTs in education
- Training (capacity building including professional development)
- Research and development
- Partnerships and resource mobilization
- Legal and regulatory framework, and
- Monitoring and evaluation.
- It is in the light of this strategy that technical training institutions in Kenya have taken steps towards making the institutions e-ready.

2.10 Critical Review

Previous studies obtained revealed broad areas covered by other researchers and scholars in pursuit of deeper insights into the understanding of complex and slipping issues which impacts the technology acceptance both positively and negatively. They have also been able to identify possible strategies to enable the organization roll-out the benefits of ICT but none of these studies showed a clear picture of citizens' readiness for e-voting as an enabler for e-democracy. The changes over the last decade forecast a trend of increased use of ICT for achievement of democratic society.

In their study Hall and Alvarez (2004) did not find all of the expected factors affecting the introduction of e-voting. The results provided only a mixed suggestion that TAM forms the basis of individual's attitudes and behaviours are significantly affected by society and ICT. Nevertheless, it is possible that the specific behaviours examined by the scholars were not relevant to the outcomes when measured at the level of readiness to adopt e-voting. Although a

number of scholars have carried out previous studies on e-voting and e-democracy; one area that perhaps got less attention is citizens' readiness to e-voting.

2.11 Summary

Carter and Belanger (2005) e-government adoption model is encompassing enough to be applied to various applications of e-government including e-voting. The model captures the fundamental factors of adoption that are relevant to examine citizens' readiness for e-voting, a paradigm in e-democracy and social development. Security and Legal Policies are fundamental as means of creating and enhancing trust in the e-voting technology. It is important to evaluate these factors in addition to Complexity, Relative advantage, Compatibility and Trust in government.

There is need for enhanced individual responsibility in the society. In this regard time needs to be budgeted and should only be spent on allocated events depending on one's schedule. The review stresses that for a simpler tomorrow; today must be taken care of through good time management in order to the expectation of the population.

Citizens need to play a role in the adoption and implementation of any technology. This requirement will demystify the complexity notion. This project explores the need for concerted effort in introduction and diffusion of technology.

CHAPTER THREE METHODOLOGY

The aim of this chapter is to give an introduction about the general research methodology used in this study together with specific tools used in data collection and analysis. Further, this chapter discusses the methods to evaluate validity and reliability of the research.

3.1 INTRODUCTION

A method can be defined as a set of techniques that researchers use to carry out an inquiry by systematically gathering information to describe, explore, explain or predict a phenomenon of interest. The methodology involved in this project used both quantitative and qualitative research. Quantitative research focuses on determining facts and the relationships among variables and seeks to describe observations through statistical analysis of data. On the other hand, qualitative research refers to descriptive study that is aimed at collecting and analyzing in-depth narrative data that provide information about subjective meaning of human experiences and phenomena, usually conducted in the natural setting.

The project hoped that by combining two research approaches (quantitative and qualitative) a more comprehensive study would be carried out that would give more accurate results and more valid conclusions at the end of the process. It is empirical examination of factors that influence adoption and usage of e-voting system. For purpose of this study, the universe consists of all persons living in Nairobi County and who use internet services in their daily activities, the exact number is unknown for now.

3.2 Research Design

Research design is the logical sequence that connects the empirical data to a study's initial research questions and ultimately to its conclusions. The research design consists of a plan to answer the research question or test the hypothesis. It includes the plan of how to measure the concepts of interest, determine who will participate and how they will be selected, what setting will be used, what data collection procedure will be employed, and how the data will be analyzed. This project used a two-phased research design, the quantitative and qualitative survey.

3.3 Population and Sampling Procedure

Sampling can be defined as the representation of subsets making up the population from which results can be generalized. How well a sample represents a population depend on the sample frame, the sample size and the specific design of the selection procedure.

3.5 Sampling Procedure: Qualitative Survey of Research

The type of research is qualitative. It is empirical examination of the factors that influence adoption of E-voting system. For purpose of this study, the universe consists of all persons living in Nairobi county and registered voters.

3.5.1 Sampling Determination

When times and resources allow, a research should take as big a sample as possible since this will ensure reliability of results (Mugenda and Mugenda, 2003). Minimum sample size for research is

$n = \{Z\alpha^2\rho(1-\rho)\}/d^2$

$Z\alpha$ = Standard normal deviation at the required level

n = Sample size

ρ = Proportion in the target population estimated to have characteristics being measured

d = Level of statistical significance set

Using confidence level of 95%, z is read from the table which is 1.96 and the proportion of a target population with certain characteristic is 0.50 the desired accuracy at the 0.05 level, then the sample size is

$n = (1.96)^2(0.50)\ (0.50)\}/\ (0.05)^2$

$= 384$

3.6 Data Collection Procedure

Data collection procedure involved the use of a questionnaire for quantitative research and use of interviews for the qualitative research.

3.6.1 Data Collection Procedure: Quantitative Survey of the Research

Data collection procedure during the quantitative survey involved the use of a short self-administered questionnaire to sample population. The questionnaires were delivered to the respondents by the researcher. The delivery of the questionnaire was accompanied by a letter explaining the purpose of the research and requesting that the questionnaire be completed.

3.6.2 Data Collection Procedure: Qualitative Survey of the Research

The qualitative survey involved the use of face-to-face interviews that were conducted in various firms and government agencies that will be directly involved with e-voting implementation (see Appendix). This sought to explore readiness for e-voting. This could not have been achieved by using the structured questionnaire. The respondents were given enough time to prepare so that they could voluntarily give the required information without pressure.

The researcher prepared himself adequately prior to the interview to ensure the success of the process. Each interviewee was briefed on the information concerning the goals of the study and the purpose of conducting the interviews. Each interview was expected to last between 20 and 30 minutes. The choice of face-to-face interviews as the data collection method for the qualitative data was motivated by various factors including the following:

(i) Interviews give a researcher an opportunity to motivate the interviewees to respond freely and openly to questions.

(ii) Interviews allow a researcher to probe for more feedback from the interviewee if necessary.

(iii) Interviews give a researcher an opportunity to observe the interviewee's body language, which is essential for time and details management.

3.6.3 Test Items

In preparing candidate items six research papers dealing in e-government adoption, assessment, usage and readiness were reviewed to identify the various facets of the constructs that should be measured (Ibragimora, 2000; Wangpipatwona et.al., 2005; Kumar et.al., 2007; Colesca and Debrica, 2008; Davis, 1989). The items were worded in reference to E-voting readiness.

The items were grouped into perceived ease of use, perceived convenience, perceived trust, perceived quality, user satisfaction and awareness. Other constructs of interest are demographic factors, political support and legal acceptability.

3.7 Questionnaire Piloting

Pre-test interviews were conducted to assess and enhance the systematic content validity of items by assessing the correspondence between candidate items and definition of the constructs that they intended to measure. This was done by using five voters in Langata Constituency in Nairobi County. The assessment results were used to re-organize the test items into different domain of constructs. Some of the tests were reframed to ensure clarity of the questionnaires and conformance to the objectives.

3.7.1 Validity

Validity is concerned with the accuracy and meaningfulness of inferences based on the research findings (Mugenda and Mugenda, 2003). It indicates the degree to which the instrument measures what it is supposed to measure (Kothari, 2008). It is the extent to which differences found with a measuring instrument reflect true differences among those being tested. The following measures were undertaken to ensure validity in inferring E-voting readiness.

(i) Data was collected from reliable sources. This took into cognizance that respondents have ICT experience.

(ii) Survey Questions were based on extensive literature review and proven models to ensure the validity of results.

(iii) Questionnaires were pre-tested for meanings and semantics against definitions of the constructs by experts.

3.7.2 Reliability

Reliability is a measure of the degree to which a research instrument yields consistent results after repeated trials (Mugenda and Mugenda, 2003). A measuring instrument is reliable if it provides consistent results done different researchers (Kothari, 2008).

There are various approaches to evaluate reliability. Cronbach (1951) developed a measure that is equivalent to splitting data into two in every possible way and computing the correlation coefficient of each split. The average of these values is equivalent to Cronbach's alpha. This is the most common measure of scale of reliability

$$KR_{20} = \{(K)(S^2 - \Sigma s^2)\}/S^2 (K - 1)$$

Where

KR_{20} = Reliability coefficient of internal consistency

K = Number of items used to measure the concept

S^2 = Variance of all scores

s^2 = Variance of individual items

3.9 Framework for E-Voting Readiness Assessment

A special framework was developed for the purpose of this project research. The framework was designed to meet the specific needs of voters in Nairobi County. It owed much of its structure on the existing e-readiness tools developed by other bodies.

3.9.1 Adaptation of E-Voting Readiness Assessment Model

The project used an e-voting readiness assessment framework based on a combination of existing e-readiness models. First, Computer Systems Policy Project (CSPP). This provides for "Readiness Guide for Living in the Networked World". Second, Asia Pacific Economic Cooperation Electronic Commerce Steering Group (APEC) provides for "E-Commerce Readiness Assessment" and thirdly, Centre for International Development (CID) provides "Readiness for the Networked World: A Guide for Developing Countries". These three tools have a total of 37 indicators some of which are not relevant to e-voting readiness. Details of the 37 factors are indicated in table 3.2 below.

No.	Indicator	Source	Factor Description	Is the factor Relevant
1	Network Infrastructure	CID, CSPP, APEC	This appertains to e-voting as a network is a necessity for connectivity and vote information sharing and management. This was adopted.	Yes
2	Internet Availability	CID	The Internet is one of the core technology used in results relay.	Yes
3	Internet Affordability	CID, APEC	It determines how much bandwidth can be acquired to manage concurrent request.	Yes
4	Network Speed and Quality	CID, APEC	The factor determines how fast information may be retrieved and transmitted over internet during the voting process	Yes
5	Network Reliability	APEC	It determines the dependability and credibility of telecommunication Infrastructure in relaying results.	Yes
6	Infrastructure market conditions	APEC	This factor is not relevant to e-voting readiness.	Yes
7	Interconnection and	APEC	It evaluates how the network is and it is important	Yes

	Interoperability		for network access.	
8	Access to necessary service	APEC	It determines accessibility voting services provided.	Yes
9	Current Level and Type of use of the internet	APEC	This factor is relevant to e-voting readiness as it determines perceived ease of use.	Yes
10	Access to ICTs	APEC	It determines the number of voters and voting officials that can access ICTs.	Yes
11	ICT Hardware and Software	CID, APEC	This factor is relevant to e-voting readiness as it forms the core of ICTs.	Yes
12	Enhancing Education with ICTs	CID	This factor is relevant to e-voting readiness since determines ICT adoption in a county and country.	Yes
13	Security of ICT equipment and software	APEC	This factor is relevant to e-voting readiness since it determines security of ICT resources.	Yes
14	ICT Privacy issues	APEC	This factor is relevant to e-voting readiness because it relates to confidentiality, integrity and availability of information.	Yes
15	ICT Services and Support	CID	This factor is relevant to e-voting readiness since it evaluates how continuous operation can be achieved.	Yes
16	People and Organizations online	CID	This factor is relevant to e-voting readiness since it determines the adoption of ICTs in voting.	Yes
17	ICT Strategy	New	This factor is relevant to e-voting readiness since it determines the current and future projections.	Yes
18	ICTs in Government offices	New	This is a new factor introduced to evaluate the level of automation in public institution and it is relevant to e-voting readiness	Yes
19	ICT Copyright issues	CID, APEC	This factor is relevant to e-voting readiness since it determines the legality of software.	Yes
20	Relevant Software	CID	This factor is relevant to e-voting readiness since it evaluates applicability and usability of software.	Yes
21	Locally Relevant Content	CID	This factor is relevant to e-voting readiness since it determines relevance of information and configurability.	Yes
22	Access to ICTs	CID	This factor is relevant to e-voting readiness since it enhances usability and reduces surprises.	Yes
23	Developing ICT	CID	This factor is relevant to e-voting readiness since it	Yes

	workforce		relates to development of skilled workforce	
24	ICTs in everyday life	CID	This factor is relevant to e-voting readiness since it relates to the adoption of ICT.	Yes
25	ICTs in workplace	CID	This factor is relevant to e-voting readiness because it relates to adoption of ICT.	Yes
26	ICT employment opportunities	CID	This factor is NOT relevant to e-voting readiness.	NO
27	Business-to-Consumer Electronic Commerce	CID	This factor is relevant to e-voting readiness since it evaluates how customers relate to and capacity of the bandwidth to support e-voting.	Yes
28	Business-to-Business Electronic Commerce	CID	This factor is relevant to e-voting readiness since it evaluates how businesses are transacted and capacity of the bandwidth to support e-voting.	Yes
29	E-Government	CID	This factor is relevant to e-voting readiness since it forms the basis of e-governance by enabling e-voting	Yes
30	Telecommunication Regulation	CID	This factor is relevant to e-voting readiness since it evaluates the capability of service providers.	Yes
31	ICT Trade Policy	CID	This factor is NOT relevant to e-voting readiness.	NO
32	Promotion and facilitation activities	APEC	This factor is NOT relevant to e-voting readiness.	NO
33	Skills and Human resources	APEC	This factor is relevant to e-voting readiness since it evaluates the personnel readiness to support e-voting	Yes
34	Legal Framework	APEC	This factor is relevant to e-voting readiness since it determines validity of results and mechanisms of resolving disputes.	Yes
35	Electronic Authentication	APEC	This factor is relevant to e-voting readiness since results and information transmitted need to be consistent and correct.	Yes
36	Security and Encryption	APEC	This factor is relevant to e-voting readiness and it was renamed as Security of ICT Equipment and Software	Yes
37	Copyright	APEC	This factor is relevant to e-voting readiness and was renamed as ICT Copyright Issues.	Yes

