



**UNIVERSITY OF NAIROBI**  
**SCHOOL OF COMPUTING AND INFORMATICS**

**ENHANCING WEB-BASED e-GOVERNMENT MODELS  
THROUGH INTEGRATED EMAIL-SMS ALERT SYSTEM**

**BY**

**PETER KYALO/MULWA**

**P56/71108/2008**

**SUPERVISOR**

**MR. MBURU S. N.**

**MAY 2011**



Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Information Systems

## DECLARATION

I, **Peter Kyalo Mulwa**, do hereby declare that this research project is my own work and where there is work or contributions of other individuals, it has been dully acknowledged. To the best of my knowledge, this research work has not been carried out before or previously presented to any other education institution in the world for a similar purpose or forum.

Signature.....

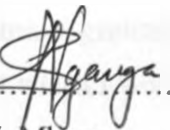
Date.....20/05/2011

Peter Kyalo Mulwa

P56/71108/2008

---

I, **Mr. Stephen N. Mburu**, do hereby certify that this project has been presented for examination with my approval as the University of Nairobi Supervisor.

Signature .....

Date .....26/05/2011

Mr. Stephen N. Mburu

Lecturer, School of Computing and Informatics

University of Nairobi, Kenya

## ACKNOWLEDGEMENT

My heartfelt gratitude goes to my supervisor Mr. Stephen N. Mburu for his prudent guidance, positive criticism, suggestions and advices throughout my project work that highly contributed to my success in the study.

I would also wish to thank Prof. Okello-Odongo and Mr. Sammy Ruhiu, Lecturers and Project Assessment Panelist, School of Computing & Informatics (SCI) for their valuable advices and comments that constantly led to the improvement of my project work. I would wish to acknowledge the entire SCI fraternity for their support and contributions that made the School environment conducive for learning.

I would wish to extend my gratitude to all respondents who took time from their busy schedules to respond to my questionnaires which enabled me to get valuable data and information for the study.

My sincere gratitude goes to my wife Jackline Ncekei and our children Onesmus Mulwa and Victor Munene for giving me humble time, encouragement and moral support during my low moments during this study.

Finally, my utmost gratitude goes to the almighty **God** for giving me wisdom, good health and energy without which I would not have come this far. Thank You Lord.

## ABSTRACT

The development of ICT has enormously influenced the social, economic and political life pattern in both developed and developing countries. Governance, democracy and commerce have changed due to the development of ICT (Tony, Goodwin and Paul, 2008). This has led to the development of new terms like e-Government, e-Democracy and e-Commerce among others. This study focused on the existing e-Government models, their functionalities, effectiveness, efficiency and reliability.

E-government models adopted by most countries are Web-based or SMS-based. This study was a case study of the use of the web-based e-Government model in the University of Nairobi which is a Government agency. The study focused on the email and SMS as the main communication tools used by government agencies for communication. The study investigated the use of the email tool to ascertain its effectiveness. The study sought to improve the email effectiveness and reduce response time through alert messages send to the mobile phones of the email account owners. This will integrate the Web-based (email) and the SMS-based e-government models to reap on the benefits of both models.

Questionnaire was used as the main data collection instrument. The data collected was analyzed using Statistical Package for Social Science (SPSS) to determine extend of the use, effectiveness, efficiency and reliability of Email and SMS based Information Systems. Stratified random sampling was used to determine the population from where the research data was collected.

The collected data was prepared for analysis using SPSS. Inferences were drawn from the research findings to justify the need of improving the Web-based e-Government Model. The findings indicated that web-based (websites, blogs and Email) models are the widely used e-government models in developed and developing countries. It was also found out that SMS-based models are increasingly becoming popular in developed and developing countries. It was further found that integrating both models is possible to enable citizens, businesses and other entities that interact with the government to reap on the benefits of both models. Based on these findings, a prototype of the proposed e-government model was designed, developed, tested and an implementation framework developed. The entire study took a maximum duration of six (6) months.

## TABLE OF CONTENTS

<b>DECLARATION</b> .....	<b>i</b>
<b>ACKNOWLEDGEMENT</b> .....	<b>ii</b>
<b>ABSTRACT</b> .....	<b>iii</b>
<b>TABLE OF CONTENTS</b> .....	<b>iv</b>
<b>LIST OF ABBREVIATIONS</b> .....	<b>viii</b>
<b>LIST OF FIGURES</b> .....	<b>ix</b>
<b>LIST OF TABLES</b> .....	<b>x</b>
<b>CHAPTER 1: INTRODUCTION</b> .....	<b>1</b>
1.1 Background .....	1
1.2 Problem Statement .....	2
1.3 Research Justification .....	3
1.4 Research Objectives.....	4
1.5 Research Questions.....	5
<b>CHAPTER 2: LITERATURE REVIEW</b> .....	<b>6</b>
2.1 Introduction.....	6
2.2 Existing E-Government Models .....	6
2.2.1 Web-Based E-Government Models .....	6
2.2.1.1.Gartner Model.....	6
2.2.1.2.United Nation's (UN's) Five-Stage Model (2001).....	8
2.2.1.3.Deloitte's Six-Stage Model (2001).....	9
2.2.1.4.Layne and Lee's Four-Stage Model (2001).....	9
2.2.1.5.Hiller and Bélanger's Five-Stage Model (2001) .....	10
2.2.1.6.Moon (2002) Five-Stage Model .....	10
2.2.1.7.Siau & Long E-Government Stage Model (2005).....	11
2.2.1.8.Public Sector Process Rebuilding (PPR) Model.....	12
2.2.1.9.Meta-Synthesis of the Web-based E-Government Models.....	13
2.2.1.10 Relevance of Web-Based Models in Developing Countries.....	14

2.2.2....SMS-Based E-Government Model .....	15
2.3 Email2sms Tools.....	18
2.4 Nokia Messaging System.....	19
2.5 Limitations of Email2SMS Systems.....	19
2.6 Addressing the Challenges of Implementing the E-Government Models .....	20

**CHAPTER 3: THE PROPOSED EMAIL-SMS ALERT SYSTEM FOR ENHANCING THE WEB-BASED E-GOVERNMENT MODELS.....22**

3.1 Introduction.....	22
3.2 The Solution For Enhancing Web-based E-government Model.....	22
3.3 The Email-SMS Alert System Architecture .....	23

**CHAPTER 4: METHODOLOGY .....24**

4.1. Introduction.....	24
4.2. Research Design.....	24
4.3. Target Population and Sampling frame .....	24
4.4. Data collection instruments.....	24
4.5. Analysis of data.....	25
4.6. Prototype design.....	25

**CHAPTER 5: FINDINGS, ANALYSIS AND INTERPRETATIONS .....26**

5.1. Introduction.....	26
5.2. Data processing and analysis .....	26
5.2.1 Coding the responses .....	26
5.2.2 Reliability and validity testing .....	26
5.2.2.1 Reliability test .....	26
5.2.2.2 Validity test.....	27
5.2.3 Reliability analysis of the collected data .....	27
5.2.4 Face Validity .....	28
5.3 Detailed analysis of data collected.....	28
5.3.1 E-government and medium of communication.....	28
5.3.2 Information on email access .....	31

5.3.2.1	Email account ownership and frequency of checking for new mails .....	31
5.3.2.2	Preferred new email notification technique .....	34
5.3.3	Information on Mobile phone and SMS use .....	36
5.3.3.1	SMS charges and popularity .....	36
5.3.3.2	SMS reliability and how it can improve email reliability .....	38
5.3.3.3	Usefulness of SMS alert on new email messages .....	39
5.3.3.4	Email versus SMS use for office communication.....	40

**CHAPTER 6: SYSTEM DESIGN AND IMPLEMENTATION .....42**

6.1.	Introduction.....	42
6.2	System analysis.....	42
6.2.1	Email-SMS Alert System architecture.....	42
6.2.2	System Use Case Diagram.....	43
6.2.3	Database design .....	44
6.2.4	System flow chart diagram .....	45
6.2.5	Software requirements and configuration.....	46
6.2.5.1	WAMP Server.....	46
6.2.5.2	HMAILSERVER mail server .....	47
6.2.5.3	Dreamweaver .....	47
6.2.5.4	Mozilla Thunderbird .....	47
6.2.5.5	FrontlineSMS SMS gateway .....	47
6.2.6	PHD SMS Code.....	47
6.3	System Testing.....	49
6.4	Handling SMS for Unwanted Email Messages .....	49
6.5	Handling Flagged/Prioritized Email Messages.....	51

**CHAPTER 7: CONCLUSION AND RECOMMENDATIONS.....53**

7.1	Conclusion .....	53
7.1.1	E-government models and medium of communication.....	53
7.1.2	Enhancing Web-based E-government model through Email-SMS alert System .....	54
7.1.3	Developing a prototype to test the proposed enhancement .....	54

7.1.4	Providing implementation framework of the enhance model.....	54
7.1.5	Integrating SMS-based e-government model with web-based Models .....	54
7.2	Challenges of the study .....	55
7.3	Recommendations.....	55
7.4	Further Research .....	56



**APPENDICES**

**Appendix A: REFERENCES.....57**  
**Appendix B: Questionnaire.....59**

## LIST OF ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
EASSy	Eastern Africa Submarine Cable System
E-Commerce	Electronic Commerce
E-Democracy	Electronic Democracy
E-Government	Electronic Government
Email	Electronic Mail
EMAIL2SMS	Email to SMS
G2B	Government to Business
G2C	Government to Citizen
G2G	Government to Government
ICT	Information Technology and Communication
ID	Identification
IP	Internet Protocol
IT	Information Technology
DNS	Domain Name System
PDF	Portable Document Format
PHP	Hypertext Preprocessor
POP3	Post Office Protocol
PPR	Public Sector Process Rebuilding
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SPF	Sender Policy Framework
SPSS	Statistical Package for the Social Sciences
SQL	Structured Query Language
WAP	Wireless Access Protocol

## LIST OF FIGURES

Figure 2.1: The Gartner e-Government Model .....	7
Figure 2.2: Layne and Lee e-government Model.....	10
Figure 2.3: Public Sector Process Rebuilding (PPR) model.....	13
Figure 2.4: A six-level model of SMS-based e-government.....	16
Figure 2.5: Email to SMS System Architecture .....	19
Figure 3.1: Proposed Email-SMS Alert System Architecture .....	23
Figure 5.1: Staff Opinion on Implementation of E-governance in their organization .....	29
Figure 5.2: Common used medium of communication.....	30
Figure 5.3: Email account ownership .....	32
Figure 5.4: frequency of checking for new mails .....	32
Figure 5.5: New mail notification technique.....	33
Figure 5.6: Effects of failure to respond to urgent message to decision making .....	34
Figure 5.7: Preferred new mail notification technique .....	35
Figure 5.8: Mobile Phones Ownership, SMS Popularity and Charges.....	36
Figure 5.9: SMS reliability compared to email .....	38
Figure 5.10: Use of SMS Email notification technique to improve email tool .....	39
Figure 5.11: Use of SMS Notification to Reduce Information Turn-Around Time.....	40
Figure 5.12: Email versus SMS use in office .....	41
Figure 6.1: Email-SMS Alert System Architecture .....	42
Figure 6.2: System Use Case Diagram .....	44
Figure 6.3: ERD diagram .....	45
Figure 6.4: System flow chart.....	46
Figure 6.5: PHP SMS Code .....	48
Figure 6.6: Sample test data for the prototype.....	49

## LIST OF TABLES

Table 5.1: Reliability test of the data collection instrument -----	27
Table 5.2: Staff Opinion on Familiarity with E-government& E-governance -----	29
Table 5.3: Medium of communication used for communication -----	30
Table 5.4: Efficiency, effectiveness and reliability of the communication tool -----	31
Table 5.5: Email Access Places Other than in the Office -----	35
Table 5.6: SMS Charges and Popularity-----	37

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

The development of ICT has enormously influenced the social, economic and political life pattern in both developed and developing countries. Governance, democracy and commerce have changed due to the development of ICT (Tony, Goodwin and Paul, 2008). This has led to proliferation of new terms like e-Governance, e-Democracy and e-Commerce among others.

This study focused on e-Government and was aimed at enhancing Web-based e-Government model to enhance easy and fast access of government services by most of its citizens. The World Bank (2005) defines e-government as “information technologies that have the ability to transform relations with citizens, businesses, and other arms of government can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management”.

According to Layne (2001), e-Government implies serving citizens in public sector via ICT. The most cited definition of e-Government in most literature is; Government’s use of technology, particularly web-based Internet applications to enhance the access to and delivery of government information and services to citizens, business partners, employees, other agencies, and government entities. The main objective is for a government to provide easy and fast accessibility of its services and information to its citizens.

E-Government models in use in different developed and developing countries are;

- a) Web-based Models – In these models, Internet based applications are used for online service delivery. Websites and e-mail facilities as the main communication tools are used in these models.
- b) SMS-based Models – In these models, Short Message Services (SMS) are used for online service delivery. This model utilizes mobile computing technologies where short messages can be used to convey information from one mobile device to another.

Choice and implementation of these models is not without challenges owing to the limitations of the communication tools and applications utilized. The limitations of Web-based models that use Internet and email applications are;

- i) Not all citizens who have access to Internet. Those who have, are however not constantly accessing the Internet and therefore may miss crucial information released while they are offline and especially information that requires urgent response
- ii) Citizens take long before visiting government websites and checking their mails hence information and messages that require urgent attention are not responded to immediately.

The limitations of the SMS-based model are;

- i) Most of the mobile devices such as mobile phones allow users to send up to a maximum of 160 words per message
- ii) Excess information can not be sent as attachment due to the limited storage capacities of these mobile devices.
- iii) SMS users use abbreviations or symbols that make it difficult for the recipient to comprehend the information conveyed.

There is a need to develop and adopt an e-Government model that ensures majority or all citizens in a country have access to all government services and information offered through e-Government and to enhance prompt responses to emails where it is mainly used as the main tool of communication.

This study focused on the email and SMS as the main communication tools used by government agencies for communication. The study investigated the use of the email tool to ascertain its effectiveness. This study sought to improve the email effectiveness and reduce response time through alert messages send to the mobile phones of the email account owners. This would integrate the Web-based (email) and the SMS-based e-government models to reap on the benefits of both models.

## **1.2 Problem Statement**

Information and Communication Technologies (ICTs) enable government agencies to disseminate its information and offer its services to its citizens through use of technologies like Internet, e-mail and

SMS. However, this has not been realized as majority of citizens especially in developing countries have no access to these technologies, which are still expensive and inaccessible to them, (Susanto, Goodwin and Paul, 2006). This deprives off the majority of the citizens in the rural areas their rights to access services and information offered by their government through e-Government.

E-government models adopted by most countries are Web-based or SMS-based, (Layne 2001). Susanto, Goodwin and Paul (2006), argue that SMS-based e-government models are more likely to increase e-government usage than the web-based e-government models. Research on SMS communication confirms that SMS communication is quick, efficient, cheap and convenient and it has been used around the world for different purposes, (Nonyongo, Mabusela and Monene, 2007)

SMS though suffers from the unique problem of the numbers of characters (usually 160 characters) that can be sent at once. This owes to the limitations of the mobiles devices used, for example memory and storage capacity of the mobile phones. This has left email as the alternative tool of communication. However, there are always delayed responses to messages send through Email especially when one is offline or does not notice when a new mail message is send to his or her inbox.