Table 5: Details of Readiness Factors

The relevance of the factors was based on the UN Survey 2008 on E-Voting Assessment. The 37 ICT Indicators were grouped under the following four categories:

(a) Technology Readiness – Network Infrastructure, Internet availability, Internet affordability, Network Speed and Quality, ICT Hardware and Software, ICT Service and Support.

(b) ICT Competency Readiness – Access to ICTs, Enhancing Education with ICTs, Developing ICT Workforce, ICT in Government Offices.

(c) E- Society – People and Organizations online, locally relevant Content, ICTs in workplaces.

(d) Security and Trust – Security of ICT Equipment and Software, ICT Privacy Issues, ICT Copyright Issues, ICT Strategy.

There are additional factors derived from the Kumar (2008):

(a) Political Support

(b) Legal Binding

Using SPSS, the above pilot data generates a Cronbach's coefficient of 0.75. This implies that items correlate highly among themselves. There is consistency among items in measuring E-voting readiness. It can therefore be inferred that the questionnaire is reliable as an instrument of measurement.

Adaptation of E-Voting Adoption Models

Adoption of e-voting is influenced by various factors as outlined in Technology Acceptance Model and E-government adoption Models. These are outline in Table 3.3 below. Understanding the factors that influence E-voting adoption and acceptance would be of great value for the successful evaluation of E-voting readiness.

Constructs Adaptation

CONSTRUCTS	CRITERIA
Perceived Ease of use (PEU)	Usability (PEU1)
	Navigation (PEU2)
	Accessibility (PEU3)
	Helpfulness (PEU4)
Perceived Convenience (PC)	Availability (PC1)
	Timeliness (PC2)
	Transparency (PC3)
	Accountability (PC4)
Perceived Trust (PT)	Trustworthiness (PT1)
	Privacy (PT2)
	Security (PT3)
	Risk (PT4)

CONSTRUCTS	CRITERIA
User Satisfaction (US)	Overall Satisfaction (US1)
	Content Satisfaction (US2)
	Interface Satisfaction (US3)
	Speed Satisfaction (US4)
	Security Satisfaction (US5)
Demographic Factors (DF)	Gender (DF1)
	Age (DF2)
	Education (DF3)
	Years of Internet Use (DF4)
E-Government Use (EU)	Willingness to use (EU1)
	Intent to use (EU2)
	Frequency (EU3)
Awareness (A)	Knowledge of available E-services (A1)
	Knowledge of what site to visit (A2)
Political Support (PS)	Political Leadership support (PS1)
	Political Parties' participation (PS2)
	Used in Parties' preliminaries (PS3)
	Acceptance of the results (PS4)
Legal Acceptability (LA)	Law Provision (LA1)
	Acceptance of electronic results (LA2)
	Resolution of disputes (LA3)
	Persistency of results (LA4)

Table 6: Adoption Constructs Criteria

Research Model for Adoption Levels of E-voting

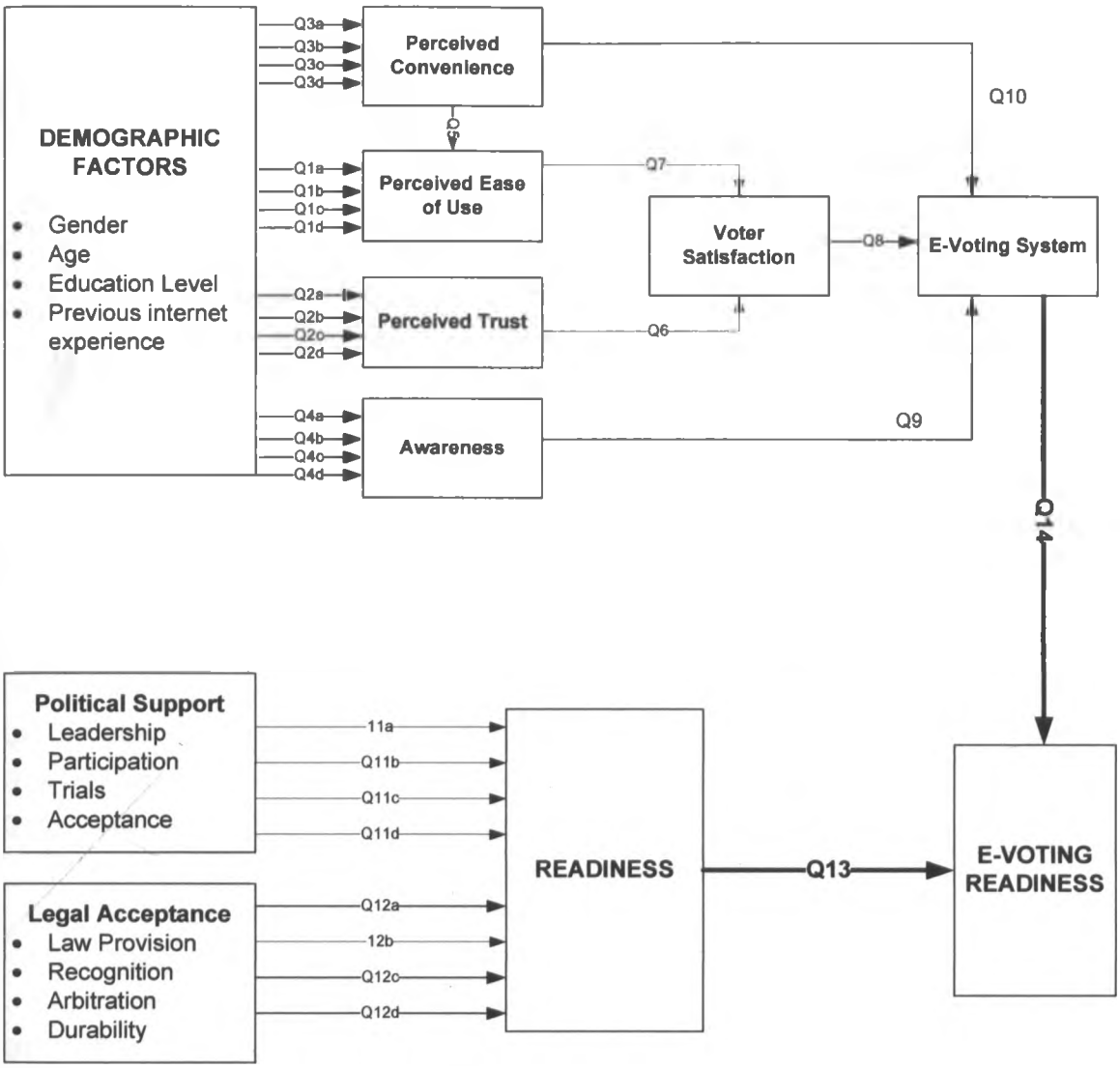

Figure 7: Proposed Research Model

This research answered the following questions which were mapped to the constructs. They were adapted from Colesca & Dobrica (2008) and Bulgerian E-readiness Assessment Model.

Q1: Do demographic factors affect perceived ease of use of E-voting System?

- Q1a: How does gender perception differ on the ease of use E-voting System?
- Q1b: How does age influence the perception on the ease of use of E-voting System?
- Q1c: What is the influence of education level on the ease of use of E-voting System?
- Q1d: How does prior use of internet influence ease of use of (readiness) E-voting?

Q2: Do demographic factors affect perceived trust of E-voting?

- Q2a: How does gender perception differ on trust of E-voting readiness?
- Q2b: How does age affect the perception on trust of E-voting readiness?
- Q2c: What is the influence of education on the perception on trust of E-voting?

Q2d: How does prior use of internet influence perception on the trust for E-voting?

Q3: Do demographic factors affect perceived convenience of E-voting?

Q3a: How does gender perception differ on convenience of E-voting readiness?

Q3b: How does age affect the perception on convenience of E-voting readiness?

Q3c: What is the influence of education on the perception of convenience E-voting?

Q3d: How does prior use of internet influence perception on the convenience for E-voting?

Q4: Do demographic factors affect awareness of E-Voting?

Q4a: How does gender perception differ on awareness of E-voting readiness?

Q4b: How does age affect the perception on awareness of E-voting readiness?

Q4c: What is the influence of education on the perception of awareness E-voting?

Q4d: How does prior use of internet influence perception on the awareness for E-voting?

Q5: How does perceived convenience of use of E-voting System influence perceived ease of use of E-voting System?

Q6: How does perceived trust while using E-Voting system influence the satisfaction in the use of E-voting system?

Q7: How does ease of use while using E-voting influence user satisfaction?

Q8: How does user satisfaction influence E-voting Readiness?

Q9: What is the effect of awareness on the use of E-voting System?

Q10: What is the effect of perceived convenience on the use of E-voting system?

Q11: Does Political Support affect Readiness for e–voting?

Q11a: How does political leadership affect E-voting readiness?

Q11b: How does political parties' participation influence E-voting readiness?

Q11c: How do prior trials influence readiness for E-voting adoption?

Q11d: What is the influence of political will on E-voting readiness?

Q12: Does Legal Acceptability affect Readiness for e–voting?

Q12a: Does constitution influence E-voting readiness?

Q12b: How does recognition of results influence E-voting readiness?

Q12c: How do arbitration of vote dispute influence readiness for E-voting adoption?

Q12d: What is the influence of durability of results on E-voting readiness?

Q13: What needs to be done to increase the level of E-Voting readiness in Nairobi County?

3.10 Factor Analysis

Factor analysis is a statistical approach that is used to analyze the interrelationships among a large number of variables. It aims at explaining variables in terms of their common underlying dimensions. Factor analysis is a data reduction technique that condenses the information contained in a number of original variables into smaller set of dimensions with minimum loss of information. It therefore groups the given set of input variables into minimal number factors with the maximum capability of extracting information with the reduced set of factors

behavioural sciences. It is applicable when there is systematic interdependence among a set of observed variables and

The common methods of Factor Analysis include:

(i) Centroid Method

(ii) The Principal Component Method

(iii) The Maximum likelihood method.

The Centroid Method maximizes the sum of absolute loadings of each factor. In this method, the coefficients of the terms in the linear composite of each factor will be either +1 or -1. It disregards the signs (Panneerselvam, 2006; and Kothari, 2006). This method is less cumbersome since it can easily be understood and involves simpler computations. The Principal Component Method maximizes the sum of squares of loadings of each identified factor. It is a popular technique which determines loadings of variables on different factors by using the standard normal values of the observations of the original (input) variables signs (Panneerselvam, 2006; and Kothari, 2006). The weights in the principal components are chosen such that the following requirements are met:

(i) The variances of principal components (eigenvalues) are in the decreasing order from the principal component – 1 to the principal component – n.