There is therefore a need to combine these two communication tools to benefit from the strengths of both. Research shows that when a new email just like a SMS is received in the user's inbox, the user can be notified through a preset alert signal either on a computer or a WAP enabled phone, (Macias 2009). An Email-SMS alert system can enhance the web-based e-Government model to ensure that e-Government services and information are accessible to the majority in time and responses required are given back almost in real time for timely and informed decision making.

### 1.3 Research Justification

Web-based and SMS-based e-Government models are the commonly used in the developed and developing countries. Some issues of concern like the effectiveness, efficiency, and the reliability of these models have been raised over years, (Layne 2001). Email and SMS based E-Government models have been used to disseminate Government information to its agencies and citizens but not without limitations, (Susanto, Goodwin and Paul, 2006).

This study enhanced the Web-based e-Government model by use of Email-SMS Alert System to improve on the functionalities, effectiveness, efficiency and reliability of the Model. The solution sought to synchronize communication between SMS gateways and Email Servers to send an alert message to the email recipient's mobile phone irrespective of the model of mobile phone or the mobile service provider subscribed to. This will ensure that citizens who can afford the cheap low-end mobile phones will be updated on new email messages send to them and can move to the nearest Internet Access Point for example, digital villages as in Kenya to access the information and give the required responses almost in real time. The enhanced model has the following benefits;

- Improved information processing turn-around time within the government agencies, employees and its citizens
- Employees in the government agencies can be able to instantly respond to emails send to them via Internet immediately they get an alert through their mobile phones
- Government agencies will be able to reach majority of its citizens through SMS who will have access to the Digital Villages for Internet access
- Citizens/employees will instantly be able to access information send to them as attachments via email on getting SMS alerts
- The government agencies are able to update its employees and clients with the current policies and developmental affairs
- Reduced the delay in informed decision making caused by delayed information.

#### **1.4 Research Objectives**

The main objective was to enhance the web-based e-government model by integrating email system with SMS system to enhance quick service and information delivery to 95% of citizens in developing countries like Kenya.

Specific Objectives;

- i) Review current e-Government models in use in the developing countries
- ii) Enhance the web-based e-Government model through Email-SMS Alert System
- iii) Develop a prototype to test the proposed enhanced model
- iv) Provide implementation framework of the enhanced model



## **1.5 Research Questions**

- i) What are the existing e-government models in use in government agencies and subsidiaries?
- ii) What communication media are used in the existing models?
- iii) What are the weaknesses, limitations and challenges that may affect reliable, effective and efficient transfer of information in the existing models?
- iv) What notification techniques for newly posted information or sent messages are used in these models to facilitate timely access and response by citizens and employees?
- v) How can Email-SMS alert system facilitate timely access and response to urgent information and messages being transferred in the existing e-government models?

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1. Introduction

The development of ICT has enormously influenced the social, economic and political life pattern in both developed and developing countries. Governance, democracy and commerce have changed due to the development of ICT, (Tony, Goodwin and Paul, 2008). This has led to development of new concepts like e-Governance, e-Democracy and e-Commerce among others. The main goal of e-Government is to enable a government to disseminate its information and offer its services to its citizens through use of Information and Communication Technologies (ICTs). These technologies include use of Internet, e-mail and SMS among other telecommunication technologies.

#### 2.2. Existing E-Government Models

Most of the governments offer e-government services through the Internet, (Siebel, 2005). Some of the current e-government models in use in developed and developing countries are, the Gartner Model (Backus, 2001), the Universal Access Model, the Broadcasting/Wider-Dissemination Model, the Interactive Service Model and the Comparative Analysis Model, (Digital Governance, 2005). These models assume the Internet as the base medium in all the phases, recommend governments to build Internet infrastructure, and urge people to use the Internet to access the system. Other e-government models are SMS-based models where government to government (G2G), government to citizen (G2C) and government to business (G2B) information is disseminated through short message services (SMS).

##### 2.2.1 Web-Based E-Government Models

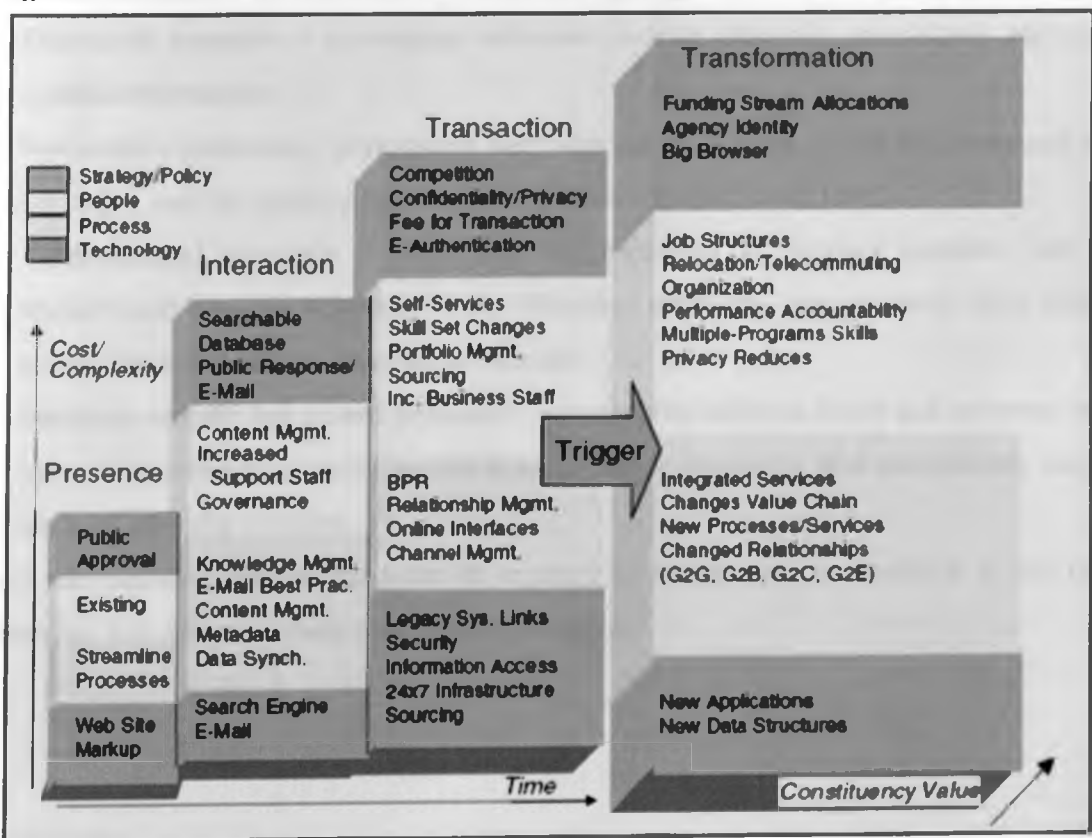
There are various web-based models that are in use in both the developing and the developed countries. These include but not limited to;

###### 2.2.1.1 Gartner Model

According to Baum and Di Maio (2000), Gartner proposed a four-stage model. The Gartner model is the most popular web-based e-government model. It is recommended by World Bank for implementation in developing countries, (InfoDev, 2002). The Gartner model consists of four-phases:

- i) **Web presence** – in this phase, agencies provide a web site to post basic information to public and immediate action is initiated toward the creation of a virtual environment on the Internet in the Presence stage, in order to provide the public with access to information.
- ii) **Interaction** – in this phase, users are able to contact agencies through web sites (for example e-mail) or do self-service, for example, download document; providing a web site with search ability, and to providing the public with access to various forms and sites.
- iii) **Transaction** – in this phase, users (including customers and businesses) can complete entire transactions (for example license application and procurement) online; implicates the online execution of public services such as the payment of accounts balances and receiving licenses.
- iv) **Transformation** – in this phase, governments transform the current operational processes to provide more efficient, integrated, unified, and personalized services. The Transformation phase is seen at the regional and national levels, consisting of integration among internal and external applications, in order to provide full communication between the governmental offices and non-governmental organizations. The Gartner's model is shown in the Figure 2.1.

**Figure 2.1: The Gartner e-Government Model (Adopted From Baum and Di Maio, 2000)**



This model can serve as a reference to evaluate where e-government project fits in the overall e-government strategy, (Backus, 2001). The main weakness with this model is that it does not provide a framework on how urgent information posted on the website or email can be responded to as quickly as required. It assumes that the citizens who interact with the websites and email are constantly connected to Internet. It provides a one-way communication at the transaction phase, where citizens are not guaranteed of feedback after carrying transactions online. Timely response is not guaranteed especially for urgent information from either Government or citizen.

### 2.2.1.2 United Nation's (UN'S) Five-Stage Model (2001)

The United Nations Division for Public Economics and Public Administration (2001) study, "Benchmarking E-government: A Global Perspective, Assessing the Progress of the UN Member States" identified five stages for quantifying progress of e-Government. The Study identified e-Government stages as representative of the Government's level of development based primarily on the content and deliverable services available through official websites. These stages are:

- i) **Emerging presence** – a single or a few independent government web sites provide formal but limited and static information
- ii) **Enhanced presence** – government web sites provide dynamic, specialized, and regularly updated information
- iii) **Interactive presence** – government web sites act as a portal to connect users and service providers, and the interaction takes place at a more sophisticated level
- iv) **Transactional presence** – users have the capability to conduct complete and secure transactions, such as renewing visas, obtaining passports, and updating birth and death records through a single government web site
- v) **Seamless or fully integrated presence** – governments utilize a single and universal web site to provide a one-stop portal in which users can immediately and conveniently access all kinds of available services.

Just like the Gartner's model, the issue of urgency of information or feedback is not put into consideration. It is also a one-way communication model.

### 2.2.1.3 Deloitte's Six-Stage Model (2001)

Believing that the purposes of e-government are to serve citizens as customers and to build a long term relationship with citizens, Deloitte & Touche (2001) proposed a six-stage;

- i) **Information publishing/dissemination** – Governments provide users with increased access to information
- ii) **“Official” two-way transaction** – agencies are used to provide interaction between governments and users by using information and communication technologies such as digital signatures and security keys
- iii) **Multi-purpose portals** – governments utilize a single portal to provide universal service across multiple departments
- iv) **Portal personalization** – governments enable users to customize portals according to their own desires
- v) **Clustering of common services** – governments enhance collaboration and reduce intermediaries (between operational processes) in order to provide a unified and seamless service
- vi) **Full integration and enterprise transaction** – an ideal vision in which governments provide sophisticated, unified, and personalized services to every customer according to their own needs and preferences.

Again, in this model, although a two way communication it does put urgency of information in to consideration.

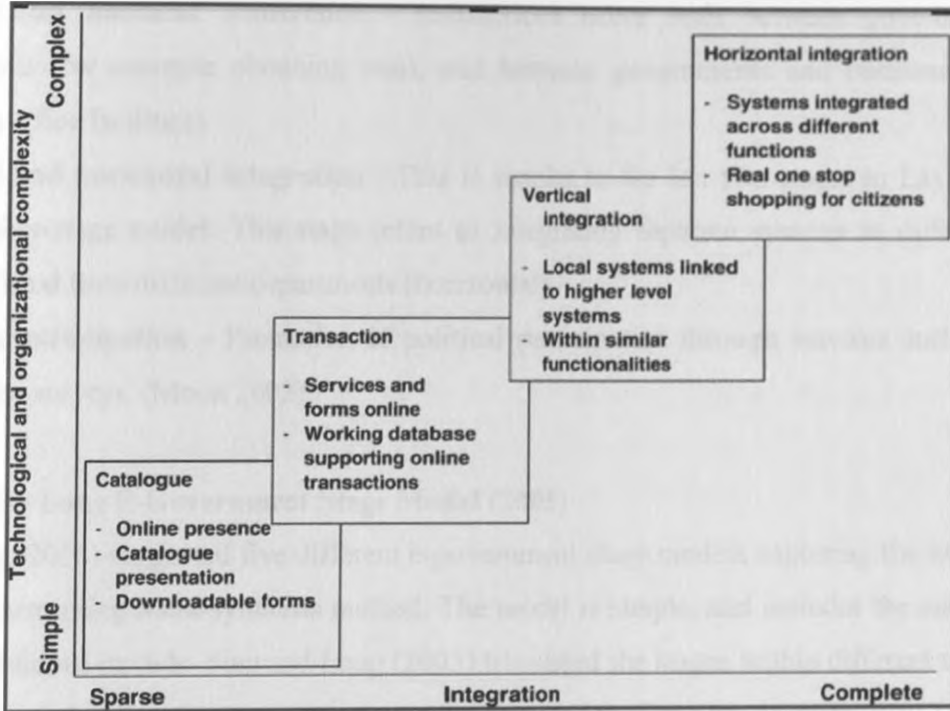
### 2.2.1.4 Layne and Lee's Four-Stage Model (2001)

Based on technical, organizational, and managerial feasibility, Layne and Lee (2001) regarded e-government as an evolutionary phenomenon and proposed a four-stage model;

- i) **Catalogue** - This stage delivers some static or basic information through web sites
- ii) **Transaction** - This stage extends the capability of catalogue and enables citizens to do some simple online transactions such as filling government forms
- iii) **Vertical integration** - This stage initiates the transformation of government services rather than automating its existing processes. It focuses on integrating government functions at different levels, such as those of local governments and state governments

- iv) **Horizontal integration** - This stage focuses on integrating different functions from separate systems so as to provide users a unified and seamless service, (Layne and Lee 2001).

**Figure 2.2 Layne and Lee e-government Model (Adopted from Layne and Lee, 2001)**



### 2.2.1.5 Hiller and Bélanger's Five-Stage Model (2001)

Hiller and Bélanger (2001) identified a five-stage model that was adapted and modified by Moon;

- i) Information
- ii) Two-way communication
- iii) Transaction
- iv) Integration
- v) Participation

### 2.2.1.6 Moon (2002) Five-Stage Model

This model was adapted from the Hiller and Bélanger (2001) model with minor differences in phrasing;

- i) **Simple information dissemination (one-way communication)** - This is the most basic form of e-government, which disseminates information by simply posting it on the web sites
- ii) **Two-way communication (request and response)** - Interaction occurs between governments and users
- iii) **Service and financial transaction** - transactions occur both between governments and individuals (for example obtaining visa), and between governments and businesses (that is, ordering office facilities)
- iv) **Vertical and horizontal integration** - This is similar to the last two stages in Layne and Lee (2001) four-stage model. This stage refers to integrating separate systems at different levels (vertical) and from different departments (horizontal)
- v) **Political participation** - Promotion of political participation through services such as online voting and surveys. (Moon 2002)

#### 2.2.1.7 Siau & Long E-Government Stage Model (2005)

Siau & Long (2005) suggested five different e-government stage models capturing the whole vision of e-government using Meta-synthesis method. The model is simple, and includes the main ideas of previous mentioned models. Siau and Long (2005) translated the stages within different models into one another and developed a new e-government stage model. The new e-government stage model has the following five stages;

- i) **Web presence** - This phase is the most basic form of e-government. In this stage, governments typically post simple and limited information through their web sites, such as the agency's vision and mission, office hours, contact information, and official documents. At first, most of the information is static. However, with the advancement of e-government capability, the information posted can be more dynamic, specialized, and regularly updated. The main difference between this stage and other higher stages is that in this stage, governments only provide information on the web sites and no interaction is possible.
- ii) **Interaction** - This phase provides simple interaction between the governments and the users. This includes basic search engines, e-mail systems, as well as official form downloads. Interaction, as the preliminary step of transaction, can be regarded as a transitional period between simple web presence and complete transaction.

- iii) **Transaction** - This phase enables users (including both individual citizens and business) to conduct complete online transactions. Citizens can conduct self-services online such as license applications, tax filing, and personal information updates. In addition, businesses can access online services such as fulfilling tax forms, applying licenses and reporting financial data. Online businesses such as obtaining order and making auctions are also possible.
- iv) **Transformation** - There is a “jump” between transformation and the previous three stages. Rather than automating and digitalizing current operational processes, this stage moves towards transforming the way that governments provide services. The transformation involves both vertical (that is governments in different levels) and horizontal integration (that is different departments or governments in different locations). For external interfaces, governments build a single and unified portal providing integrated and seamless services instead of separate and distributed services. To achieve this aim, governments should initiate an internal integration to re-engineer existing processes by reducing bottlenecks and intermediaries
- v) **E-democracy** - This is a long-term goal for e-government development. By offering tools such as online voting, polling and surveys, governments attempt to improve political participation, citizen involvement, and politics transparencies. At the same time, e-government gradually changes the way in which people make political decisions.

#### 2.2.1.8 Public Sector Process Rebuilding (PPR) Model

Andersen & Henriksen (2006) proposed the Public Sector Process Rebuilding (PPR) Model which was an extension of the Layne and Lee Model four stages. The major difference between the Layne and Lee model and the Public Sector Process Rebuilding (PPR) model that is, PPR is based on customer centric approach rather than the technological capability. The PPR model has four phases:

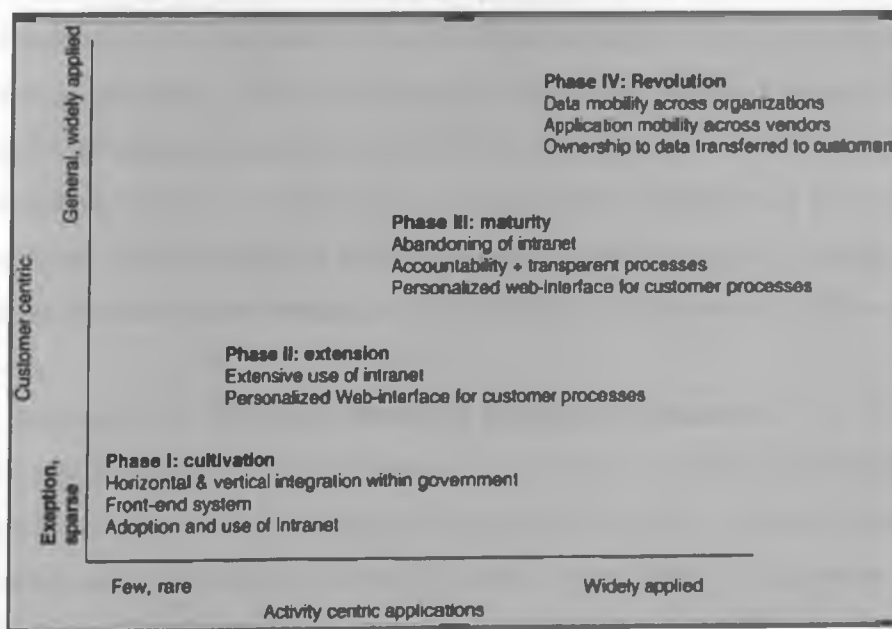
- i) **Cultivation** – This phase shelters horizontal and vertical integration within government, limited use of front-end systems for customer services, and adoption and use of Intranet within government. There can be elements of self-service but most often in the form of PDF files that can be downloaded, completed, and then returned either as an attachment to e-mail or by mailing the completed form to government.
- ii) **The extension stage** - with extensive use of intranet and adoption of personalized Web user interface for customer processes, at this stage there are still many manual routines, and while



the user might be likely to find many forms and information, the agency is equally interested in re-directing the users to information at other agencies

- iii) **Maturity stage** – this is the stage where the organization matures and abandons the use of the intranet, have transparent processes, and offers personalized Web interface for processing of customer requests. The Internet and intranet have merged and the key concern is to use IT to lower the marginal costs for processing the customer requests for services.
- iv) **Revolution Phase** - characterized by data mobility across organizations, application mobility across vendors, and ownership to data transferred to customers. In this phase, the employees' actions can be traced through the Internet and there is information available online about progress in, for example, case handling. The PPR model can be summarized in Figure 2.3.

**Figure 2.3 Public Sector Process Rebuilding (PPR) Model (Adopted From Andersen & Henriksen, 2006)**



### 2.2.1.9 A Meta-Synthesis of the Web-based E-Government Models

Various web-based e-government models indicate that most of the models confer with first four stages, that is, Web presence, interaction, transaction and transformation. While most of them stop at that stage, Siau and Long (2005) included e-democracy as the fifth stage of e-government to enable

the citizens to participate in the political decision making. E-democracy is considered as part of e-governance and not necessarily part of e-government.

In general, the e-government stage models focus on citizen-centric and functionality which is grounded on technology, organizational and managerial feasibility. The models indicate that there are two stages critical to citizens when accessing government services. That is;

- a) **Interaction:** This stage provides interaction between the governments and the users through basic search engines, e-mail systems, as well as official form downloads.
- b) **Transaction:** This stage enables users (including both individual citizens and business) to conduct complete online transactions. Governments create websites that allow users to conduct transactions online, for example, license application and procurement.

It is worthwhile to note that the web-based models discussed above do not put into considerations the information processing turn-around time depending on the urgency of the information but rather just provides guidelines of how e-Governments can avail its services and information to its citizens. This means that citizens may not immediately notice information posted on the government websites or send into their email accounts. This in turn means that sometimes citizens never provide information or feedback to the government or provide it late. These models assume that all citizens have access to Internet connectivity and/or are constantly connected, which is always not the case especially in developing countries. Therefore, there is a need to develop a mechanism for notifying the citizens of new information posted on the government's websites or send through email systems.

#### **2.2.1.10 Relevance of Web-Based Models in Developing Countries**

Investigations on e-government and ICT situations in developing countries show that these models may not be appropriate in the countries that lack Internet infrastructure, has high Internet costs, low Internet penetration and its citizens are Internet illiterate, (Ndau, 2004). For example, in Indonesia, after 5 years implementing e-government using the Gartner model, as of 2003 the success level was just 2%: 3 out of 169 e-government systems have achieved the Interaction and Transaction levels. 98% of the local e-government systems in Indonesia still operate at the lowest level (Web Presence only) and are characterized by static and insufficient information that is infrequently updated, few interactive features, non-existent online service, and low citizen participation, (Rusdiah, 2003).

Moreover, a survey by Heeks (2003) regarding the success and failure rates of e-government in developing countries shows that most of the e-government initiatives in developing countries have not yet been successful and more than one-third of initiatives are total failure, half are partial failures and only one-seventh are successful. Heeks (2003) identified three critical factors that lead to failure of e-government projects in developing countries. These factors include unrealistic design, inadequate technological infrastructure and lack of requisite competencies. A realistic e-government model should be appropriate to the current situation of the country; otherwise there will be a gap between the model and reality. The larger this gap is, the greater the risk that the e-government projects will fail, (Heeks, 2003). Hence, the current web-based e-government models are likely to fail if implemented in developing countries without localizing or customizing them to suit the social, economic, technological and political development needs of the country.

### **2.2.2 SMS-Based E-Government Model**

According to Susanto, Goodwin and Paul (2006), developing countries, which may lack Internet infrastructure or have expensive internet services, but have mobile infrastructure and citizens are familiar with mobile phones and SMS, it is appropriate to propose an e-government model that uses mobile phones and SMS as the main communications channel.

Susanto, Goodwin and Paul (2006), argue that SMS-based e-government is more likely to increase e-government usage than the current Internet-based e-government. SMS-based e-government may be defined as a strategy and its implementation involves the utilization of Short Message Service (SMS) technology, services and applications for improving benefits to the parties involved in e-government including citizens, business, and government institutions.

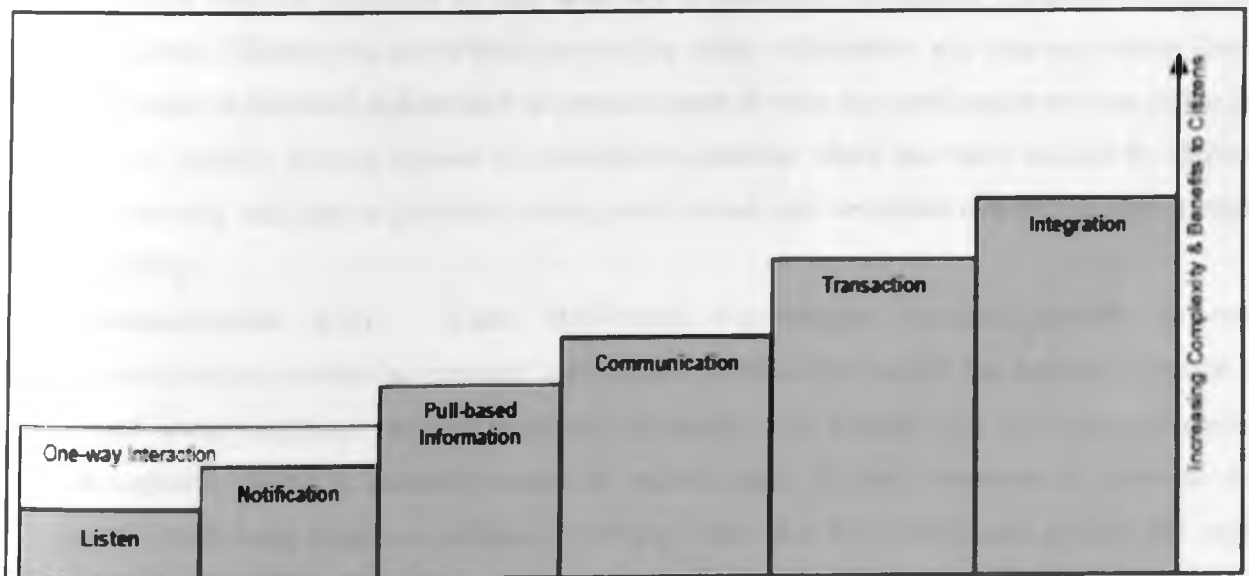
It may address the existing design-reality gap between the common proposed channel (Internet) and the real ICT situation in developing countries which is high Internet illiteracy, lack of Internet infrastructure, high Internet cost and low affordability, (Susanto and Goodwin 2006). Based on the facts that people in developing countries are more familiar with SMS than Internet, the number of SMS users is much higher, the SMS infrastructure is more extensive, and the SMS cost as well as mobile phone prices are much lower and affordable compared to the Internet and PCs, SMS-based e-

government could be the more appropriate channel to deliver e-government services in developing countries, (Susanto and Goodwin 2006).

Based on the technology acceptance theories, the cheaper service/technology might have a higher speed in adoption (Innovations Diffusion Theory by Rogers in Wikipedia 2008), and the facilitation conditions (the available resources and knowledge) have a direct influence on the usage (Unified Theory of Acceptance and Use of Technology by Venkatesh (2003). Since e-government service is for every citizen, a leading-edge technology should not be adopted unless most citizens are ready to use it, (Lee and Hong, 2002), the governments should provide the channels which people have the technology and skills to access it, (Dalziel 2004).

Susanto, Goodwin and Paul (2006), proposes a Six-Level Model of SMS-based e-Government. The model suggests that SMS-based e-government services can be classified into six levels based on the service offerings: *Listen*, *Notification*, *Pull-based Information*, *Communication*, *Transaction*, and *Integration* as illustrated in the Figure 2.4.

**Figure 2.4: A Six-Level Model of SMS-Based e-Government (Adopted From Susanto, Goodwin and Paul, 2006)**



- i) **Listen level** - Most of the systems in this level use SMS to enable citizens to send messages directly to government agencies. However, these systems are not designed to reply to the input-messages or to inform the sender of the following actions. This one-way communication mode

from citizens to government is categorized as the Listen level. The main benefit contributed by this level is accessibility. Citizens have a channel to share or broadcast their views on important issues directly to their government. It contributes to the citizens' empowerment. However, the lack of responsiveness and transparency, as well as protection for the senders' privacy and security prevent the public from actively participating in using these services (Signo, 2006).

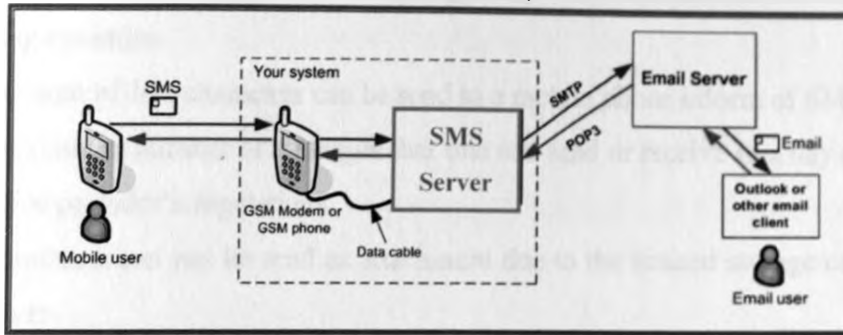
- ii) **Notification level** - In the second level, current SMS-based e-government systems have enabled one-way communication from government to citizens. The government is able to notify citizens about their personal information and to broadcast important public information. This model classifies these applications as Notification level. Services in this level use Push-based mechanism, which sends the messages to citizens activated by data on the server, not by a user's request.
- iii) **Pull-based Information level** - Current SMS-based e-government systems also provide two-way communication that enables citizens to access public or personal information by sending a request-message. The services use the pull method: citizens send a 'request SMS' to the service and the replied service is sent back to the sender's handset via SMS. The information options provided by services in this level are limited and the request-text must be in a certain format. The dominant benefits delivered by this level are accessibility, availability, responsiveness, and timeliness. Citizens can access their personal or public information any time any where. Some challenges in this level include how to provide cheap or even free notification services (value for money benefit), how to choose the information services which are really needed by citizens (awareness), and how to provide a simple, easy to use and remember request message formats (usability).
- iv) **Communication level** - Some SMS-based e-government systems provide two-way communication between government and citizens in which the people can inquire, complain or report about anything (without worrying about the text format) and get responses/replies immediately. Since it enables citizens to express their opinion, comment or query to the government using sentences without worrying about the text format and getting the reply immediately, this level offers more benefits in accessibility, availability, responsiveness, courtesy and helpfulness, usability, timeliness, accountability, and transparency. Potential issues at this level are low protection for privacy and security of the senders, and lack of the assurance of fast and effective response to any input-messages (the responsiveness).