(ii) The values of the factor loadings of the principal components are uncorrelated.

(iii) The sum of the squares of the weights used in principal component is equal to 1.

Maximum Likelihood method consists of obtaining sets of factor loadings successively in such a way that each explains as much as possible of the population correlation matrix as estimated from the sample correlation matrix. This method is complex hence not commonly used.

3.10.1 Formula used for Computing E-Voting Readiness

Once data was collected on each of the indicators across the four different categories, each indicator was given a score based on a scale of 1 to 4 with 1 representing the state of unpreparedness while 4 represents full e-voting readiness status. The score is arrived at by comparing the indicator data against the set of predetermined factors defining the characteristics of each stage of ICT development.

E-voting readiness$_i$ = $\Sigma_{j=1,n}\, e_{ij}$ /n

E-voting readiness – Overal e-voting readiness value

i – Organization; j – Each of the indicators

eij – Individual score for each indicator on a scale of 1 to 4; n – Total number of measures.

CHAPTER FOUR DATA COLLECTION AND ANALYSIS

Data collection took place in January and February 2011. It was collected by targeting voters in Nairobi County in the eight constituencies. Data was also collected from voters in all the eight constituencies.

The process targeted Nairobi County since it has stratified sample population. 320 questionnaires were set out. 203 valid responses were received. This represented a response rate of 63.4%.

4.1 Reliability

Reliability analysis on the questionnaire using the data from the field was performed using Cronbach's alpha. The results of the reliability are presented in the table below. As shown, the reliability analysis gives an alpha coefficient of 0.8937. This exceeds 0.70 which is the lower limit of the acceptable reliability coefficient. This justifies that questionnaire have high reliability.

Reliability Coefficient	N of cases	=	79
	Alpha	=	0.8937
	n	=	34

4.2 Factor Analysis

The 34 test items testing factors that influence e-voting readiness were subjected to principal component analysis (method for Factor Analysis) using SPSS. Evaluation of the correlation matrix showed that most facts have coefficients of 0.3 and above.

Kaiser-Meyer-Olkin (KMO) value 0.8688 which is greater than a significant value of 0.0000. The KMO values indicate that Factor Analysis can be used to validate the test items under respective constructs.

KMO Measure of Sampling Adequacy	Approx. Chi-Square = 0.8688
Bartlett's Test of Sphericity	DF = 145 Significance = .0000

Table 7: KMO and Bertlett's Test on Field Data

The Eigenvalues associated with each factor before extraction, after extraction and after extraction were generated.

Before extraction, SPSS identified 34 components within the data set. Component illustrates that all factors with eigenvalues greater than 1 are considered. Eigenvalues associated with these values are again displayed.

The data collected during the research was divided into two sections. The first section presented the E-voting readiness of voters in each constituency of Nairobi County. The second section contains results of adoption of e-voting system in the County. Each section concludes with a summary of results. All questionnaires were subjected to voters in Nairobi County.

4.2 E-Voting Readiness Results of Various Constituencies

4.2.1 Status of Voters' readiness in Dagoreti Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 65% Voters with cell Phone – 70%	**Stage 1.5** (Have a tele-density of 5 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.9** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.2** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 53%	**Stage 1.6** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 2.1** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.3** (Support is available)

Table 8: Dagoreti Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 54%	**Stage 1.6** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.3** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.8** (Offices automated)

Table 9: Dagoreti Constituency ICT Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 1.7** (Less than 0.05% use internet)
locally relevant Content	Most systems have menu in English or Kiswahili	**Stage 1.2** (Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.0**

Table 10: Dagoreti Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.5** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.2** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.3** (Need Policy and regulation)

Table 11: Dagoreti Constituency Security and Trust Readiness

4.2.2 Status of Voters' readiness in Embakasi Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 50% Voters with cell Phone – 75%	**Stage 1.8** (Have a tele-density of 15 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.3** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.2** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps; Drop-rate – 65%	**Stage 1.5** (Various connection means are used)
ICT Hardware and Software	Have used ICT	**Stage 1.9**

	Informally trained in ICT	(Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.1** (Support is available)

Table 12: Embakasi Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 54%	**Stage 1.6** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.3** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.7** (Offices automated)

Table 13: Embakasi Constituency ICT Competency Readiness

Table 4.2.1 Embakasi Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 1.8** (Less than 1% use internet)
locally relevant Content	Most systems have menu in English or Kiswahili	**Stage 1.2** (Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.0**

Table 14: Embakasi Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.4** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.3** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.5** (Need Policy and regulation)

Table 15: Embakasi Constituency Security and Trust Readiness

4.2.3 Status of Voters' readiness in Kamkunji Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 75% Voters with cell Phone – 80%	**Stage 2.3** (Have a tele-density of 76 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.5** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.2** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 45%	**Stage 1.8** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 2.1** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.4** (Support is available)

Table 16: Kamkunji Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 65%	**Stage 1.8** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.3** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.9** (Offices automated)

Table 17: Kamkunji Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 2.0** (Less than 1% use internet)
locally relevant Content	Most systems have menu in English or	**Stage 1.2**

	Kiswahili	(Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.3**

Table 18: Kamkunji Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.5** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.3** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.4** (Need Policy and regulation)

Table 19: Kamkunji Constituency Security and Trust Readiness

4.2.4 Status of Voters' readiness in Kasarani Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 40% Voters with cell Phone – 58%	**Stage 1.2** (Have a tele-density of 10 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.9** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.3** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 55%	**Stage 1.4** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 1.5** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.3** (Support is available)

Table 20: Kasarani Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 45%	**Stage 1.3** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.6** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.8** (Offices automated)

Table 21: Kasarani Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 1.5** (Less than 1% use internet)
locally relevant Content	Most systems have menu in English or Kishwahili	**Stage 1.1** (Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.0**

Table 22: Kasarani Constituency E-Soceity Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.4** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.1** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1** (Need Policy and regulation)

Table 23: Kasarani Constituency Security and Trust Readiness

4.2.5 Status of Voters' readiness in Langata Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 65% Voters with cell Phone – 75%	**Stage 2.4** (Have a tele-density of 35 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.5** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.6** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 40%	**Stage 1.8** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 1.6** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.1** (Support is available)

Table 24: Langata Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 60%	**Stage 1.4** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.3** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.7** (Offices automated)

Table 25: Langata Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 2** (15% use internet)
locally relevant Content	Most systems have menu in English or	**Stage 1.2**

	Kishwahili	(Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.0**

Table 26: Langata Constituency Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.3** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.2** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.3** (Need Policy and regulation)

Table 27: Langata Constituency Security and Trust Readiness

4.2.6 Status of Voters' readiness in Makadara Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 60% Voters with cell Phone – 70%	**Stage 2.2** (Have a tele-density of 35 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.5** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.6** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 40%	**Stage 1.9** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 1.5** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.3** (Support is available)

Table 28: Makadara Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 60%	**Stage 1.2** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.7** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.7** (Offices automated)

Table 29: Makadara Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 2.4** (15% use internet)
locally relevant Content	Most systems have menu in English or Kishwahili	**Stage 1.6** (Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.3**

Table 30: Makadara Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.4** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1.2** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.4** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.5** (Need Policy and regulation)

Table 31: Makadara Constituency Security and Trust Readiness

4.2.7 Status of Voters' readiness in Starehe Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 60% Voters with cell Phone – 80%	**Stage 1.8** (Have a tele-density of 35 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.4** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.3** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 40%	**Stage 1.6** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 1.9** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.3** (Support is available)

Table 32: Starehe Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1.2** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 60%	**Stage 1.7** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 1.3** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 1.7** (Offices automated)

Table 33: Starehe Constituency ICT Competency Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 1.8** (Less than 1% use internet)
locally relevant Content	Most systems have menu in English or	**Stage 1.2**

	Kishwahili	(Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.2**

Table 34: Starehe Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.4** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1.1** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.3** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.5** (Need Policy and regulation)

Table 35: Starehe Constituency Security and Trust Readiness

4.2.8 Status of Voters' readiness in Wetlands Constituency

(a) Technology Readiness

Indicator	Status	E-voter Readiness Stage
Network Infrastructure	Structured cabling done – 70% Voters with cell Phone – 85%	**Stage 2.5** (Have a tele-density of 35 fixed lines per 100 people
Internet availability	Access to internet thro wireless Internet Availability	**Stage 1.5** (Internet can be accessed anytime)
Internet affordability	Connection charge: Kshs. 150 Voters can afford	**Stage 1.6** (telephone rates are affordable)
Network Speed and Quality	Max. Internet Speed – 2 – 8Mbps Current speed – 512Kbps Drop-rate – 35%	**Stage 2.3** (Various connection means can be used)
ICT Hardware and Software	Have used ICT Informally trained in ICT	**Stage 1.9** (Uses are familiar with ICT)
ICT Service and Support	Familiar with computer applications Can trouble-shoot common problems Usability of system of the systems	**Stage 1.7** (Support is available)

Table 36: Westlands Constituency Technology Readiness

(b) ICT Competency Readiness

Indicator	Status	E-voter Readiness Stage
Access to ICTs	Most can access ICT personal use	**Stage 1** (use of limited)
Enhancing Education with ICTs	Percentage of voters with ICT skill – 65%	**Stage 1.6** (Government is encouraging use of ICT)
Developing ICT Workforce	Most have informal ICT	**Stage 2.0** (Not formally trained)
ICT in Government Offices	Most offices are computerized	**Stage 2** (Offices automated)

Table 37: Westlands Constituency ICT Readiness

(c) E- Society

Indicator	Status	E-voter Readiness Stage
People and Organizations online	Voters use E-mail and search	**Stage 2.4** (15% use internet)
locally relevant Content	Most systems have menu in English or Kishwahili	**Stage 1.8** (Content is not customized)
ICTs in workplaces	Connection charge: Kshs. 150 Voters can afford	**Stage 1.4**

Table 38; Westlands Constituency E-Society Readiness

(d) Security and Trust

Indicator	Status	E-voter Readiness Stage
Security of ICT Equipment and Software	Voters are aware of security and effects of alternation of results. No sufficient knowledge on Firewall or backup	**Stage 1.5** (Need more awareness and information)
ICT Privacy Issues	Limited knowledge on Policies	**Stage 1.5** (No privacy laws)
ICT Copyright Issues	No policy on copyright	**Stage 1.4** (No privacy law and awareness)
ICT Strategy	Are aware of ICT regulation and its importance	**Stage 1.2** (Need Policy and regulation)

Table 39: Westlands Constituency Security and Trust Readiness

4.3 Survey Results

The survey included 14 questions and 1 field for general suggestions if a respondent had any. We had a target of 320 respondents in eight constituencies in Nairobi. We received 223 completed questionnaires. 20 respondents did not answer question about gender, education level or their constituency. These questionnaires were excluded during the process of vindication.