- v) **Transaction level** - Some SMS-based e-government systems can process transactions. Through these systems citizens can pay bills and send or update their personal data through SMS. This level offers more benefits in the accessibility, availability, accuracy, responsiveness, courtesy and helpfulness, timeliness, trust, privacy, and security. However, trust and security are still the dominant issues.
- vi) **Integration level** - The ultimate level of this model is when all the SMS-based systems are integrated and organized in a single portal so people just send messages to a single service number for all services. This level predicts the integrated-SMS systems will be also integrated with the Internet/web-based e-government systems so citizens have options whether accessing the services by sending SMS to one number or through the Internet at one web address. The SMS and the Internet may complement each other in a service, for example: a citizen may send form or pay a public service electronically by Internet and get notification via SMS, or pay the services through SMS and get the receipt by email. As the ultimate level, this level should accommodate all of the benefits of mobile governments including value for money, high quality of service, efficient transaction, and strategic data benefits. Interoperability among the SMS-based systems, databases, and the Internet-based systems will be a potential issue.

### 2.3. EMAIL2SMS Tools

So far, none among the Web-based models and SMS-based models has been independently successful. Several attempts have been made to come up with an integrated model that integrates features of these two models to overcome the limitations of the two models. Attempts made so far to enhance effectiveness; efficiency and reliability of the email tool have led to the development of EMAIL2SMS tools. The EMAIL2SMS tools enable one to send SMS messages to any single or multiple destinations (mobile numbers) from an e-mail account and vice versa. E-mails can be delivered to the user's mobile phone at a much personal and faster way. Using this tool, one is able to send messages to any local or international mobile phone as illustrated in the figure below;

**Figure 2.5: Email to SMS System Architecture (Adopted From OZeki SMS Technology Manual, 2010)**



In this architecture, SMS Gateway forwards an incoming e-mail as an SMS message to a specified phone number. It periodically downloads e-mails from a POP3 e-mail account and forwards the first 160 characters of the body of an e-mail to the phone number specified in the configuration form of the user. It also forwards an e-mail as an SMS message to a phone number (or phone numbers) specified in the subject line of the e-mail. However, this calls for use of sophisticated high-end communication devices, for example, the Nokia N97 mobile phone. Such devices are still expensive and unaffordable to citizens in developing countries. This creates a need to bridge the digital divide between the developed and the developing countries.

#### 2.4. Nokia Messaging System

Mobile manufacturing companies have also developed some high-end mobile phones that attempt to integrate Email and SMS services. An example is the Nokia N97 series which provides Nokia Messaging tool. Nokia Messaging tool enables users to quickly set up, access, and use their email on their Nokia devices through a service that is optimized for mobile email. The Nokia Messaging connects to most email services such as Gmail, Yahoo, Hotmail, etc. and excludes corporate email like Microsoft Exchange, (Macias 2009). This tool enables a user to send SMS to an Email account of the recipient and vice versa. When a new email just like a SMS is received in the user's inbox, the user is notified through a preset alert signal, (Macias 2009).

#### 2.5. Limitations of Email2SMS Systems

The Email2SMS tools have not been without limitations some of which are;



- a) Only specific mobile handsets that are WAP-enabled can be used to send SMS to a mail server or mail to SMS. Such mobile phones are still expensive not accessible to the majority of citizens in developing countries
- b) Only a maximum of 160 characters can be send to a mobile phone inform of SMS
- c) There is a maximum number of messages that one can send or receive in a day depending on the mobile service provider's regulations
- d) Excess information can not be send as attachment due to the limited storage capacities of these mobile devices.
- e) The short messages (SMS) are in summary form with most of words in acronyms, abbreviated or symbols used. This makes it difficult for the recipient unfamiliar with these acronyms, abbreviations or symbols to understand the content of the message making it an unreliable mode of transmitting critical government information

This leaves a need to explore more on the interaction and transaction phases shared by both the web-based and SMS-based e-government models to reap from the benefits of both and minimize on the limitations of both.

## **2.6. Addressing Challenges of Implementing the e-Government Models in Developing Countries**

It is generally agreeable that, there has been a mismatch of the technological design for accessing e-government systems and the skills and access to the technology by the citizens. Many developing countries face problems of lack of internet infrastructure, internet illiteracy, and high costs of internet and mobile phone tariffs. However, these countries have tirelessly put a lot of effort to reduce or eliminate these problems. African telecommunications companies for example are trying to de-link from the costly international Internet routes by building their own exchange points to cut on charges and investing heavily on infrastructure. In Kenya for example, there are three live optical fibre cables, that is, the East Africa Marine System, SeaCom and EASSy that have led to optimal connectivity charges, (Daily Nation, 13/8/2010, pg. 29). Recently, in Kenya, following competition between Mobile Telecommunications Companies, voice call and SMS tariffs have drastically dropped in favour of the consumers.



Other initiatives by African countries are those of starting “digital villages” in every constituency/district exemplified by the Kenya Government with the help of the private sector (Directorate of e-government, Kenya, 2009). In the year 2008, Kenya kicked off the ambitious Digital Villages project designed to connect the whole country, from rural to urban areas, and accelerate growth of information communication technology (ICT). The project was a government and private-sector initiative, mapped out using political districts where every constituency represented in parliament was to get a minimum of eight workstations, either PCs or monitors hooked to PCs, grouped within a 15-kilometer radius, (Daily Nation, February 02, 2008). Basically, the Digital Village initiative was rolled with the purpose of narrowing the digital divide between rural and urban areas and accelerating the growth of ICT in Kenya enabling citizens at the grassroots to have access to Internet and email facilities, (Nation Business Daily, September 27, 2010). A lot of training on ICT is being carried out in all levels of education and other sectors in these developing countries. This means that ICT illiteracy is being reduced making these countries’ populace well versed with web-based e-government models with the major challenge being the lack of sufficient ICT infrastructure. In these developing countries mobile phones are becoming low in cost, widely used, and citizens are more familiar with the short message service (SMS) application. This makes the SMS-Based e-government model applicable in these developing countries.

## CHAPTER 3

### THE PROPOSED EMAIL-SMS ALERT SYSTEM FOR ENHANCING THE WEB-BASED E-GOVERNMENT MODELS

#### 3.1. Introduction

Research shows that e-mail has become the most popular mode of communication and transfer of information between G2G, G2B and G2C especially at these days when developing countries are investing heavily to improve ICT infrastructure, (Backus, 2001). Information created virtually in any application can be send to recipients through their e-mail accounts. On the other hand, SMS which is also a popular tool of communication, (Decker, 2006), is quick, efficient, cheap and convenient and it has been used around the world for different purposes, (Nonyongo, Mabusela and Monene, 2007).

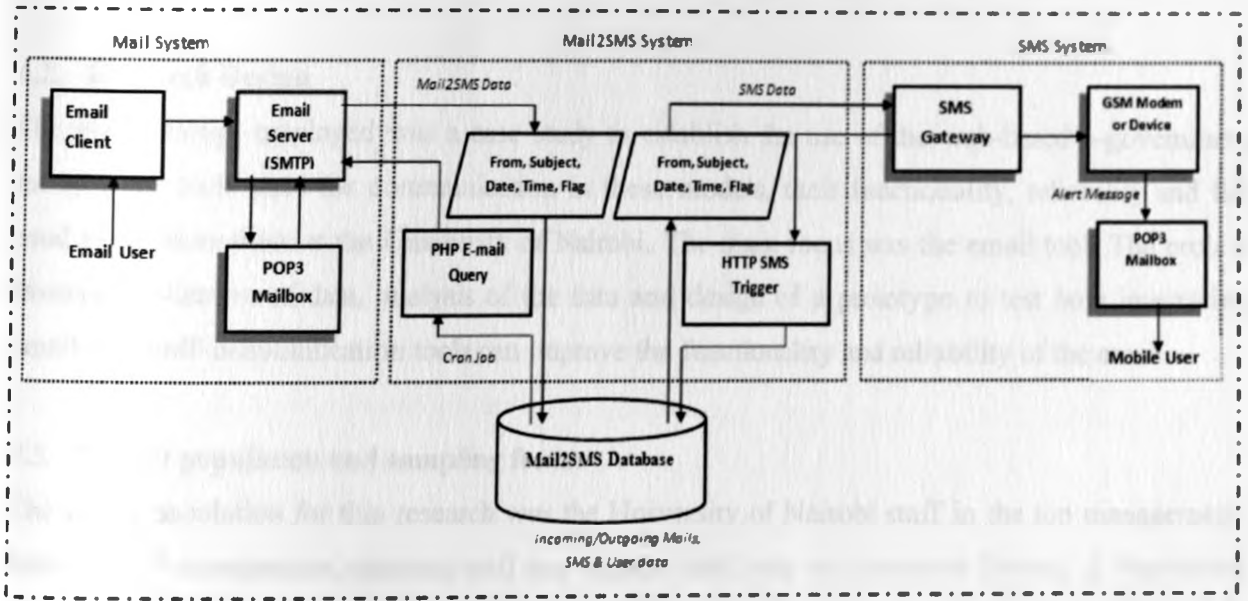
#### 3.2. The Solution of Enhancing Web-Based E-Government Model

The proposed solution was to enhance the Web-based e-Government model by improving the functionality, reliability, effectiveness and efficiency of email communication tool commonly used in this model. The solution sought to synchronize communication between government SMS gateways and mail servers. This was to integrate both the web-based models (with focus on the email tool) and the SMS models. The main objective was to have a communication model that eases the access of information and facilitate almost instantaneous response to information and services send through E-mails by sending instant alerts messages to the recipient's mobile phones when new emails are registered in their inbox. This aimed at eliminating the major limitation of e-mails where one can not notice when a new email is send to him/her especially when offline. Situations where staff in offices and citizens receive critical information through their e-mail accounts but fail to respond to it immediately because they are not near their computers connected to Internet will be eliminated through SMS alerts that are send to their mobile phones whenever a new mail is registered in the recipient's inbox. This model would eliminate cunning and unfaithful Government staff and agencies who evade duties assigned to them via email on excuse of not being aware of email messages send to them. The enhanced models will fill the gap between the email and the SMS as communication tools used by government to private entities.

### 3.3. Proposed Email-SMS Alert System Architecture

The proposed design sought to interface an email server and a SMS gateway to ensure that when new messages are received in an email server, then an SMS showing the sender's address, Subject, Date, Time and the email Flag/Priority is send to the recipient's mobile phone. **Figure 3.1** shows the architectural design of the Email-SMS Alert System;

**Figure 3.1 Proposed Email-SMS Alert System Architecture**



A PHP script was to be written to constantly query the email server for any new emails received. The query returns the email address of the sender, subject, date, time and flag information in the email that will indicate whether the mail is and urgent one or not. This information is written to a database. The SMS gateway sent http triggers to the database for the new data which will in turn constitute the notification SMS send to the recipient's mobile number that is also stored in the database. A cron job was set up to execute the PHP script at some intervals of time for example, after every one (1) minute. On receiving a notification message, the recipient can then log in to read the email on his or her computer, in the nearest Internet Access Centre for example in a Digital Centre, Cyber Café or a WAP enabled phone. This will ensure that an owner of an email account can be updated on every new email message sent to him or her and respond to it in time. This is expected to reduce the information turn-around time in organizations.

## CHAPTER 4

### METHODOLOGY

#### 4.1. Introduction

The main objective of this research was to investigate the functionality and reliability of the email as a communication tool used mostly in government agencies. The research was a case study of the implementation of Web-based e-government models at the University of Nairobi which is one of the government agencies. It was aimed at improving the existing web-based e-government models implemented in the Government agencies.

#### 4.2. Research Design

The methodology employed was a case study to establish the use of the web-based e-government models, the tools used for communication in these models, their functionality, reliability and the need to improve them at the University of Nairobi. The main focus was the email tool. The project involved collection of data, analysis of the data and design of a prototype to test how integrating email and SMS communication tools can improve the functionality and reliability of the email.

#### 4.3. Target population and sampling frame

The target population for this research was the University of Nairobi staff in the top management, middle level management, teaching staff and support staff who are computer literate. A Population of 1200 University of Nairobi members of staff who are computer literate was targeted for this study. Using a confidence level of 95% and confidence interval of 6, the sample size was estimated to 218 respondents from the targeted population. This was done by use of an online sample size calculator for statistics available at <http://www.surveysystem.com/sscalc.htm>, accessed on 5<sup>th</sup>, Feb 2011. Stratified sampling was further used to group the target population in to four strata; top management, middle level management, teaching staff and support staff.

#### 4.4. Data Collection Instruments

In order to investigate the functionality and reliability of the communication tools used for communication in the University of Nairobi, a questionnaire was mainly used from the sampled population. A sample of the questionnaire is attached in the appendix. The questionnaires were initially piloted to test for ambiguity and ease of response using few respondents.

The validity of the questionnaire was tested by subjecting it to a few respondents. Content validity and relevance was analyzed through peer-review. Statistical package for Social Sciences (SPSS) was used to determine the *Cronbach Alpha coefficient of validity*.

#### **4.5. Analysis of Data**

The collected data was prepared for analysis SPSS. Descriptive statistics was used mainly for analysis of the data. Frequency tables, charts and crosstab tables were used for presentation of the results

#### **4.6. Prototype Design**

Based on the findings, a prototype of the proposed E-mail-SMS alert system was designed. This involved designing the system Use case, database, configuring an e-mail server, SMS gateway, and then writing PHP scripts for synchronizing the communication between the email server and SMS gateway. Tests of sending e-mails and receiving alert messages inform of SMSs were carried out to ascertain the functionality and reliability of the system.

## CHAPTER 5

### FINDINGS, ANALYSIS AND INTERPRETATIONS

#### 5.1 Introduction

The purpose of collecting data for this project was to carry out a need assessment of improving the web-based e-government models with focus on the email communication tool. This chapter presents the research findings and the researcher's interpretation from data collected from respondents.

#### 5.2 Data Processing and analysis

Data processing involved editing, coding and tabulation of the collected raw data while analysis involved calculation of some parameters from the coded data in order to get patterns or relationship among data items. In this study, a total of eighty four (84) questionnaires were administered on University of Nairobi staff stratified in strata; top management, middle level management, teaching staff and support staff.

##### 5.2.1 Coding the responses

In order to analyze the data using SPSS Statistical software, numbers were assigned to all closed and Likert-type questions, while for open-ended questions, similar ideas were identified, grouped and given numbers for ease of coding.

##### 5.2.2 Reliability and Validity testing

Before the data analysis was done, reliable and validity tests were carried out on the data collection instruments. In this case, the techniques used were;

- Face validity through peer review and experts judgment
- Reliability analysis using Cronbach Alpha
- Content validity using Factor analysis

###### 5.2.2.1 Reliability test

Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects. There are two ways

that reliability is usually estimated namely *test/retest* and *internal consistency*. The idea behind test/retest is that you should get the same on several tests. On the other hand, *internal consistency* estimates reliability by grouping questions in a questionnaire that measure the *same concept*

### 5.2.2.2 Validity test

Validity refers to the best available approximation to the truth or falsity of a given inference, proposition or conclusion. Three commonly used validity testing techniques are construct, content and face validity.