	18 – 24	25 – 34	35 – 50	Above 50	Total
Male	34	24	20	10	**88**
Female	39	34	26	16	**115**
Total	73	58	46	26	**203**

Table 40: Gender and Age group

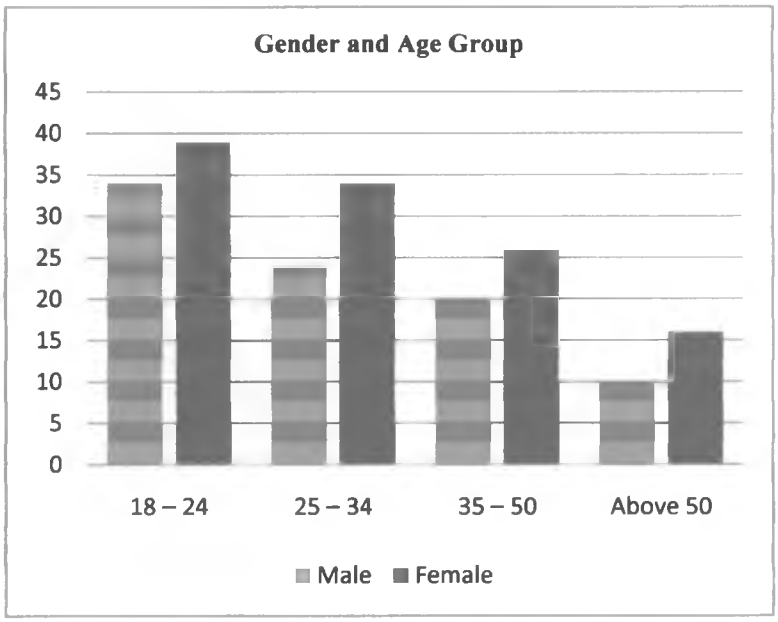

Figure 8: Comparison of Gender and Age Group

According to table 40 above, there were 88 male and 115 female who participated in the survey. Graphically the above can be represented as follows:

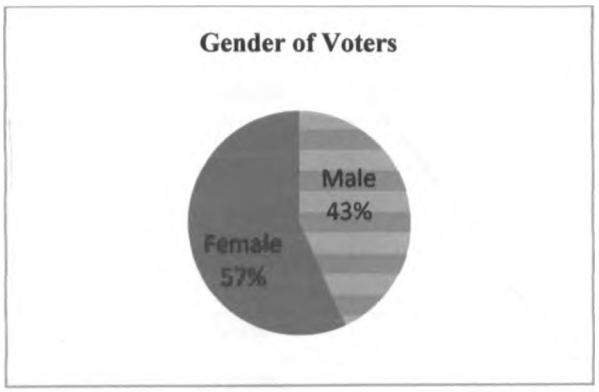

Figure 9: Gender Distribution

Table 42 shows that people who participated in our survey had mixed education level. Most of the respondents turned to be either having secondary or basic education.

Constituency	Male	Female
Dagoreti	6	10
Embakasi	10	12
Kamkunji	13	17
Kasarani	7	9
Langata	16	23
Makadara	10	13
Starehe	12	14
Westlands	14	17
Total	**88**	**115**

Table 41: Gender distribution in different constituencies in Nairobi County

Age of Respondents		Basic	Secondary	College	University
18 - 24	Male	2	10	12	10
	Female	8	7	10	14
25 - 34	Male	4	10	8	2
	Female	10	10	10	4
35 - 50	Male	7	9	3	1
	Female	9	12	4	1
Above 50	Male	4	5	1	0
	Female	8	4	3	1
Total		**52**	**67**	**51**	**33**

Table 42: Gender participation from various constituencies of Nairobi County

Age of Respondents		1 year and below	1 - 2 years	3 - 6 years	Above 7 years
18 - 24	Male	5	19	10	0
	Female	15	17	6	1
25 - 34	Male	4	12	5	3
	Female	15	13	5	1
35 - 50	Male	7	10	2	1
	Female	10	12	4	0
Above 50	Male	6	3	1	0
	Female	5	9	2	0
Total		67	95	35	6

Table 43: Computer Experience of the respondents

From Table 43, it is evident that most of the voters in Nairobi County are computer literate. The largest ratio has 1 – 2 years experience of computer use.

Age of Respondents		Yes	No
18 - 24	Male	30	4
	Female	33	6
25 - 34	Male	23	1
	Female	27	7
35 - 50	Male	19	1
	Female	24	2
Above 50	Male	10	0
	Female	13	3
Total		179	24

Table 44: Ownership of Mobile Phone

Age of Respondents		1 year & below	1 - 3 years	4 - 6 years	Above 7 years
18 - 24	Male	8	15	7	0
	Female	12	17	4	0
25 - 34	Male	3	5	9	6
	Female	8	10	7	2
35 - 50	Male	0	6	10	3
	Female	1	6	11	6
Above 50	Male	0	0	6	4
	Female	1	2	8	2
Total		33	61	62	23

Table 45: Years of Mobile Phones Usage

Age of Respondents		a	b	c	d
18 - 24	Male	6	19	8	1
	Female	7	20	10	2
25 - 35	Male	4	9	9	2
	Female	4	15	12	3
35 - 50	Male	2	12	4	2
	Female	3	14	7	2
Above 50	Male	3	6	1	0
	Female	4	5	5	2
Total		33	100	56	14

Table 46: Preferred Voting Method

Where:

a = Manual Ballot System

b = Mobile Phone Voting

c = Internet Voting

d= Internet Polling Boots

According to Table 46, most voters prefer electronic voting through mobile phones or through internet.

Age Group / Gender		Yes	No	Total
18 - 24	Male	30	4	34
	Female	32	7	39
25 - 35	Male	21	3	24
	Female	30	4	34
35 - 50	Male	15	5	20
	Female	20	6	26
Above 50	Male	8	2	10
	Female	9	7	16
Total		165	38	203

Table 47: Need for E-voting in Nairobi County

Most of the voters in Nairobi County consider e-voting system necessary for Nairobi County as indicated in Table 47 and Figure 11.

Need for E-voting

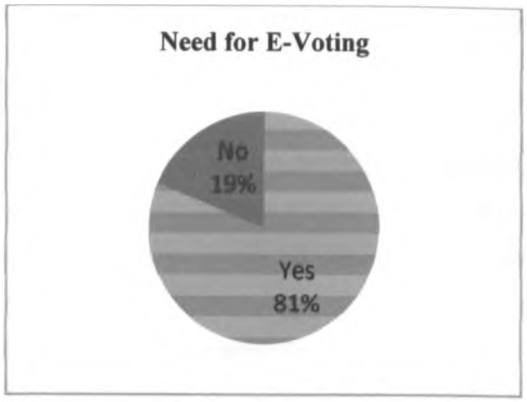

Figure 10: Need for E-voting

4.4 Inferential Analysis

Construct Correlation

4.4.1 Awareness

The mean value of the test items of the constructs of awareness indicates that government had carried out sensitization about e-voting. There was a significant correlation of 0.3997 between two test items under the construct of awareness.

		Mean	Std. Deviation	Cases
1.	A1	5.6597	1.6652	79
2.	A2	5.7725	1.7397	79

Correlation Matrix

	A1	A2
A1	1.0000	
A2	0.3997	1.0000

n = 79

4.4.2 Perceived Convenience

Correlation for Perceived Convenience

		Mean	Std. Deviation	Cases
1.	PC1	5.4799	1.8049	79
2.	PC2	5.9484	1.6768	79

Correlation Matrix

	PC1	PC2

PC1	1.0000	
PC2	0.5798	1.0000

n = 79

These values indicate that the respondents agree with the fact that E-voting offers convenience compared to manual voting. Further it reduces amount of time it takes to access the results or confirmation of the results. The correlation between the items perceived convenience is significant at 0.5798.

4.4.3 E-Government Participation

The mean values of E-government adoption levels indicate that most of the users have used e-government and internet services. The correlation between items of E-government participation is significant at 0.5134.

Correlation for E-government participation

		Mean	Std. Deviation	Cases
1.	EP1	3.4933	2.1597	79
2.	EP2	3.3098	2.2582	79

Correlation Matrix

	EP1	EP2
EP1	1.0000	
EP2	0.5134	1.0000

n = 79

4.4.4 Perceived Ease of Use

Correlation for Perceived Convenience

		Mean	Std. Deviation	Cases
1.	PEU1	5.0344	1.9055	79
2.	PEU2	4.8317	1.9726	79
3.	PEU3	3.9618	1.9095	79

Correlation Matrix

	PEU1	PEU2	PEU3
PEU1	1.0000		
PEU2	0.7013	1.0000	
PEU3	0.4805	0.5323	1.0000

n = 79

This shows that the cases are significant and suggests that they can be used in evaluating E-Voting readiness in Kenya.

4.4.4 Overall Model Summary

When regression analysis is run, two values of importance are the Beta Coefficient (β) and Sig. Value (S). When a variance exhibits a high Beta Value, then it implies that there is a strong unique contribution to explain the dependent variable, when variance explained by all other variables is explained for. The Sig. Value explains whether the variable is making statistical significant unique contribution to the equation. If the Sig. Value is less than 0.05 then the variable is making a significant unique contribution to prediction of the dependent variable. If the value is greater than 0.05, then the variable is not making significant contribution to the prediction of dependent variable. Regression analysis allows for sophisticated exploration of interrelation amongst set of variables making it ideal for investigation of complex real life research questions (Panneerselvam, 2006). It suggests how well a set of variables are able to predict a particular outcome. Subsequently it was used to answer the questions mapped to the constructs discussed from Colesca and Debrica (2008) and Bulgerian E-readiness Assessment Model.

Using SPSS generated values and based on the above discussion, the proposed research model is presented below

Question	Construct	Beta Coefficient	Sig.	Answer
Q1	DF-PEU	.065	.045	There is positive Influence
Q2	DF-PT	.088	.032	There is a positive influence
Q3	DF-PC	.090	.033	There is a positive and significant influence
Q4	DF-A	.095	.040	There is positive and significant influence
Q5	PC-PEU	.356	.002	There is a positive influence
Q6	PT-VS	.158	.025	There is a positive influence
Q7	PEU-VS	.752	.020	There is influence
Q8	VS-ES	.975	.003	There is influence
Q9	A-ES	-.535	.012	There is influence
Q10	PC-ES	.045	.023	There is a positive influence
Q11	PS-R	.568	.050	There a is a positive influence
Q12	LA-R	.820	.031	There is a positive and significant influence
Q13	R-ER	.215	.025	There is influence
Q14	ES-ER	.120	.013	There is influence

Table 48: Beta and Significant Values for relationship among constructs

Based on the above beta coefficient and Significant values, the research model was generated.

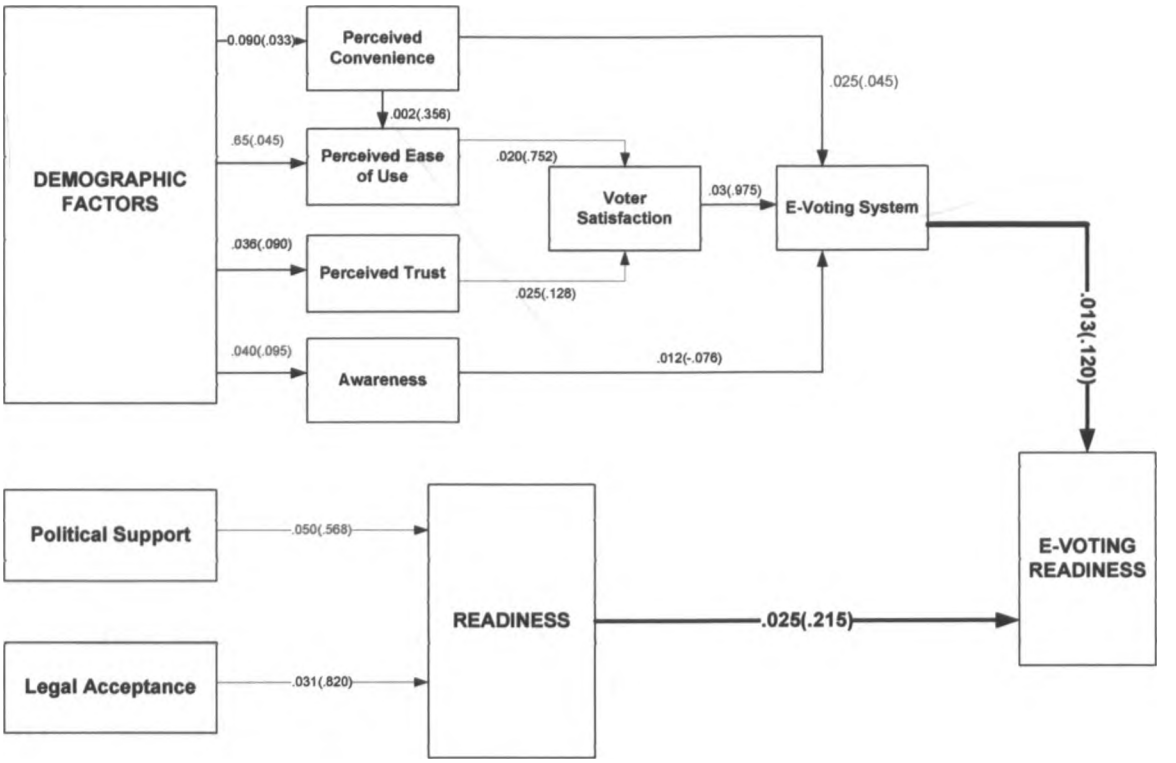

Figure 11: Research Model

Answers to Research Questions

Q1: Effects of Demographic factors on perceived ease of use of E-voting System

Demographic factors do significantly affect perceived ease of use for E-voting system. Beta value (β) = .0065 and Sig. is less than .005.

Q2: Effects of demographic factors on perceived trust of E-voting

Demographic factors have a significant and positive effect on perceived trust of E-voting system. Beta value (β) = .088 and Sig. is less than .005.

Q3: Effect of demographic factors on perceived convenience of E-voting.

Demographic factors have a positive influence on perceived convenience of E-voting. Beta value (β) = .090 and Sig. is less than .005.

Q4: Effects of demographic factors on awareness of E-Voting.

Demographic factors have a significant influence on awareness of E-voting. Beta value (β) = .052 and Sig. is less than .005.

Q5: Effects of perceived convenience of use of on perceived ease of use of E-voting System

There is a positive and significant effect of perceived convenience on perceived ease of use of E-voting systems. Beta value (β) = .356 and Sig. is less than .005.

Q6: Effect of perceived trust on the satisfaction in the use of E-voting system.

There is a significant effect of perceived trust on the voter satisfaction. Beta value (β) = .158 and Sig. is .005.

Q7: Effect of perceived ease of use of E-voting system on voter satisfaction.

There is a positive and significant effect of perceived ease of use of e-voting system on Voter Satisfaction. Beta value (β) = .752 and Sig. is less than .005.

Q8: Effect of voter satisfaction on E-voting Readiness.

There is a positive and significant effect of Voter Satisfaction on E-voting readiness. Beta value (β) = .975 and Sig. is less than .005.

Q9: Effect of awareness on the use of E-voting System adoption.

There is a positive and significant effect awareness of e-voting system adoption. Beta value (β) = -.535 and Sig. is less than .005.

Q10: Effect of perceived convenience on the use of E-voting system

There is no significant influence of perceived convenience on the adoption of E-voting system. Beta value (β) = .045 and Sig. is less than .005.

Q11: Extent of Political support for of E-voting.

Political factors have no significant effect on readiness of E-voting system. Beta value (β) = .568 and Sig. is less than .005.

Q12: Extent of Legal acceptability for E-voting.

Legal factors have a significant and positive effect on readiness of E-voting system. Beta value (β) = .820 and Sig. is .005.

Q13. Extent of Social Readiness for E-voting

Social factors have a significant and positive effect on readiness for E-voting. Beta value (β) = .215 and Sig. is less than .005.

Q14. Extent of Technological readiness for E-voting

Technological factors have a significant and positive effect on readiness for E-voting. Beta value (β) = .215 and Sig. is less than .005.

CHAPTER FIVE - DATA ANALYSIS

5.1 Determination of Correlation

The table **5.1** below shows the overall e-voting readiness and diffusion results for voters in Nairobi County.

S/No	Constituency	E-Voting readiness Stage (x)	Adoption of E-voting (y)
1	**Dagoreti**	1.5	53
2	**Embakasi**	1.4	58
3	**Kamkunji**	1.3	65
4	**Kasarani**	1.21	56
5	**Langata**	1.6	62
6	**Makadara**	1.8	64
7	**Starehe**	1.4	46
8	**Westlands**	1.7	65

Table 49: Summary of E-Voting Readiness and Adoption Level

The results were analyzed through the use of statistical techniques and statistical packages in order to establish the correlation between the two variables. E-voting readiness status was plotted against Adoption of E-voting for the various factors.

Through the use of the software, a best fit line is drawn through the scatter chart which represents the regression line.

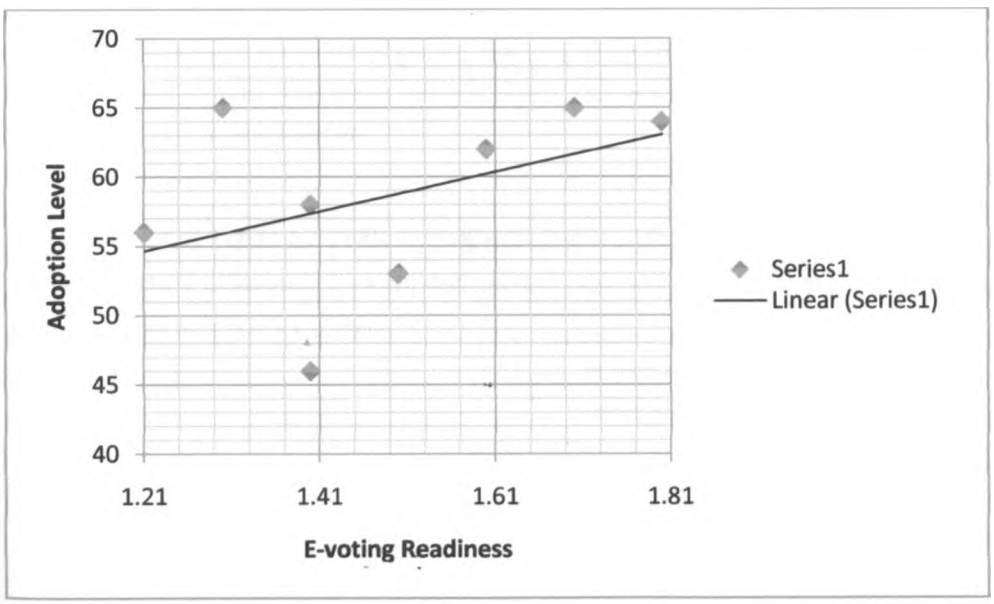

Figure 12: E-Voting Readiness versus Adoption Level

5.2 Determination of the Regression Model

Formula for Determining Regression Model – Least Squares Method

Consider a scatter diagram of a set of bivaiate data. Of all the regression lines that could be drawn to represent data, the least squares regression line of y on x that line for which the sum of the squares of the vertical deviations of all the points from the line is least.

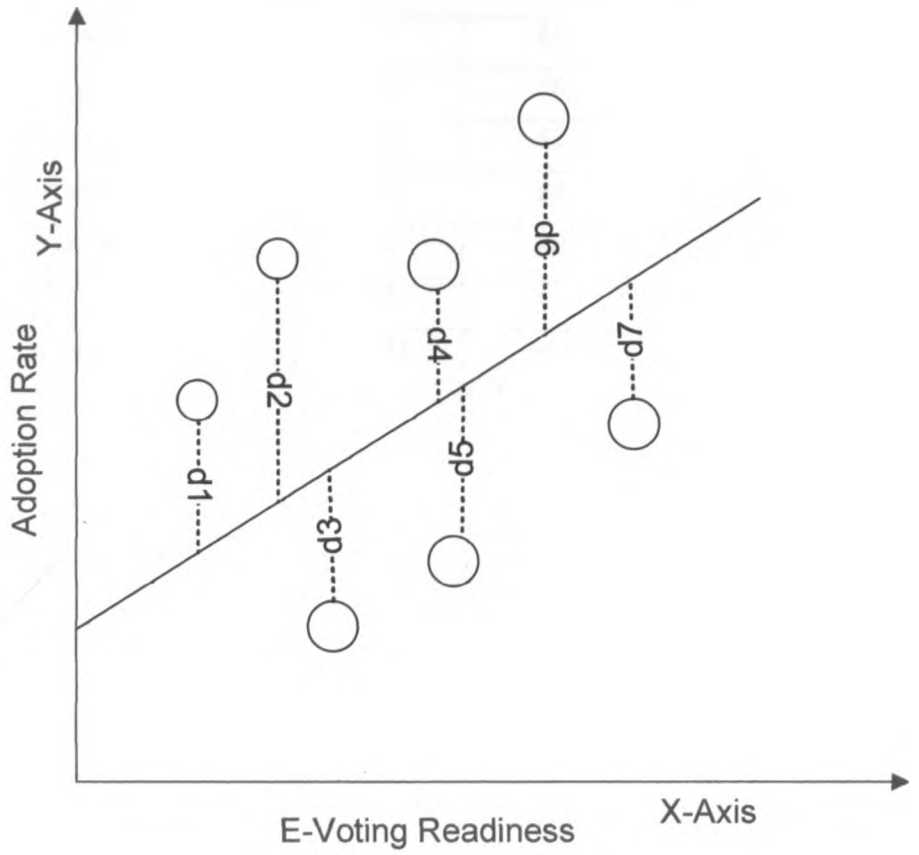

Figure 13: Scatter Diagram

The line shown in Figure 5.2 is the least squares line of y on x. d_1, d_2... d_n are the numerical differences between each plotted value and the regression line. If the least squares regression lin of y on x is given by $\mathbf{y = a + bx}$, then:

$$b = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

$$a = \frac{\Sigma y}{n} - \frac{b\Sigma x}{n}$$

From the graphical results it is possible to generate the equation of a straight line through the points that can be used to describe the relationship between two variables. Assuming the regression model is of the form $\mathbf{y = a + bx}$ where y

represents E-voting adoption level and **x** represents E-voting readiness status, **a** and **b** can be determined through statistical techniques.

S/No	Constituency	X	y	xy	x2	y2
1	**Dagoreti**	1.5	53	79.5	2.25	2809
2	**Embakasi**	1.4	58	81.2	1.96	3364
3	**Kamkunji**	1.3	65	84.5	1.69	4225
4	**Kasarani**	1.21	56	67.76	1.4641	3136
5	**Langata**	1.6	62	99.2	2.56	3844
6	**Makadara**	1.8	64	115.2	3.24	4096
7	**Starehe**	1.4	46	64.4	1.96	2116
8	**Westlands**	1.7	65	110.5	2.89	4225
	Total	**11.91**	**469**	**702.26**	**18.0141**	**27815**

Table 50: Regression Analysis of E-Readiness and Adoption Rates

From the table above,

$\Sigma x = 11.91$

$\Sigma y = 469$

$(\Sigma x)^2 = 141.8481$

$\Sigma xy = 702.26$

$\Sigma x^2 = 18.0141$

$\Sigma y^2 = 27815$

Therefore

$$b = \frac{n\Sigma xy - \Sigma x \Sigma y}{n\Sigma x^2 - (\Sigma x)^2}$$

$$b = \frac{8 * 702.26 - 11.91 * 469}{8 * 18.0141 - 141.8481}$$

b = 14.25795911

$$a = \frac{\Sigma y}{n} - \frac{b\Sigma x}{n}$$

a = 37.39846337

Therefore the Linear regression model for the two variables is given by:

y = a + bx

y= 37.39846 + 14.25796x

This implies that given an e-voting readiness status of voters, the adoption rate can be determined from the above equation. These results show there is a correlation between adoption rate and e-voting readiness. This justifies the government investment in education and ICT obtain democratic and acceptable results.

5.3 Determination of Correlation Coefficient

A measure of strength of the correlation between two variables is fundamental and absolute for the study. This can be derived using a correlation coefficient normally represented by **r**. This is a numerical that ranges from -1 to +1. Hence -1<=r<=+1.

A value of r = 0 signifies that there is no correlation between the variables. The bigger the coefficient (absolute value) indicates the stronger the association between the two variables. If the correlation coefficient is positive (+), it means that there is a positive relationship between the two variables. According to our study, positive coefficient means that as E-voting Readiness increases, adoption and acceptability of e-voting system increases.