- *Construct validity* refers to the totality of evidence about whether a particular operationalization of a construct adequately represents what is intended by theoretical account of the construct being measured. Such lines of evidence include statistical analyses of the internal structure of the test including the relationships between responses to different test items.
- *Content validity* is a non-statistical type of validity that involves the systematic examination of the test content to determine whether it covers a representative sample of the behaviour domain. Such validity testing is done by a panel of experts who review the specifications of selected items. Through their recommendation, the content validity of a test can be improved.
- *Face validity* is also a non-statistical validation method used to get opinions on whether an instrument “looks like” it is going to measure what it is supposed to measure. While content validity requires more rigorous analysis by subject experts, face validity only requires an intuitive judgment.

### 5.2.3 Reliability Analysis of the collected data

The reliability analysis on Likert-type perception questions was done aiming at establishing whether our revised questionnaires met the proposed minimum Cronbach Alpha coefficient. On analysis using the SPSS, the Cronbach Alpha coefficient value obtained was 0.728 as in the Table 5.1.

**Table 5.1: Reliability test of the questionnaire**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.726	.758	28

#### **5.2.4 Face validation**

In order to investigate the face validity of the research instruments, the questionnaire was given out to technical and nontechnical people to check on whether the questions were clear and in line with this research questions. Changes were made before the questionnaires were administered as recommended by the reviewers.

### **5.3 Detailed Analysis of Data Collected**

In this section a detailed analysis and discussion of the valid data obtained from the preliminary investigations using 84 questionnaires is presented.

#### **5.3.1 E-government, E-governance and Medium of Communication**

The Government of Kenya through the Directorate of e-Government in the Office of the President has initiated e-government services to its citizens through the various government departments and agencies, (Directorate of e-government, Kenya, 2009). This study sought to find out whether citizens and government employees are familiar with e-government and e-governance advocated by the government of Kenya and whether e-governance is implemented in their organizations. Citizens who are familiar with e-government and e-governance are those who either use e-government services or are aware of the e-government services offered through their departments or agencies. From the data obtained, most of the respondents indicated that they are familiar with e-government and e-governance. This was evidenced by 50.0% of the respondents who agreed and 27.4% strongly agreed to be familiar with the terms e-government and e-governance, see **Table 5.2**.

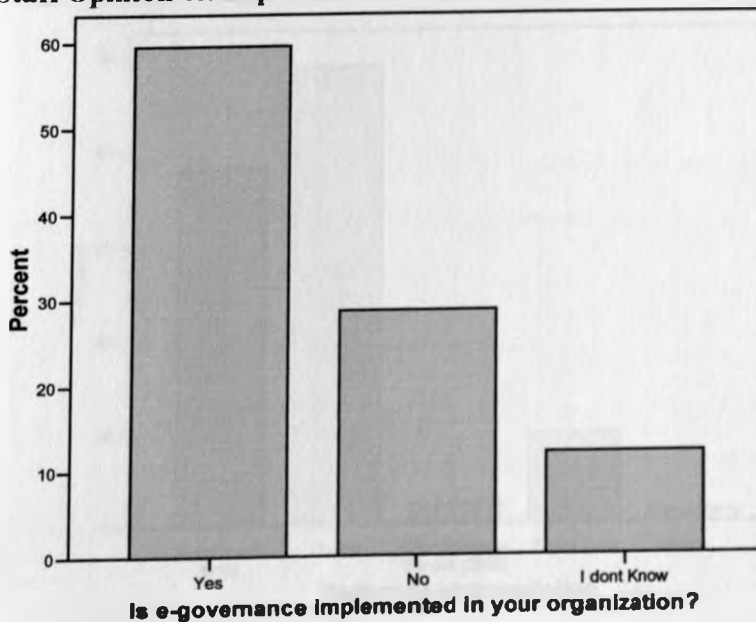


**Table 5.2: Staff Opinion on Familiarity with e-Government and e-governance**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	23	27.4	27.4	27.4
	Agree	42	50.0	50.0	77.4
	Not Sure	12	14.3	14.3	91.7
	Disagree	6	7.1	7.1	98.8
	Strongly disagree	1	1.2	1.2	100.0
	Total		84	100.0	100.0

On whether e-governance is implemented in government agencies like University of Nairobi, the study sought the opinion of the respondents who are familiar with e-governance on whether e-government is being implemented in their organization. The study established that majority of the respondents were aware that e-governance is being implemented in their organization. This was evidenced by 59.5% of the respondents who indicated to be aware of e-governance in their organization. However, 28.6% of the respondents disagreed that e-governance is implemented in their organization with 11.9% indicating to be not aware of e-governance use in their organization, see **Figure 5.1**. This was an indication that the e-governance is yet to be fully populated among the citizens and government staff.

**Figure 5.1: Staff Opinion on Implementation of e-Governance in their Organization**

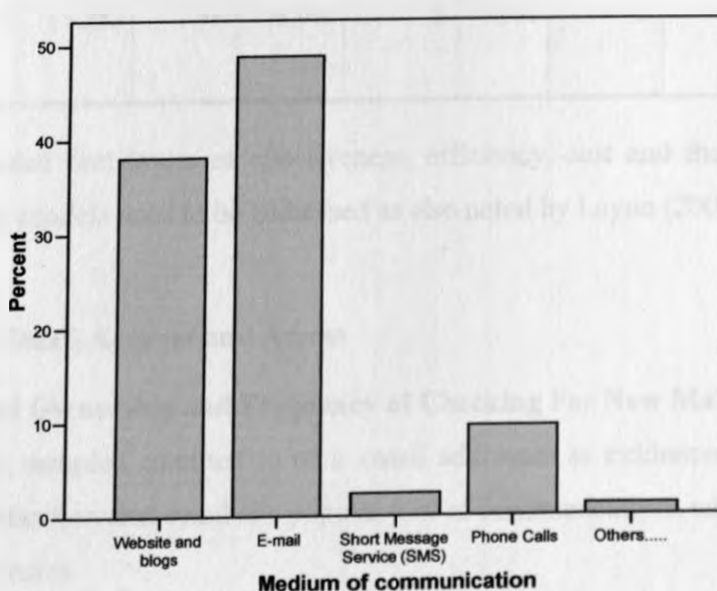


The study also sought to establish the medium of communication used in e-governance in the organization. This study found that Websites and email are the commonly used medium of communication in Government agencies to offer services to the citizens and employees. A cumulative percentage of 86.9% of the respondents who admitted that websites, blogs and email are the widely used medium of communication, see **Table 5.3**. Of the respondents, 38.1% indicated that websites and blogs are used as medium of communication and 48.8% indicated that e-mails were being used in their organization. This indicated that email tool was the widely used tool of communication, see **Figure 5.2**.

**Table 5.3: Medium of Communication Used in e-Governance**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Website and blogs	32	38.1	38.1	38.1
	E-mail	41	48.8	48.8	86.9
	Short Message Service (SMS)	2	2.4	2.4	89.3
	Phone Calls	8	9.5	9.5	98.8
	Others.....	1	1.2	1.2	100.0
	Total	84	100.0	100.0	

**Figure 5.2: Commonly Used Medium of Communication**



Siebel (2005), in his study indicates that most of the governments and government agencies offer e-government services through the Internet as found out in this study. This means that information in the government departments and agencies is published on websites for employees to access and conveyed through email.

On the effectiveness, efficiency, affordability and reliability of the communication medium used, most of the respondents tend to agree, but a low percent strongly agree with this as indicated in **Table 5.4**.

**Table 5:4 Efficiency, Effectiveness and Reliability of the Communication Tool**

	Strongly Agree		Agree		Not sure		Disagree		Strongly Disagree	
	Count	%	Count	%	Count	%	Count	%	Count	%
The communication medium used in my organization is effective and efficient	8	11.1%	52	72.2%	2	2.8%	9	12.5%	1	1.4%
The communication medium used in my organization is affordable	11	15.3%	52	72.2%	6	8.3%	2	2.8%	1	1.4%
The communication medium used in my organization is reliable	8	11.3%	56	78.9%	5	7.0%	1	1.4%	1	1.4%

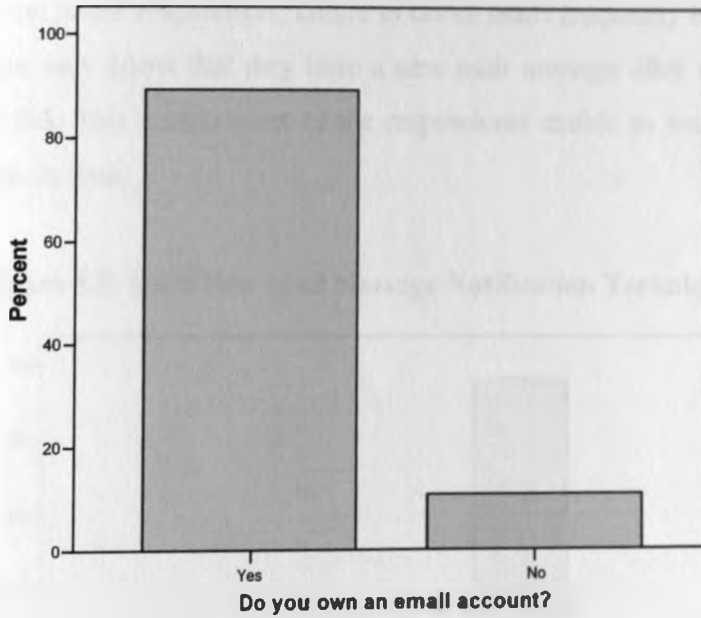
The findings here indicated that issues of effectiveness, efficiency, cost and the reliability of the web-based e-government models need to be addressed as also noted by Layne (2001) in his study.

### 5.3.2 Information on Email Account and Access

#### 5.3.2.1: Email Account Ownership and Frequency of Checking For New Mails

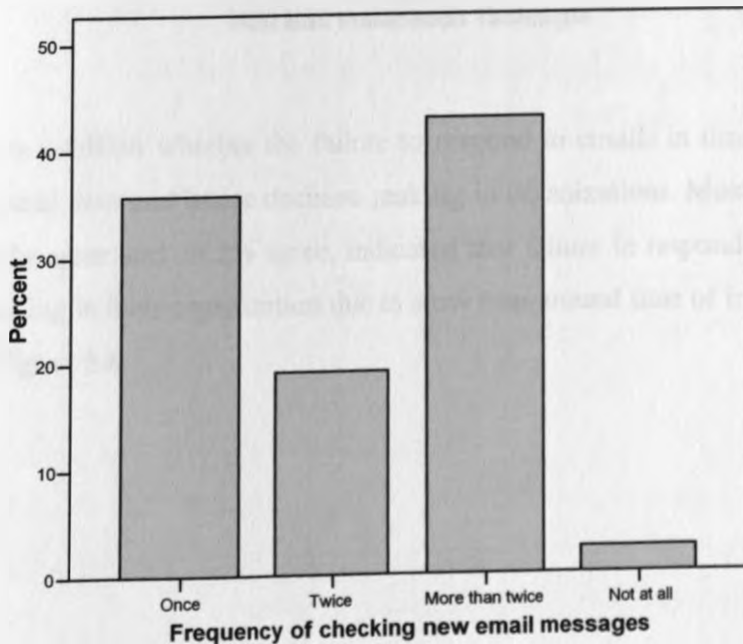
Most of the respondents sampled admitted to own email addresses as evidenced by 89.3% as in **Figure 5.3**. This is an indication that email is a popular tool of communications used in Government department and other agencies.

**Figure 5.3: Email Account Ownership**



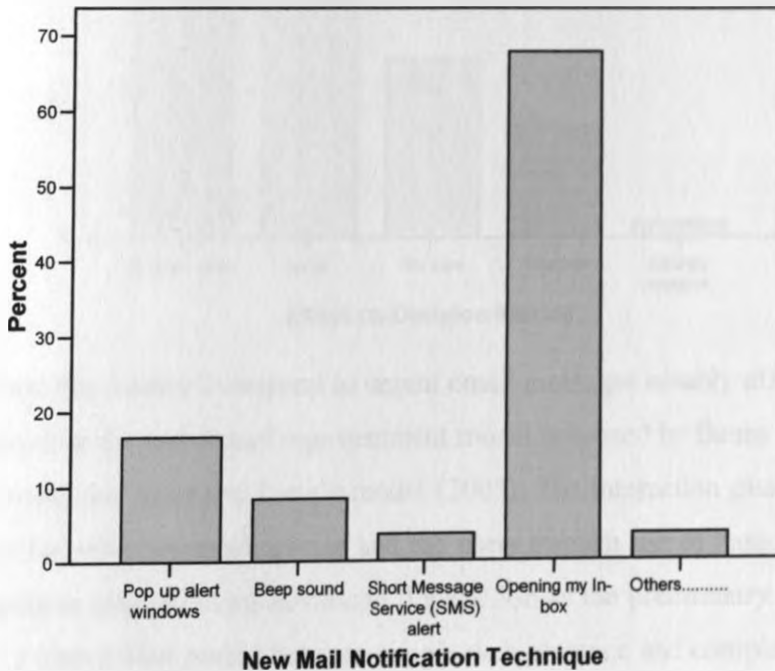
On how often those who own email accounts check for new emails, most of the respondents indicated that they are able to check for new emails at least twice per day which is also an indication that email is frequently used as tool of communication and most of information is conveyed through email, see **Figure 5.4**.

**Figure 5.4: How Frequently Email Account Holders Check for New Mails**



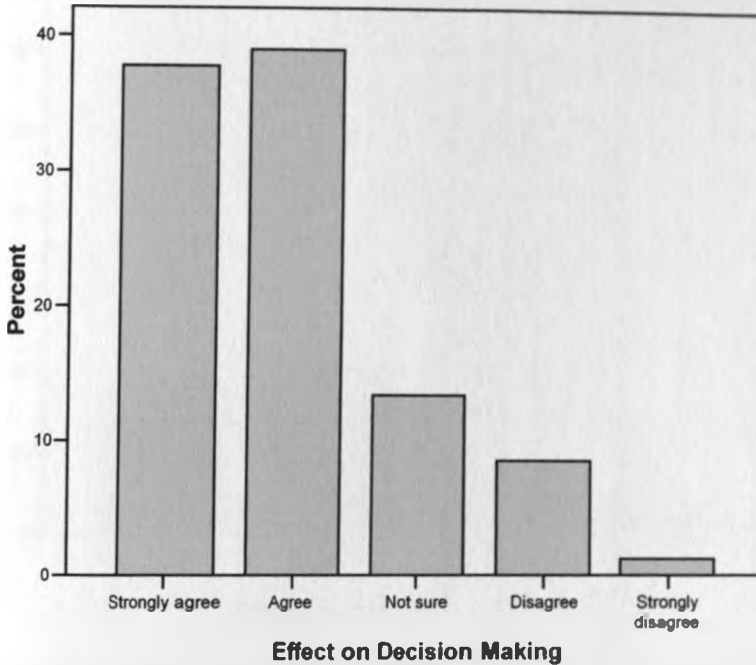
This study sought to establish how email account holders know when a new email message has been sent to them. According to the respondents, failure to check mails frequently is attributed to the fact that most of them can only know that they have a new mail message after opening their account inboxes, see **Figure 5.5**. This makes most of the respondents unable to respond to urgent email messages send to them in time.