From statistics, the formula for r is given by:

Correlation Coefficient, r =

$$\frac{n\Sigma xy - n\Sigma x\Sigma y}{\sqrt{n\Sigma y^2 - (\Sigma y^2)}\sqrt{n\Sigma x^2 - (\Sigma x)^2}}$$

$$\frac{n\Sigma xy - n\Sigma x\Sigma y}{\sqrt{n\Sigma y^2 - (\Sigma y^2)}}$$

r = 0.8672

The value of r = 0.8672 is closer to +1 implying that there is a strong correlation between the two variables. Also the fact that the value of r is positive implies that there is a positive correlation. This means that an increase in the value of one variable tends to be associated with an increase in the value of the other variable. This implies an increase in e-voting readiness will cause a proportionate increase in e-voting adoption. This inference makes the null hypothesis $\mathbf{H_0}$ to be rejected and the alternative hypothesis $\mathbf{H_1}$ to be approved.

5.4 The Coefficient of Determination

The coefficient of determination, r^2 is used in the context of statistical models whose main purpose is to predict future outcome based on related variables' information. It is the proportion of variability in a data set that is accounted for by the statistical model. It provides a measure of how well future outcomes are likely to confirm to the model and to be used to predict with high degree of certainty the outcome.

Coefficient of determination, r^2 is derived from:

$$r2 = \frac{Explained\ variation\ in\ all\ \ items}{Total\ variation\ in\ all\ items}$$

Statistically, correlation coefficient r^2 ranges from -1 to +1, hence the value of r^2 is positive and lies in the range of $0 < r^2 < 1$.

Therefore Coefficient of determination, r^2 = 0.8672 x 0.8672

= **0.7520**

This implies that 75.2% of the variation in the adoption rate is due to e-voting readiness in Nairobi County. The percentage of the variation in adoption of e-voting due other factors (other than e-voting readiness) is 24.8%.

5.4.1 Minimum Adoption Rate at Stage 1 of E-Voter Readiness Status

In terms of e-voting readiness status, stage 1 represents the minimum state of unpreparedness in a county. The expected percentage adoption rate at this stage is computed as follows:

y = a + bx

The values of a and b are 37.39846 and 14.25796 respectively and x = 1;

y = 37.39846 + 14.25796 *1

= 51.65642%

This implies that without ICT facilities and networking infrastructure at all to facilitate e-voting, the expected adoption rate will be 51.65642%.

5.4.2 Maximum Adoption Rate at Stage 4 of E-Voting Readiness Status

In terms of e-voting readiness status, stage 4 represents the maximum stage of preparedness of voters is in a county. The expected percentage adoption rate at this stage will be computed as follows:

y = a + bx

The values of **a** and **b** are 37.39846 and 14.25796 respectively and x = 4;

y = 37.39846 + 14.25796 *4

= **94.43%**

This implies that with adequate ICT facilities and networking infrastructure to facilitate e-voting, the expected adoption rate will be **94.43%.** This is lower than expected value of 100% by 5.57%. This implies that there are some extenuating factors that need to analyze further for the diffusion and adoption of e-voting systems.

5.4.3 Percentage Error in Adoption Rate E-Voting Systems

Based on the maximum e-voting readiness of stage 4, the percentage error in academic performance estimation may be computed as follows:

$$\%\ error = \frac{Estimated\ Percentage - Actual\ Percentage}{Actual\ Percentage}$$

$$= \frac{94.43 - 100}{100} x\ 100$$

$$= -5.57\%$$

CHAPTER SIX – CONCEPTUAL FRAMEWORK

6.1 The Proposed Conceptual Framework for E-voting Readiness

Using the finding from the research, the researcher proposes a conceptual framework for the adoption for e-voting. The framework had 10 elements. 9 of these elements were directly affecting voter. Security and Legal are directly relating to E-Voting System. The Framework is presented below.

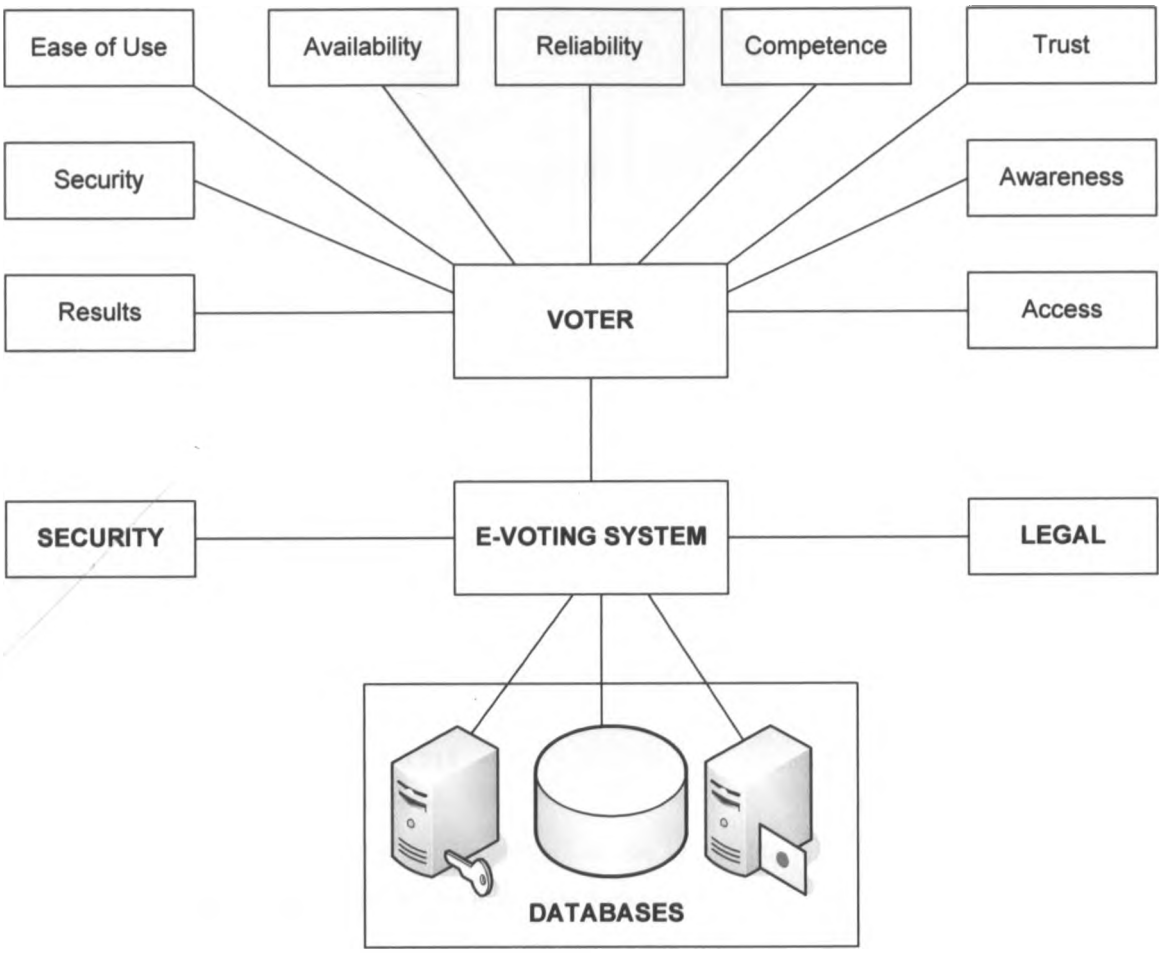

Figure 14: Proposed Conceptual Framework for E-Voting Readiness

6.2 Framework Validation

The proposed framework was tested to assess how well it served the requirements for e-voting. This was done by developing questionnaire based on the framework elements. The questionnaire contained a perception items that can be use to predict e-voting readiness. It also contained open-ended questions to solicit other suggestions.

A total of 320 questionnaires were distributed to voters in Nairobi County. There were 204 valid responses giving a response rate of 63.4%.

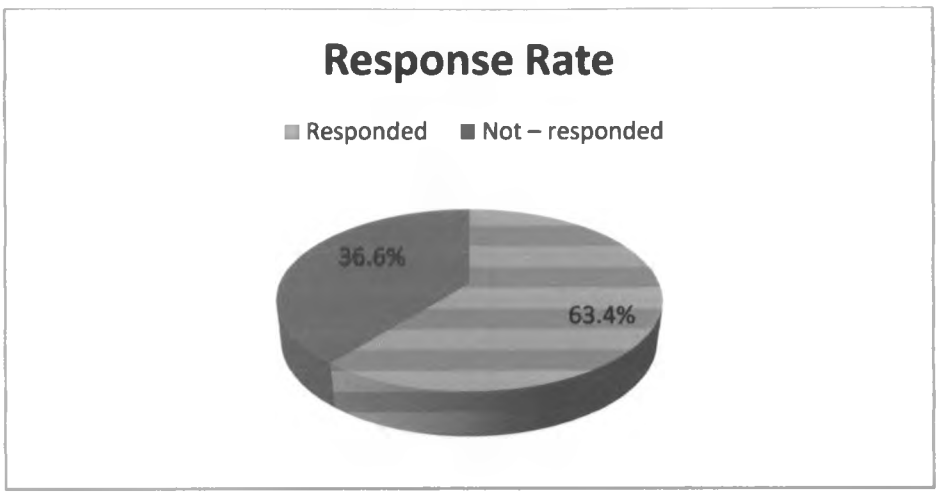

Figure 15: Response Rate

Figure 15 above shows analysis of the response rate at 63.4% of the respondents responded while the remaining 36.6% of the respondents failed to respond to the questionnaire of the research study. This represented an above average response and a clear indication that much data was gathered thereby providing the much needed information.

6.3 Reliability Test

Cronbach Alpha Test

Using SPSS, Cronbach coefficient was generated to ensure that results correlate.

N of Cases	=	79
Alpha	=	0.715
N of items	=	9

This value exceeds 0.70 which is the lower limit of the acceptable reliability coefficient. This shows that the questionnaires used collected reliable data to be used in experiment.

6.4 Framework Validation Using Regression Analysis

Regression is the dependence of a variable on one or more variables. Regression Analysis performed using SPSS generated the following summarized results.

Model	R	R squared	Adjusted R squared	Standard Error of Estimates
1	0.884(a)	.781	.753	.3768

Table 51: Regression Analysis of Adoption Factors

This value of R2 is higher than 0.5

Summary of Adoption factors

Model	Un-standardized coefficients		Beta	*t*	Sig.
	ρ	Std. error	β		
(Constant)	8.158	.518		15.748	.000
Awareness	.450	.060	.077	7.534	.000
Access	.035	.056	-.045	.629	.531
Availability	.690	.041	.112	1.393	.094
Ease of Use	-.178	.040	-.286	-4.461	.000
Reliability	-.235	.490	-.317	-4.834	.000
Trust	.062	.139	.057	.444	.000
Results	.204	.052	.334	-3.882	.000
Competence	.302	.072	.413	-4.210	.000
Security	.517	.067	.649	-7.697	.000

Table 52: Summary of E-voting Adoption factors

Based on the above Beta (b) and Sig. values, the validated Framework is shown figure 6.1 below

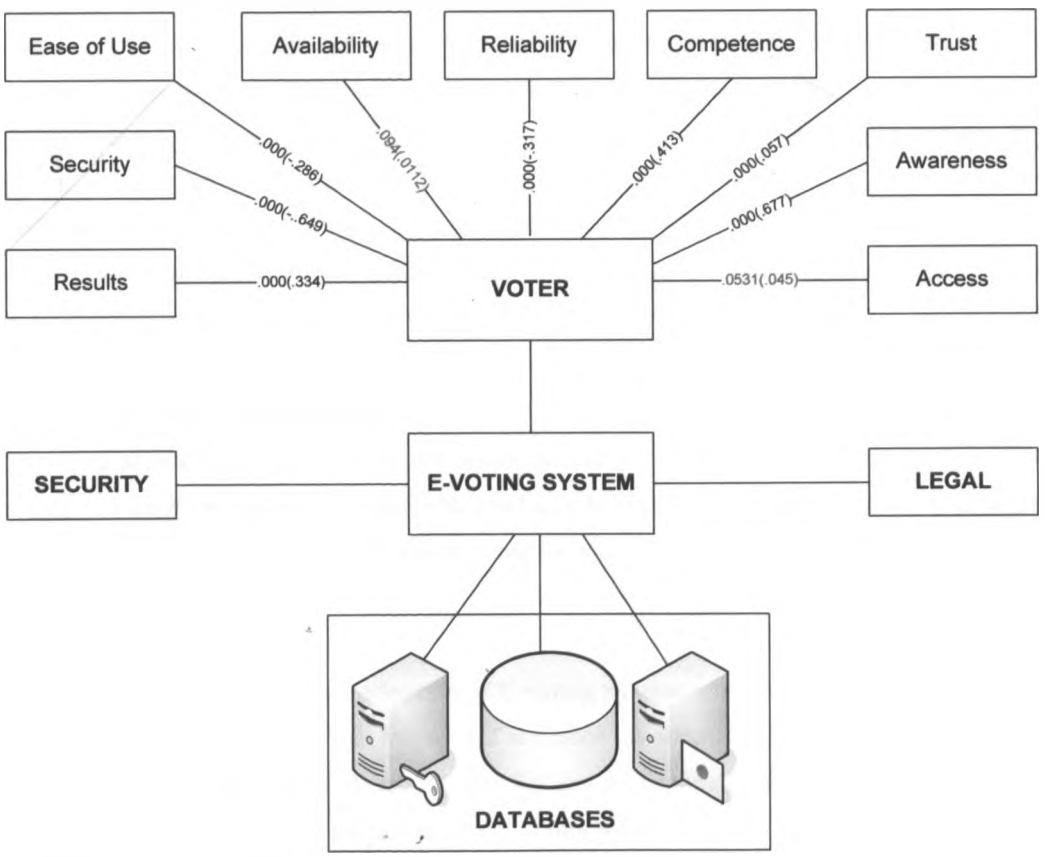

Figure 16: Validated Conceptual Framework for E-voting Readiness

CHAPTER SEVEN - RECOMMENDATIONS AND CONCLUSION

Based on the findings of the research, this final chapter will present the findings based on the research objectives and next the implication for practice and theory. The chapter concludes by presenting the limitations of the study.

7.1 Discussion of Results

This project addresses a framework for adoption factors of e-voting. The framework synthesizes, refines, and extends current approaches to understand adoption factors. The study started with a background research to identify factors determining the adoption of innovation and e-voting. Then, study is continued with a survey carried out in eight constituencies in Nairobi County which had questions about voter readiness for e-voting. The study was conducted by surveying 203 voters from eight constituencies in Nairobi County. The project aimed at exploring the correlation between e-voter readiness and the diffusion rate in Nairobi County. E-voting Readiness is achieved by determining the stage of readiness and comparing to the UN 2008 indices for developing countries. The findings indicate that there is a positive correlation between e-voting readiness and its adoption. The e-voting readiness results generate various indices for constituencies in Nairobi County on a scale of 1 to 4 with 1 representing a state of unpreparedness while 4 representing full readiness status.

The adoption level was obtained using 1- 7-Linkert Scale questionnaires where 1 represents strongly disagree and 7 represents strongly agree. The results were analyzed using statistical tool SPSS and converted to percentage.

By plotting the e-voting readiness status against the adoption level and obtaining a straight line through the various points, a direct link between the e-voting readiness and adoption level of for each constituency in Nairobi County was established.

The regression model established can be used to determine the e-voting adoption levels of any constituency given e-voting readiness status.

7.1.1 Strength of the Correlation

Statistical analysis gave a coefficient of determination of 0.752. This value indicates a measure of the strength of correlation between the two variables with a value of 0 indicating no correlation while a value of 1 indicates perfect correlation. The difference of 0.248 may account for a variety of factors such voter apathy and political biasness.

7.2 Research Objectives

7.2.1 Factors that influence adoption of E-voting System

The first objective was to find out factors that influence the adoption of e-voting in Nairobi County. After validation it was found out that Security, Trust, Access, Reliability, Competence, Results, Ease of Use and awareness have a positive and significant effect on adoption of E-voting Systems.

Further, availability and access indicated significant influence on the intention to adopt electronic voting. They have been shown to have significant contribution to influence the E-voting adoption due to various reasons. First the

sample for the study focused mainly in Nairobi County where voters have unlimited access to internet services. The choice of the sample may have removed any a bias in the results.

7.2.2 E-voting Readiness

The level of E-voting readiness was assessed by 203 responses received. 30% of the respondents did were skeptical of electronic voting due reliability and lack of trust. 43% of the respondents suggested that E-voting would introduce corruption, thereby not improving democracy.

The findings were not encouraging and closely agree with UN Survey on E-Voting readiness of 2008 where by developing countries had an index of 0.03 on a scale of 0 to 1.

7.2.3 Factors that influence E-voting Readiness

E-voting readiness was investigated by both qualitative and quantitative research. The study identified the Legal and Security dimensions as primary determinants for e-voting readiness. In addition, Communication and Telecommunication Infrastructure play a significant role to ensure e-voting is to be implemented successfully.

7.2.4 Framework for E-voting

A framework for E-voting was proposed. The key factors that were found to have significant influence on the adoption of e-voting in Nairobi County include Security, Access, availability, perceived ease of use, reliability, competence, trust, awareness and access. Security and Legal factors have a direct effect on e-voting system.

7.3 Implications for Theory

The research has added to the body of knowledge since it brings to e-voting readiness in Kenya.

7.4 Implications for Practice

The study shed light on readiness for e-voting and some of the main factors that influence adoption of E-voting in Nairobi County. The findings from the research can be considered by Independent Electoral and Boundaries Commission since it is directly involved in managing election. Hence e-voting can be used in 2012 to avert any contention and manipulation of results delay. Further, it can reduce the time required to conclude election petitions significantly since evidence can adduced in court.

7.5 Limitations and Suggestion for Future Research

The study focused in Nairobi County that is cosmopolitan. Other counties were not considered. These could generate an interesting and new dimension. The questionnaire approach is not free of subjectivity in the respondent and was taken at one point at a time. User reaction change in time and may depend on the political environment.

Other factors affecting e-voting may exist. Further testing and expansion of our framework may capture factors that were not considered in this research. We recommend further research in rural and monolithic counties in Kenya.

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E-VOTING SURVEY QUESTIONNAIRE

SERIAL NO .....

Time interview started ----------

Time interview ended ----------

Date of interview ----------

NB

1. Fill your answers to all questions in the space provided
2. Do not indicate your name anywhere in the questionnaire
3. It is important that all the sections have responses

INSTRUCTIONS

1. In the sections based on 7-point scale, give your opinion whereby
   a. 7 means Strongly agree
   b. 6 Agree
   c. 4 means not sure
   d. 1 means strongly disagree
2. All questions should have **ONE** answer
3. Make sure you tick inside the box
4. For questions where there are no numbers to be ticked, we ask you to write your answer in your own words in the space provided.

1. DEMOGRAPHIC DETAILS (This is for analysis only)

Gender

- ☐ Male
- ☐ Female

Age

- ☐ 18 – 24
- ☐ 25 - 35
- ☐ 35 – 50
- ☐ Above 50

Education Level

- ☐ Basic
- ☐ Secondary
- ☐ College
- ☐ University

Years of Computer use

- ☐ 1 year and below
- ☐ 2 years and below
- ☐ 3 – 6 years
- ☐ Above 7 years

Constituency: Tick the constituency that you reside in Nairobi

- ☐ Dagoreti
- ☐ Embakasi
- ☐ Kamkunji
- ☐ Kasarani
- ☐ Langata
- ☐ Makadara
- ☐ Starehe
- ☐ Westlands

2. Mobile Phones

Have you ever owned a mobile phone? ☐ Yes ☐ No

If you own a phone, indicate the number of years of Using Mobile phones

☐ Less than 1 year ☐ 1 – 3 years ☐ 4 – 6 years ☐ Over 7 years

3. **Preferred Voting Methods**

☐ Manual Ballot system ☐ Mobile Phone ☐ Internet Voting ☐ Internet Polling Boots

4. **Need for E-voting**

Do you agree that e-voting is required in Nairobi County? ☐ Yes ☐ No

5. **Willingness to use E-Voting System**

To what extent do you agree with the following statement on your willingness to use E-voting system?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) I will be willing to use the system	☐	☐	☐	☐	☐	☐	☐
(b) I will accept the results of e-voting	☐	☐	☐	☐	☐	☐	☐

6. **Voter Readiness for E-Voting**

To what extent do you think you are ready to use E-voting system as a voter in Nairobi County?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) I am ready to use e-voting System	☐	☐	☐	☐	☐	☐	☐
(b) I am ready to use if all concerns have been addressed.	☐	☐	☐	☐	☐	☐	☐

7. **Reasons of Implementing E-Voting**

To what extent do you agree with the following statements regarding reasons for implement e-voting system?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) E-voting will reduce rigging	☐	☐	☐	☐	☐	☐	☐
(b) E-voting will Ensure fair election	☐	☐	☐	☐	☐	☐	☐
(c) E-voting reduce tally results time to 48hrs	☐	☐	☐	☐	☐	☐	☐
(d) E-voting reduce results altering	☐	☐	☐	☐	☐	☐	☐

8. **Minimum E-voting Readiness**

To what extent do you agree with the following statements regarding requirements of e-voting system?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) Ease to Use during voting	☐	☐	☐	☐	☐	☐	☐
(b) Reliable to be used	☐	☐	☐	☐	☐	☐	☐

(c) Tally results within 12 hours	☐	☐	☐	☐	☐	☐	☐
(d) E-voting give accurate results	☐	☐	☐	☐	☐	☐	☐
(e) E-voting allows voting anywhere	☐	☐	☐	☐	☐	☐	☐

9. Perceived Usability {Change of one's decision after voting and before committing the vote}

To what extent do you agree with the following statements regarding usability of electronic voting system?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) E-voting ease to use	☐	☐	☐	☐	☐	☐	☐
(b) I feel its flexible to use the system	☐	☐	☐	☐	☐	☐	☐
(c) Correcting errors is easy	☐	☐	☐	☐	☐	☐	☐

10. Access

To what extent do you agree with the following statement regarding accessibility of voters to e-voting points?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) E-voting access points available	☐	☐	☐	☐	☐	☐	☐
(b) Access points be proportional to number of registered voters.	☐	☐	☐	☐	☐	☐	☐

11. Perceived Trust

To what extent do you agree with the following statement regarding trust e-voting being conducted?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) Voting over the internet can be trusted	☐	☐	☐	☐	☐	☐	☐
(b) Voting over mobile phones can be trusted	☐	☐	☐	☐	☐	☐	☐
(c) Manual paper voting can be trusted	☐	☐	☐	☐	☐	☐	☐

12. Availability

To what extent do you agree with the following statements regarding availability and speed of internet?

	Strongly Agree 1	2	3	4	5	6	Least Agree 7
(a) The Government should ensure speed of Internet is sufficient to facilitate e-voting	☐	☐	☐	☐	☐	☐	☐

13. Perceived Reliability of E-voting Results

To what extent do you agree with the following statement on reliance of E-voting results?

	Strongly Agree						Least Agree
	1	2	3	4	5	6	7
(a) Results will not be tampered with	☐	☐	☐	☐	☐	☐	☐
(b) Results will be use to resolve disputes {Max time allowed for petition in the current constitution is 12 months}	☐	☐	☐	☐	☐	☐	☐

14. Political Support

To what extent do you agree with the following statement political support on E-voting system?

	Strongly Agree						Least Agree
	1	2	3	4	5	6	7
(a) E-voting will be accepted	☐	☐	☐	☐	☐	☐	☐
(b) Executive will support E-voting system Implementation	☐	☐	☐	☐	☐	☐	☐

15. Security

To what extent do you think E-voting system will ensure security of voting process and results?