**Figure 5.5: Used New Mail Message Notification Technique**



This study sought to establish whether the failure to respond to emails in time adversely affected information turn-around time and hence decision making in organizations. Most of the respondents, whom 37.8% strongly agree and 39.0% agree, indicated that failure to respond to emails adversely affected decision making in their organization due to slow turn-around time of information conveyed through email, see **Figure 5.6**.

**Figure 5.6: Opinion on Effect of Failure to Respond to Urgent Mails on Decision Making**



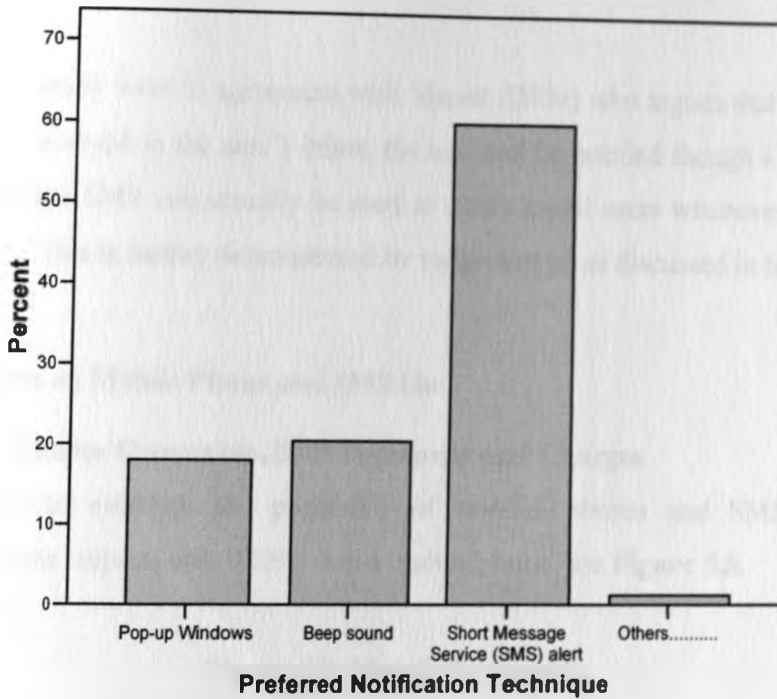
The study established that failure to respond to urgent email messages notably affects the interaction and transaction phases of the web-based e-government model proposed by Baum & Di Maio (2001), UN's Five-stage model and Siau and Long's model (2005). The interaction phase provides simple interaction between the governments/agencies and the users through use of basic search engines, e-mail systems, as well as official forms download. Interaction as the preliminary step of transaction can be regarded as a transitional period between simple web presence and complete transaction. The transaction phase enable users (including both individual citizens and business) to conduct complete online transactions. Governments create websites that allow users to conduct transactions online, for example, license application and procurement.

This study established that the web-based e-government models can be slow mode of service delivery, especially at the interaction and transaction phases if information turn-around time is not put into consideration during the design and implementation of these models.

### **5.3.2.2: Preferred New Email Notification Technique**

This study sought the opinion of the respondents on the notification technique they would prefer for new mail message sent to their inboxes. Most of the respondents, 60.2%, indicated that that they would prefer to be notified about new mail through Short Message Services (SMS), see **Figure 5.7**.

**Figure 5.7: Preferred new mail notification technique**



Notification of new emails through SMS will enable government employees and citizens to be able to respond to urgent mails and new information posted on websites from wherever they are as 94% of the respondents indicated that when they are out office, they can check for new mails either in a cyber café, WAP enabled mobile phones, Modems on their computers or from a digital village, see **Table 5.5**. This will help to improve the interaction and transaction phases propagated by most of the web-based e-government models.

**Table 5.5: Email Access places Other Than in the Office**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cyber café	36	42.9	42.9	42.9
	WAP enabled mobile phone	30	35.7	35.7	78.6
	Use of Modem on my computer	11	13.1	13.1	91.7
	Digital Village Centre	2	2.4	2.4	94.0
	Don't access at all	5	6.0	6.0	100.0
	<b>Total</b>	<b>84</b>	<b>100.0</b>	<b>100.0</b>	

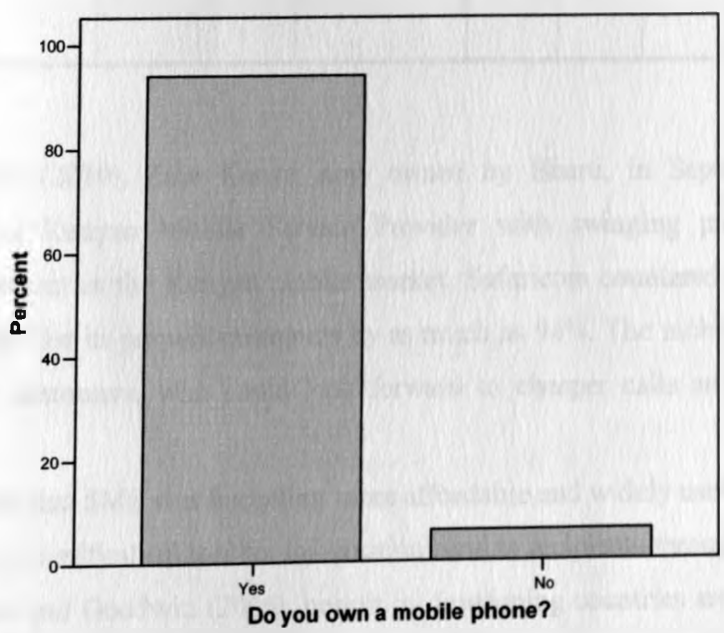
The finding in this study were in agreement with Macias (2009) who argues that when a new email just like a SMS is received in the user's inbox, the user can be notified though a preset alert signal. This study shows that SMS can actually be used to notify email users whenever they receive new mail in their inbox. This is further demonstrated by the prototype as discussed in the chapter 6.

### 5.3.3 Information on Mobile Phone and SMS Use

#### 5.3.3.1: Mobile Phones Ownership, SMS Popularity and Charges

This study sought to establish the popularity of mobiles phones and SMS use among the respondents. From the respondents, 98.6% own a mobile phone, see **Figure 5.8**.

**Figure 5.8: Mobile Ownership**



On SMS use and charges, most of the respondents, 42.9% strongly agree and 48.8% agree that the current downward trend of SMS charges has made SMS become an affordable tool of communication among mobile users. This has made SMS a popular tool of communication compared to email as according to 47.6% who strongly agree and 42.9% who agree of the respondents, see **Table 5.6**.



**Table 5.6: SMS Charges and Popularity**

	Strongly Agree		Agree		Not sure		Disagree		Strongly disagree		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
According to the current trend in mobile phone service charges, SMS charges have become affordable	36	42.9%	41	48.8%	1	1.2%	3	3.6%	3	3.6%	84	100.0%
SMS has become a popular tool of communication owing to its affordable charges	40	47.6%	36	42.9%	4	4.8%	4	4.8%	0	.0%	84	100.0%

According to Emeka (2010), Zain Kenya, now owned by Bharti, in September 2010, rattled Safaricom, the main Kenyan Mobile Service Provider with swinging price cuts, triggering unprecedented movement in the Kenyan mobile market. Safaricom countered this by slashing the cost of SMS messages for its prepaid customers by as much as 94%. The mobile services price war was good news for customers, who could look forward to cheaper calls and SMS messages in Kenya.

This study established that SMS was becoming more affordable and widely used for communication hence qualifying it as a notification tool for information send to recipients through the email.

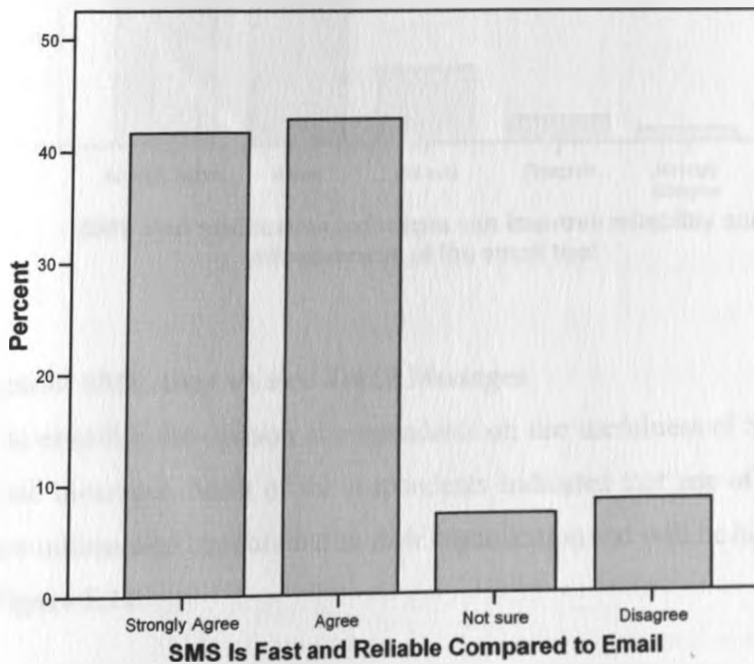
According to Susanto and Goodwin (2006), people in developing countries are more familiar with SMS than Internet, the number of SMS users is much higher, the SMS infrastructure is more extensive, and the SMS cost as well as mobile phone prices are much lower and affordable compared to the Internet and PCs, indicating that SMS-based e-government could be the most appropriate channel to deliver e-government services in developing countries. Based on the technology acceptance theories, a cheaper service/technology might have a higher speed in adoption (Innovations Diffusion Theory by Rogers in Wikipedia 2008), and the facilitation conditions (the available resources and knowledge) have a direct influence on the usage (Unified Theory of

Acceptance and Use of Technology by Venkatesh et al 2003). This explains why SMS has become a popular tool of communication among the mobile phone users.

### 5.3.3.2 SMS Reliability and How it Can Improve Email Reliability

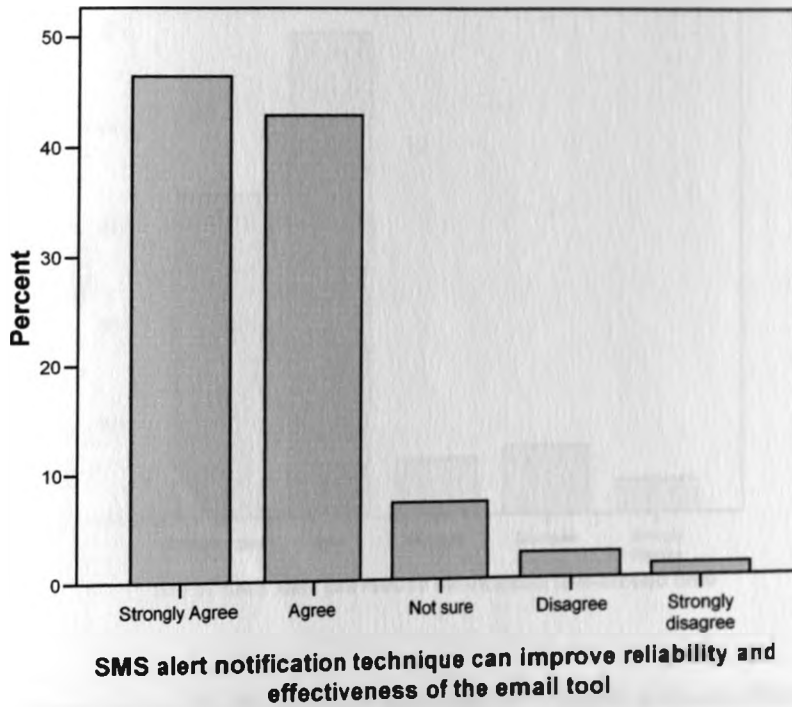
This study sought to establish the reliability of SMS as compared to that of email tool and whether SMS can be used to improve reliability of email. Most of the respondents, whom 41.7% strongly agree and 42.9% agree, admitted that SMS is a faster and reliable tool of communication compared to email, see **Figure 5.9**.

**Figure 5.9: SMS Reliability As Compared To Email Tool**



Most of the respondents, whom 46.4% strongly agree and 42.9% agree, preferred SMS as a notification tool for newly received email messages. This will enhance quick response especially to urgent email messages see **Figure 5.10**.

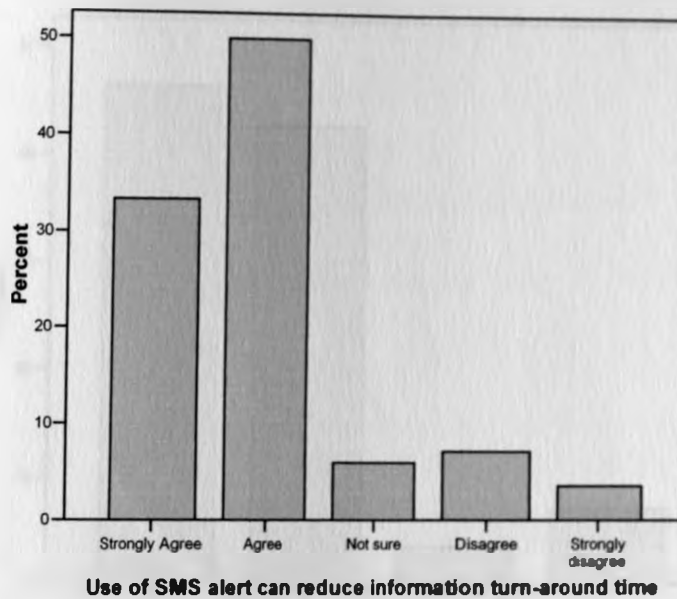
**Figure 5.10: Use of SMS Notification Technique to Improve Email Tool**



### 5.3.3.3 Usefulness of SMS Alert on new Email Messages

This study sought to establish the opinion of respondents on use usefulness of SMS notification for newly received email messages. Most of the respondents indicated that use of SMS alert for new emails would reduce information turn-around in their organization and will be highly useful for their organization, see **Figure 5.11**.