	Strongly Agree						Least Agree
	1	2	3	4	5	6	7
(a) E-voting will give accurate results	☐	☐	☐	☐	☐	☐	☐
(b) E-voting will ensure Confidentiality	☐	☐	☐	☐	☐	☐	☐
(c) E-voting will ensure voter details are safe	☐	☐	☐	☐	☐	☐	☐

SUGGESTION

In your own words, suggest any other thing that needs to be done to make the use of E-voting appealing and acceptable.

QUALITATIVE QUESTIONNAIRE E-VOTING READINESS

SERIAL NO .....

Time interview started ----------

Time interview ended ----------

Date of interview ----------

Name of Institution ----------{optional}

Address ---------- {optional}

NB

4. Fill your answers to all questions in the space provided
5. It is important that all the sections have responses

Network Access Indicators

Network Infrastructure

1. Has your constituency been networked? ----------
    a. If yes, what area has been networked? ----------
2. What is the tele-density of each constituency? ----------

Internet Availability

1. What is the capacity of your leased lines available to your constituency? ----------
2. Does your phone have wireless access capability? ----------

Network Speed and Quality

1. What is the maximum Internet access speed available in the constituency? ----------
2. How frequent does your internet or phone fail to connect ----------
3. What is the mean drop rate of calls in the constituency? ----------

ICT Hardware and Software Availability

1. How frequent do you use ICTs like computers? ----------
2. Are you trained in ICT? ----------
    a. If yes, up-to what level ----------

ICT Service and Support

1. How long have you used computer applications? ----------
2. Can you troubleshoot common problems? ----------
3. How easily can you use and modify ICT tools? ----------

ICT COMPENCY READINESS

Access to ICTs

1. Do you have access to ICTs? .....

2. How frequent do you access ICTS? .....

Enhancing Education with ICTs

1. To what extent is CDF encouraging the ICTs Update? .....
2. Do you have ICT Skills? .....

Developing ICT workforce

1. Is there any committee on ICT in your constituency? .....
2. Is the community actively involved in the development of the strategies? .....

.....

.....

.....

ICT in government Offices

1. How do you pay for your bills? .....
2. How do you file your annual income returns? .....

(C) E-SOCIETY

People and Organization Online

1. List any websites that you commonly visit. .....
2. How frequently do you use e-mail as a communication tool? .....

Locally relevant content

1. What language is your web browser using?
2. Which language are you comfortable with what communicate over the net?

ICTs in workplaces

1. Is your workplace automated? .....
2. How much do you spend on telecommunication on monthly basis? .....

(D) SECURITY AND TRUST

Security of ICT equipment and Software

1. Are you aware of how variations/alterations can be done through computers? .....
2. How can security of equipment be attained? .....
3. Have you ever seen a firewall? .....

ICT Privacy Issues

1. Are you aware of any ICT Privacy Issues? .....
    a. If yes, describe any.....
2. How is confidentiality, Integrity and auditability being implemented? .....

.....

ICT COPYRIGHT ISSUES

1. Do you use custom-made software? .....
    a. If yes, from which developer? .....
2. What do recommend on software piracy? .....

.....

.....

ICT Strategy

1. Have you ever read ICT Strategy of 2006? .....
    a. If yes, how can it help you to ensure compliance to the rule of law? .....

    .....
2. What possible benefits can be accrued from complying with ICT Strategy? .....

.....

.....

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1. The Network (Infrastructure)

	Speed & Availability		Competition	
	Residential	Commercial	Wired/Fixed Wireless	Mobile Wireless
Stage 1	▪ 56k dial-up available to 100% of homes. ▪ Only analog mobile wireless services offered.	▪ 56k dial-up available to 100% of businesses. ▪ Only analog mobile wireless services offered.	▪ 1 high-speed data provider for residential and business markets. ▪ Installation takes 2 weeks.	▪ 1 mobile voice/ data wireless provider. ▪ Monthly contracts available on per-minute basis.
Stage 2	▪ DSL/Cable or fixed wireless equivalent available to 20% of homes. ▪ Mobile digital wireless data service covers 30% of the community at 12kbps.	▪ High-speed (DSL/Cable or dedicated T1') access available to 40% of businesses. ▪ Mobile digital wireless data service covers 30% of the community at 12kbps.	▪ 2 residential high-speed data providers servicing more than 50% of the community. ▪ 3 high-speed data providers for the business market. ▪ Installation takes less than 2 weeks.	▪ 3 mobile voice/ data wireless providers. ▪ Mobile wireless long distance flat rates available on per-minute basis.
Stage 3	▪ DSL/Cable or fixed wireless equivalent available to 80% of homes. ▪ Mobile digital wireless data services covers 50% of the community at 12kbps.	▪ High-speed access available to 80% of businesses. ▪ Mobile digital wireless data service covers 50% of the community at 56kbps.	▪ 3 residential high-speed data providers servicing more than 75% of the community. ▪ 5 high-speed providers for the business market. ▪ Installation takes 1 week.	▪ 5 mobile voice/ data wireless providers. ▪ Mobile wireless data flat rate available on per-minute basis.
Stage 4	▪ Every home has access to high-speed connections and people can access the Network wirelessiy from anywhere in the community.	▪ Every business has access to high-speed connections and employees can access the Network wirelessly from anywhere in the community.	▪ High-speed data services for the residential and business markets are highly competitive for price, innovation, and quality of service.	▪ Mobile wireless services are highly competitive for price, innovation, and quality of service.

Employees dial-up for Internet access. 25% of employees have email accounts.	50% of government buildings have always-on connection. 25% of employees have email.	10% of classrooms have always-on connection to the Internet. 25% of teachers have email accounts.	100% of offices, libraries, and labs have always-on connection to the Internet. 25% of dorm rooms have always-on connection to the Internet. 100% of students, faculty, and staff have email accounts.	25% of providers have dial-up Internet access. 25% of providers have email accounts for external communication.	25% of homes have a computer/ access device. 15% of homes use the Internet.
30% of employees have access to an always-on connection to the Internet. 50% of employees have email accounts. 50% of mobile employees use wireless devices.	100% of government buildings have always-on connection to the Internet. 100% of employees have email. 50% of mobile employees use wireless devices.	50% of classrooms have always-on connection to the Internet. 100% of teachers have email accounts.	50% of dorm rooms have always-on connection to the Internet. 25% of campuses have a wireless network.	25% of providers have always-on connection to the Internet. 50% of providers have email accounts for external communication.	50% of homes have a computer/ access device. 30% of homes use the Internet.
60% of employees have access to an always-on connection to the Internet. 75% of employees have email accounts. 100% of mobile employees use wireless devices.	100% of mobile employees use wireless devices. Public terminals are available in 50% of buildings that are accessible to the public.	75% of classrooms have always-on connection to the Internet. 100% of students have email accounts. Public ports and terminals are available in some common areas.	100% of dorm rooms have always-on connection to the Internet. 50% of campuses have a wireless network.	50% of providers have always-on connection to the Internet. 100% of providers have email accounts for external communication.	80% of homes have a computer/ access device. 80% of homes use the Internet.
All businesses of all sizes and in all sectors are always connected to the Network and every employee is able to access the Network when it is needed to perform their job, even when mobile.	Governments make the Network always available to employees and become a point of Network access for the public when they are in a public building.	All K-12 campuses are highly networked environments where the Network is available to students, faculty, and staff from anywhere on campus.	All higher ed campuses are highly networked environments where the Network is available to students, faculty, and staff from anywhere on campus.	All health care providers have high-speed access for communication and telemedicine purposes.	All homes are connected to the Network and enable people and devices to access the Network from multiple sites in the home.

3. Networked Applications & Services

Business	Government	K-12	Higher Ed	Health	Home
▪ 10% order goods online. ▪ 10% transact with customers online. ▪ 10% manage HR/administrative information online.	▪ 50% of agencies have informational websites. ▪ 25% of agencies manage HR/administrative information online.	▪ 100% of schools have an informational website. ▪ 25% of teachers trained to use digital content and web-based learning for instruction. ▪ 25% of classes use digital content and/or web-based learning.	▪ 25% of campuses offer online registration. ▪ 25% of faculty trained to use digital content and web-based learning for instruction. ▪ 25% of classes use digital content and/or web-based learning.	▪ 10% of providers have an informational website.	▪ 25% of community-based organizations have an informational website.
▪ 25% order goods online. ▪ 25% transact with customers online. ▪ 25% manage HR/administrative information online.	▪ 25% of agencies have transactional websites for citizens and suppliers. ▪ 50% of agencies share data electronically. ▪ 50% of agencies manage HR/administrative information online.	▪ 25% of schools have an interactive website including access to homework assignments and email contact with teachers and administrators. ▪ 50% of teachers trained to use digital content and web-based learning for instruction. ▪ 50% of classes use digital content and/or web-based learning.	▪ 50% of campuses offer online registration. ▪ 50% of faculty trained to use digital content and web-based learning for instruction. ▪ 50% of classes use digital content and/or web-based learning.	▪ 25% of providers have an informational website. ▪ 10% of providers store records electronically.	▪ 50% of community-based organizations have an informational website.
▪ 50% order goods online. ▪ 50% transact with customers online. ▪ 50% manage HR/administrative information online.	▪ 75% of agencies have transactional websites for citizens and suppliers. ▪ 75% of agencies share data electronically. ▪ 75% of agencies manage HR/administrative information online.	▪ 75% of schools have an interactive website including access to digital content and email contact with teachers and administrators. ▪ 100% of teachers trained to use digital content and web-based learning for instruction. ▪ 100% of classes use digital content and/or web-based learning.	▪ 75% of campuses offer online registration. ▪ 75% of faculty trained to use digital content and web-based learning for instruction. ▪ 100% of classes use digital content and/or web-based learning.	▪ 75% of providers have an informational website. ▪ 25% of providers have an interactive website for scheduling and basic questions. ▪ 50% of providers store records electronically.	▪ 75% of community-based organizations have an informational website. ▪ A unified community portal provides access to a broad range of community information and services.
▪ Businesses incorporate the Network into every aspect of their operations, creating greater efficiencies, spurring innovation, and connecting online to everyone that is part of the business, both internally and externally.	▪ Governments use the Network to run operations more efficiently internally and to serve constituents 24x7 externally.	▪ Schools use the Network to connect students, teachers, and parents; improve learning using digital content; and manage administrative responsibilities more efficiently.	▪ All aspects of higher ed are available through the Network including instruction, content and administration.	▪ Providers interact with their patients online and perform some consultations and procedures remotely.	▪ Community-based organizations are able to use the Network to engage people in the community and make their services available to everyone.

4. Networked Economy

	Innovation	Workforce	Consumer
Stage 1	▪ Business permits and licenses take up to 3 months to secure. ▪ 25% of existing businesses have transformed their internal and external practices due to the Internet.	▪ 10% of the workforce participates in training/education programs either online or in person every 5 years. ▪ 10% of employers post job openings on online job listing services.	▪ 10% of households purchase goods or use services online.
Stage 2	▪ Business permits and licenses take up to 1 month to secure. ▪ 50% of existing businesses have transformed their internal and external practices due to the Internet.	▪ 25% of the workforce participates in training/education programs either online or in person every 5 years. ▪ 25% of employers post job openings on online job listing services. ▪ 5% of the workforce telecommutes at least once a week.	▪ 33% of households purchase goods or use services online.
Stage 3	▪ Business permits and licenses take less than 2 weeks to secure. ▪ 75% of existing businesses have transformed their internal and external practices due to the Internet.	▪ 50% of the workforce participates in training/education programs either online or in person every 5 years. ▪ 75% of employers post job openings on online job listing services. ▪ 15% of the workforce telecommutes at least once a week.	▪ 75% of households purchase goods or use services online.
Stage 4	▪ Starting a new business has minimal bureaucratic and economic barriers and support mechanisms are in place to assist and encourage new business development. Existing businesses are embracing new technologies and best practices.	▪ People are continually upgrading their skills to adjust to new technologies and best practices. Online job banks are able to dynamically match employees with openings and connect to training/ education programs to identify changing workforce skill requirements. Telework becomes a standard operating procedure in most work environments.	▪ Consumers can find information about, compare, and buy any good or service located anywhere in the world online.