**Figure 5.11: Use of SMS Notification to Reduce Information Turn-Around Time**



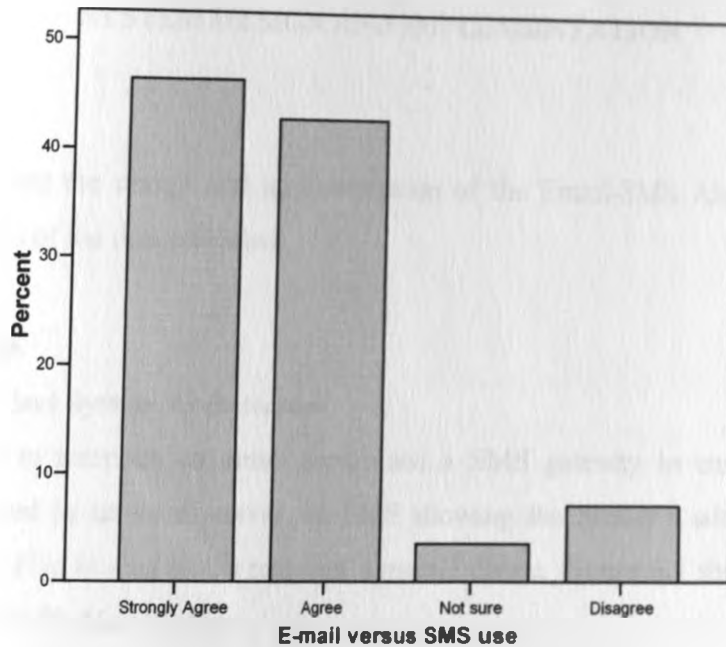
Most of the respondents, whom 33.3% strongly agree and 50% agree, indicated that use of SMS alert technique can improve the reliability of email communication tool. This implies that SMS can be used as a notification tool for new email messages that are received in the user's inbox, prompting the user to open his/her inbox to read the mail wherever he or she is.

#### **5.3.3.4 Email versus SMS Use for Office Communication**

Research show that e-mail is the most popular mode of communication and transfer of information between G2G, G2B and G2C especially these days when developing countries are investing heavily to improve ICT infrastructure (Backus, 2001).

This study sought to establish the use of email as a tool of communication in government offices. It was established that email was frequently used for office communication than SMS. Among the respondents, 46.4% strongly agreed and 42.9% agreed that email is frequently used in office communication than SMS see **Figure 5.12**.

**Figure 5.12: Email Use versus SMS Use**



This finding was attributed to the fact that information created virtually in any application can be sent to recipients through their e-mail accounts even as attachments compared to the limit of 160 characters per a SMS.

However, on the other hand, SMS is becoming popular as a tool of communication, (Decker 2006). Research on SMS communication confirms that SMS communication is quick, efficient, cheap and convenient and it has been used around the world for different purposes, however, one can only send a maximum of 160 characters when using SMS, (Nonyongo, Mabusela and Monene, 2007).

It is based on this literature and the response obtained from this study that an Email-SMS Alert Systems was designed and prototyped. This can be implemented at interactive and transaction phases of the Web-based E-government Models to improve the interaction between all government stakeholders for efficient and reliable service delivery.

## CHAPTER 6

### SYSTEM DESIGN AND IMPLEMENTATION

#### 6.1 Introduction

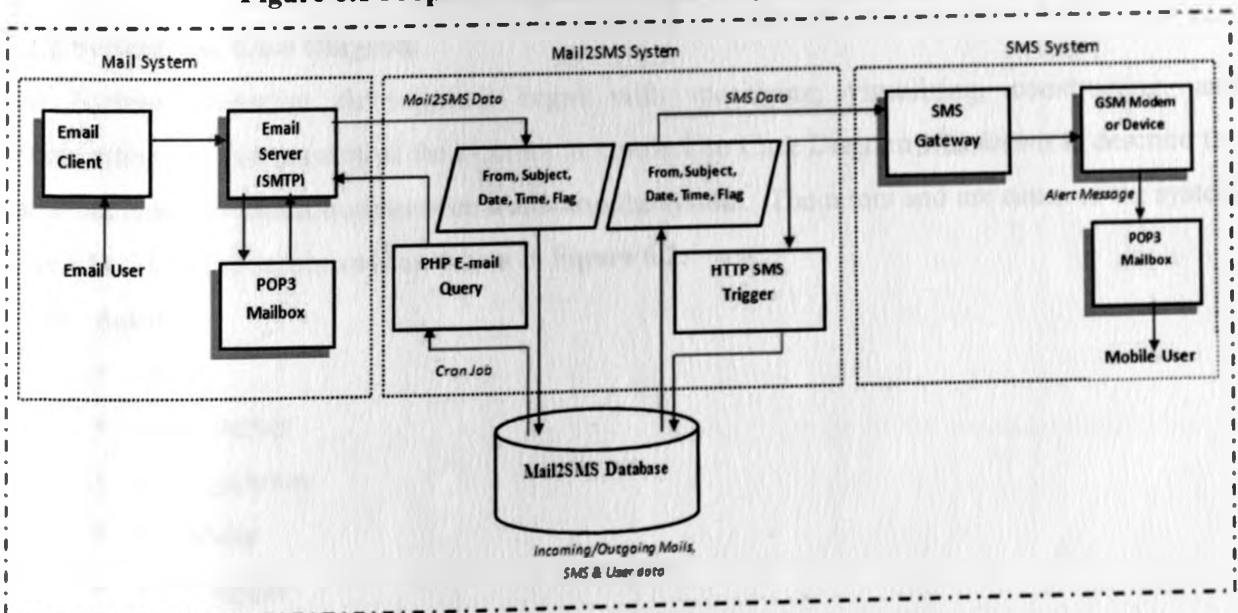
This chapter discusses the design and implementation of the Email-SMS Alert System prototype based on the analysis of the data collected.

#### 6.2 System Design

##### 6.2.1 Email-SMS Alert System Architecture

The system sought to interface an email server and a SMS gateway to ensure that when new messages are received in an email server, an SMS showing the Sender's address, Subject, Date, Time and the Email Flag is send to the recipient's mobile phone. Figure 6.1 shows the architectural design of the Email-SMS Alert System:

**Figure 6.1 Proposed Email-SMS Alert System Architecture**



A PHP script was written to constantly query the email server for new emails received. The query will return the email address of the sender, subject, date, time and flag information in the email that will indicate whether the mail is urgent or not. This information will be written to a database. The SMS gateway through the http trigger listens through port 5050 to the database for the new data

added which in send as a notification SMS through the SMS gateway to the recipient's mobile number that is stored in the database. A cron job was set up through the Windows Scheduler to execute the PHP script at regular intervals, for example, after one (1) minute, see excerpt below:

### ***Cron Job Configurations***

*Start in:*

*C:\wamp\www\kyalo*

*Run:*

*C:\wamp\bin\php\php5.3.0\php-win.exe -f C:\wamp\www\kyalo\sms\_sender.php*

On receiving the notification SMS, the recipient can then log in to the inbox read the email on his or her computer, in the nearest Internet Access Centre for example in a Digital Centre, Cyber Café or a WAP enabled phone. This will ensure that an owner of an email account can be updated on every new email message sent to him or her and respond to it in time. This is expected to reduce the information turn-around time in organizations.

## **6.2.2 System Use Case Diagram**

The System prototype development began with specifying, visualizing, constructing, and documenting the components of the systems. A system Use Case Diagram was drawn to describe the set of scenarios of interaction between a user and the system. The actors and use cases of the system were identified and represented as shown in **Figure 6.2**.

### **i) Actors;**

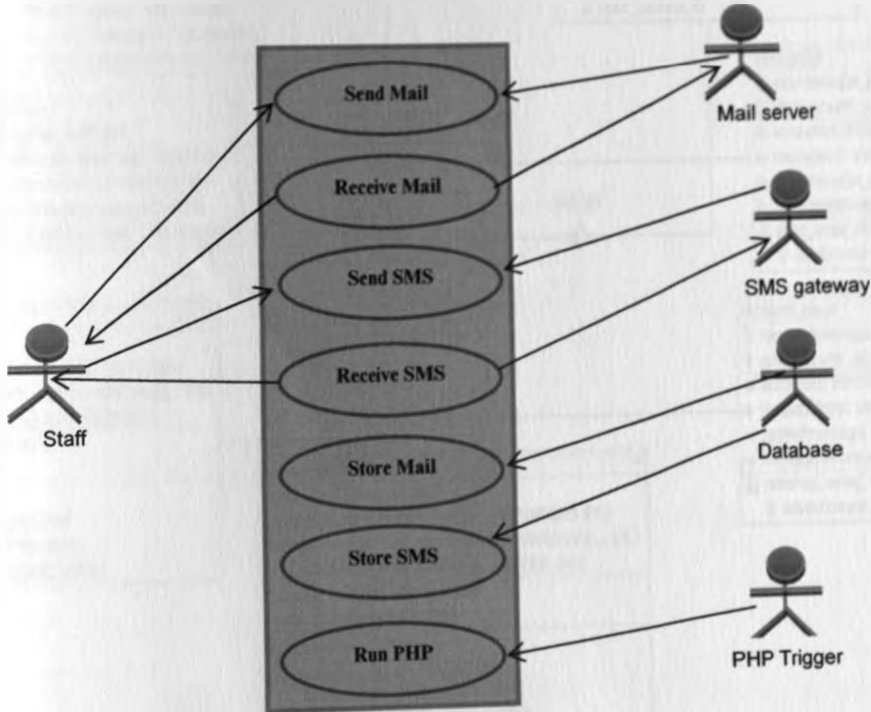
- Staff
- Mail Server
- SMS gateway
- Database
- PHP trigger

### **ii) Use Cases**

- Sending mail
- Receiving mail
- Sending SMS
- Receiving SMS

- Storing Mail
- Storing SMS
- Running the PHP trigger

**Figure 6.2: System Use Case Diagram**

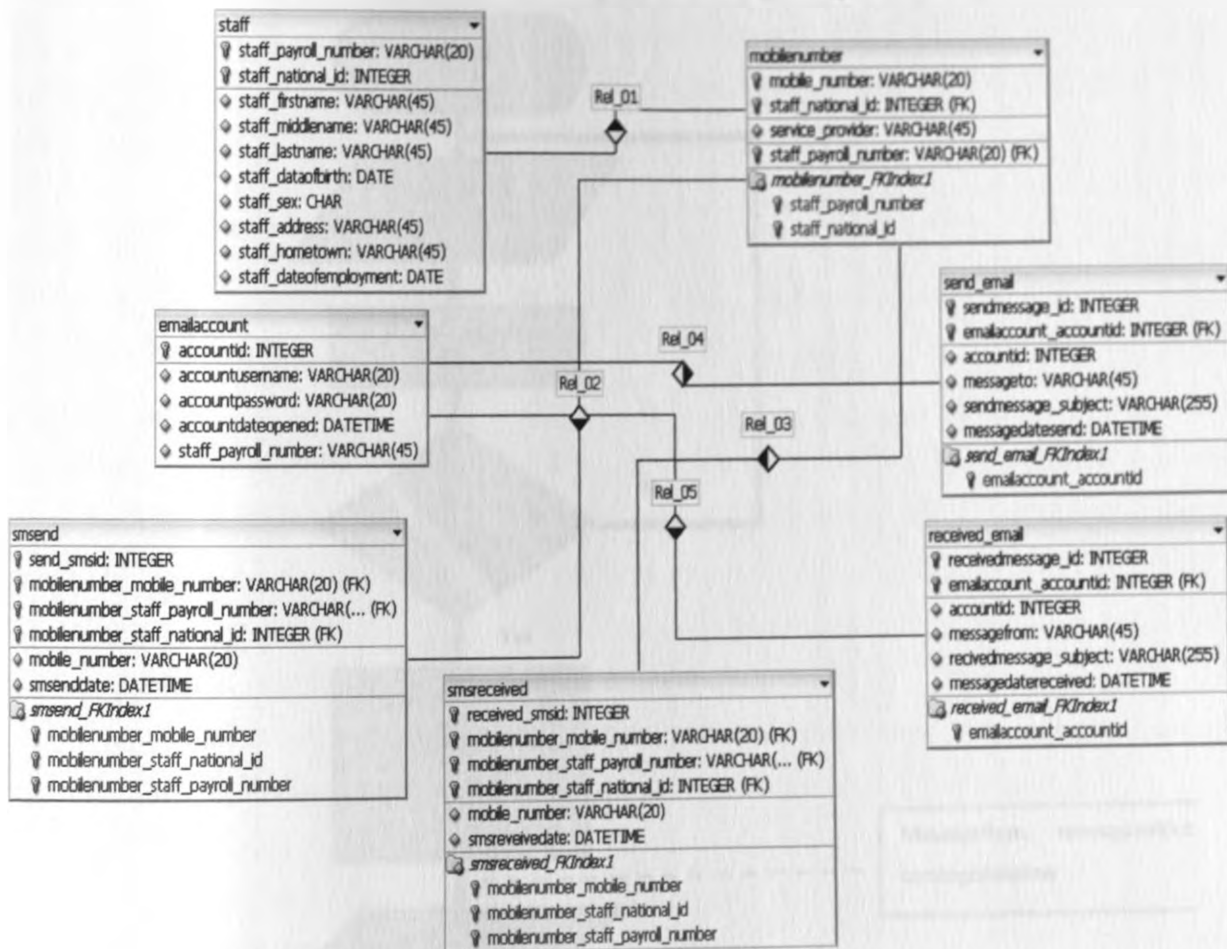


### 6.2.3 Database design

A database for storing the various system entities was designed. The database will hold staff details, sent and received Email and SMS data. An Entity Relationship Diagram (ERD) was developed as shown in the **Figure 6.3**.



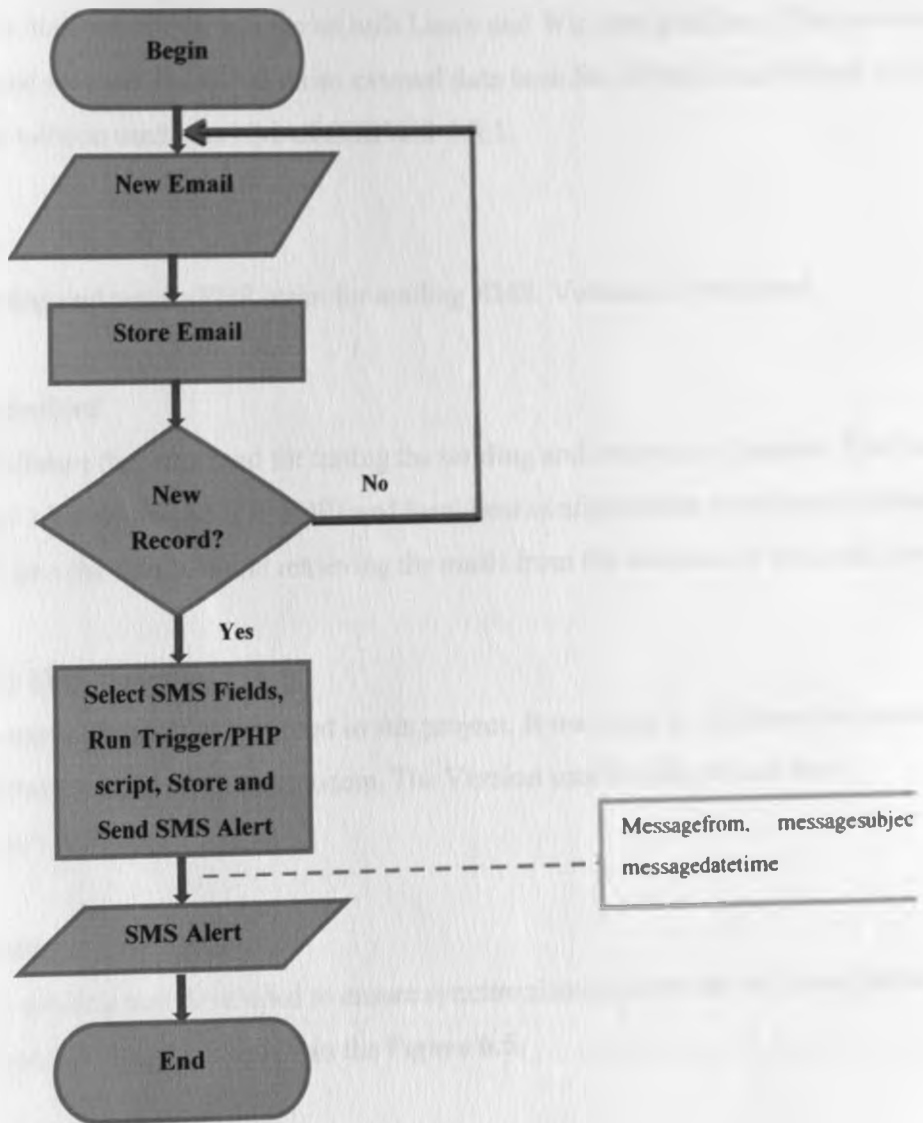
**Figure 6.3: System Entity Relationship Diagram (ERD)**



**6.2.4. System Flow Chart Diagram**

A system flow chart showing the logical sequence of events from when a new email is received until when an SMS is send was designed, see **Figure 6.4**. The sent SMS shows the source of the mail, the subject, date and time the email is received in the inbox.

**Figure 6.4: System Flow Chart Diagram**



**6.2.5. Software Requirements and Configuration**

Open source software was used in this system. The Web server, Email Server, SMS Gateway, PHP code editor and the Email Client software were installed on the same computer. The software used included;

**6.2.5.1 WAMP Server**

WAMP Server is a Windows Machine/Software that has Apache, MySQL, and PHP on it. This is a webserver and was installed for local web administration using MySQL database and Apache. The version of WAMP used for this project is WAMP 2.0. A database named EMAIL2SMS was created.

#### **6.2.5.2 HMAILSEVER Mail Server Software**

This is an open source mail server that can run on both Linux and Windows platform. This was used in order to administer mail services. It can run on an external data base like MySQL and helped to create an email domain. The version used was HMAILSERVER 5.3.1.

#### **6.2.5.3 Dreamweaver**

This was used for coding and testing PHP script for sending SMS. Version 8.0 was used.

#### **6.2.5.4 Mozilla Thunderbird**

This is email client software that was used for testing the sending and receiving of emails. The version used was Thunderbird 3.1.6. In this SMTP, POP3 and local host configurations were done and enable push and pull of mail into the database and retrieving the mails from the database in the local host.

#### **6.2.5.5. FrontlineSMS SMS Gateway**

This is the SMS gateway software that was used in this project. It was used to facilitate the sending and receiving of SMS through a GSM device or modem. The Version used in this project was FrontlineSMS Version 1.6.16.3.

#### **6.2.6 PHP SMS Code**

A PHP code for SMS sending was developed to ensure synchronization between the Email Server and SMS gateway. The code developed is shown in the **Figure 6.5**.

Figure 6.5: PHP SMS Sender Code

```
<?php
$con=mysql_connect("localhost:3306","root","");

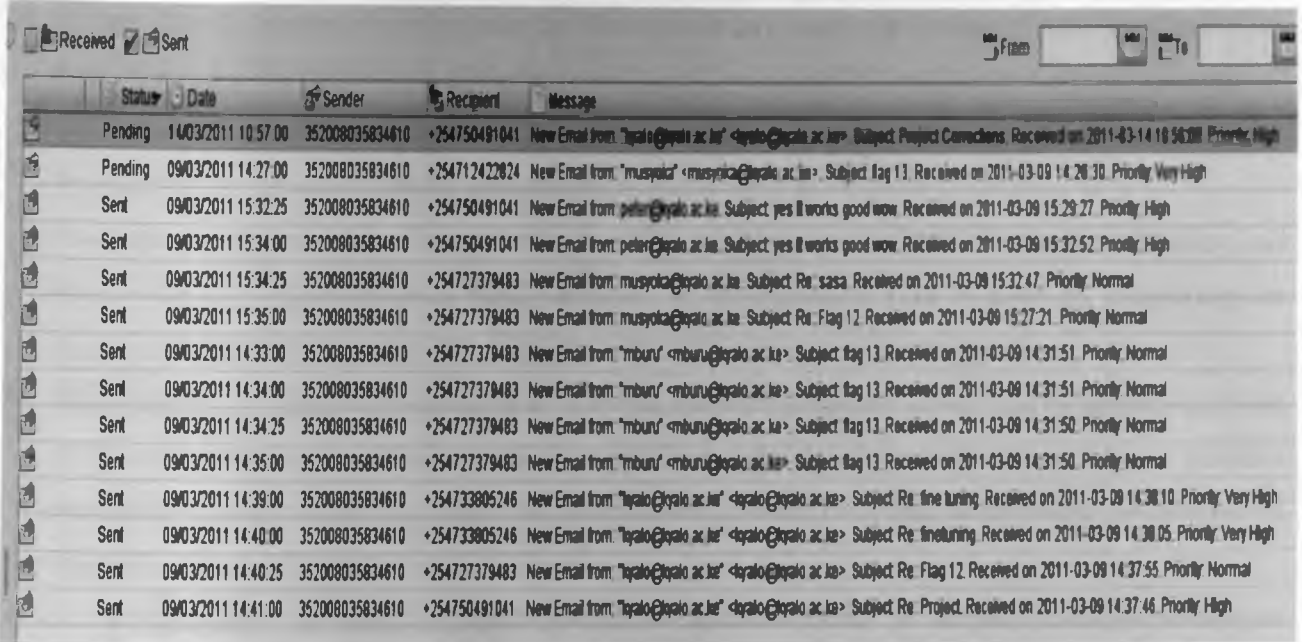
if ($con)
{
mysql_select_db("mail2sms",$con);
}
else
{
die("Could not Connect");
}

$query="select max(messageid) as msgID from hm_messages where is_read='0'";
$result=mysql_query($query);
if (mysql_num_rows($result)>0)
{
$fetch=mysql_fetch_array($result);
$details=mysql_fetch_array(mysql_query("select
metadata_from,metadata_subject,messagecreatetime,metadata_accountid,messageaccountid,accountaddress,accountid,acco
untdomainid,accountpriority,accountmobile from hm_messages,hm_message_metadata,hm_accounts where
messageid=metadata_messageid and accountid=metadata_accountid and messageid='".$fetch['msgID']."'"));
$recipient=urlencode($details['accountmobile']);
if($details['messageaccountid']=$details['accountid'])
{
$sender=urlencode($details['accountpriority']);
}
$message=urlencode("New Email from: ".$details['metadata_from'].". Subject: ".$details['metadata_subject'].". Received
on ".$details['messagecreatetime'].". Priority: ".$sender);
$confirm=urlencode($details['accountdomainid']); //Confirms the domain to filter the emails at the domain level
if($confirm<2 and $details['accountmobile']) //Ensures that SMS is send only to the email accounts in DomainId 1 and only
to the mobile number fetched
{
//send sms alert
file("http://localhost:5050/send/sms/".$recipient."/".$message."/");
mysql_query("update hm_messages set is_read='1' where messageid='".$fetch['msgID']."'"); //Ensures an SMS is not send
to same number for same email message more than once
mysql_close($con);
}
else
{
die("");
}
}
?>
```

### 6.3 System Testing

Testing the functionality of the system was done to ascertain whether the system could send SMS notification to the mobile number of an email account when a new mail was received in the user's inbox. Sample output of the send SMS test data is shown in Figure 6.6.

Figure 6.6: Sample Test Data Output



Status	Date	Sender	Recipient	Message
Pending	14/03/2011 10:57:00	352008035834610	+254750491041	New Email from "lajalo@kypalo.ac.ke" <lajalo@kypalo.ac.ke> Subject: Project Conclusions. Received on 2011-03-14 10:56:20. Priority: High
Pending	09/03/2011 14:27:00	352008035834610	+254712422824	New Email from "musyrika" <musyrika@kypalo.ac.ke> Subject: flag 11. Received on 2011-03-09 14:26:30. Priority: Very High
Sent	09/03/2011 15:32:25	352008035834610	+254750491041	New Email from "peter" <peter@kypalo.ac.ke> Subject: yes it works good wow. Received on 2011-03-09 15:29:27. Priority: High
Sent	09/03/2011 15:34:00	352008035834610	+254750491041	New Email from "peter" <peter@kypalo.ac.ke> Subject: yes it works good wow. Received on 2011-03-09 15:32:52. Priority: High
Sent	09/03/2011 15:34:25	352008035834610	+254727379483	New Email from "musyrika" <musyrika@kypalo.ac.ke> Subject: Re: sasa. Received on 2011-03-09 15:32:47. Priority: Normal
Sent	09/03/2011 15:35:00	352008035834610	+254727379483	New Email from "musyrika" <musyrika@kypalo.ac.ke> Subject: Re: Flag 12. Received on 2011-03-09 15:27:21. Priority: Normal
Sent	09/03/2011 14:33:00	352008035834610	+254727379483	New Email from "mburu" <mburu@kypalo.ac.ke> Subject: flag 13. Received on 2011-03-09 14:31:51. Priority: Normal
Sent	09/03/2011 14:34:00	352008035834610	+254727379483	New Email from "mburu" <mburu@kypalo.ac.ke> Subject: flag 13. Received on 2011-03-09 14:31:51. Priority: Normal
Sent	09/03/2011 14:34:25	352008035834610	+254727379483	New Email from "mburu" <mburu@kypalo.ac.ke> Subject: flag 13. Received on 2011-03-09 14:31:50. Priority: Normal
Sent	09/03/2011 14:35:00	352008035834610	+254727379483	New Email from "mburu" <mburu@kypalo.ac.ke> Subject: flag 13. Received on 2011-03-09 14:31:50. Priority: Normal
Sent	09/03/2011 14:39:00	352008035834610	+254733805246	New Email from "lajalo" <lajalo@kypalo.ac.ke> Subject: Re: fine tuning. Received on 2011-03-09 14:38:10. Priority: Very High
Sent	09/03/2011 14:40:00	352008035834610	+254733805246	New Email from "lajalo" <lajalo@kypalo.ac.ke> Subject: Re: finetuning. Received on 2011-03-09 14:38:05. Priority: Very High
Sent	09/03/2011 14:40:25	352008035834610	+254727379483	New Email from "lajalo" <lajalo@kypalo.ac.ke> Subject: Re: Flag 12. Received on 2011-03-09 14:37:55. Priority: Normal
Sent	09/03/2011 14:41:00	352008035834610	+254750491041	New Email from "lajalo" <lajalo@kypalo.ac.ke> Subject: Re: Project. Received on 2011-03-09 14:37:46. Priority: High

### 6.4 Handling SMS for Unwanted Email Messages

In this study it was found that users may not be willing to receive SMS notifications for all emails received in their inbox since some could be junk mails. This called for filtering the unwanted emails to ensure that SMS notifications are sent for only the authenticated mail sources.

Domain based filtering techniques were used to filter unwanted emails from being received in the users email account. This means that if an email is blocked at the domain level, it will not be received in the user's account and therefore an SMS will not be sent. Some of the techniques that can be used are;

- a) **Sender Policy Framework (SPF)** – This works by adding information in a domain's DNS record indicating which machines may legitimately send email for that domain. Domain must identify the machines that are authorized to send email on their behalf. This means that when a mail server receives email, it can check which computers are authorized to send mail for the domain of the email address in the From: field, and see if this message actually came from one of those authorized

computers. If it did, the message is assumed to be legitimate and allowed through. If it did not, or if it is questionable, the receiving mail server can accept the message, mark it and accept it, or refuse to receive it.

- b) **Sender ID Frame Work** – In this, the Sender ID Framework is tasked with verifying that each e-mail message originates from the Internet domain from which it claims to come based on the sender's server IP address. Only authenticated messages are allowed to reach the Receiver.
- c) **Caller ID** - E-mail servers can query the DNS record and match the source IP address of incoming e-mail messages to the address of the approved sending servers. Caller ID involves two key steps:  
One, sender of e-mail publishes the IP addresses of their outgoing mail servers in Domain Name System (DNS) in an e-mail policy document.  
Two, the e-mail software at the receiving end of a message queries DNS for the e-mail policy and determines the "purported responsible domain" of the message. This is done by comparing the information in DNS to ensure it matches the information on the originating mail.
- d) **Blacklisting** - A Black-list is a database of known Internet Addresses (IP's) used by spammers. Most of the Internet Service Providers (ISPs) and Bandwidth providers subscribe to these blacklist databases in order to filter out spam sent across their network or to their subscribers. Some types of blacklists that can be applied are:
  - i) **IP Blacklist** - IP Blacklist blocks specific IP addresses (and IP ranges), message senders or message recipients (local mailboxes) as determined in the Blacklists.
  - ii) **DNS Blacklist** – DNS Black list is a list of IP addresses that are the source of unsolicited emails. By taking help of this list, system administrators can block unwanted domains. They refuse access to the server and prevent unwanted email messages.
  - iii) **Spam Blacklist** - Spam Blacklists are lists of mail servers or open relays known to be used by spammers to deliver unwanted email. By placing these lists in their mail transport agent's rules system, system administrators can block spam transmitted from these sources.
  - iv) **Email Blacklist** - Email Blacklists contain known mail servers and addresses used by spammers. With these lists in place, access to the server can be denied and unwanted email messages are discarded. However, your legitimate emails may also be blocked.
  - v) **IP blockers & IP Black holes** - IP Black Hole lists are large repositories of IP addresses that are known to be spamming. When a spammer is identified by IP or IP block, the spammer is added to the Black Hole list. Other ISPs and email providers can configure their email servers to query the Black Hole list any time a new email comes in. When a new mail arrives at the server,

prior to putting it into the recipient's mailbox, the server will examine the email, and trace its origin. Then it will ask the Black Hole list if this email came from a source that is a currently known spammer. If the email does not originate from a source known to be spamming, it will be properly delivered into the recipient's email box. If the mail fails the test and is flagged as spam, the mail will not be delivered, but rather will be moved to a storage box for future examination by either the system administrator or the end-user.

For the purpose of this study, Domain Name Server Blacklist was used to ensure that SMSs are not send for email accounts in the blacklisted domain/s. The PHP SMS sender code was also designed to send SMS only for emails from only one of the given domains, see excerpt below;

```
$confirm=urlencode($details['accountdomainid']); //Confirms the domain to filter the emails  
at the domain level  
if($confirm<2) // checks whether the domainid is less 2 and if so sends SMS to only the email  
account in this domain  
{  
file("http://localhost:5050/send/sms/".$recipient."/". $message."/");  
mysql_query("update hm_messages set is_read='1' where  
messageid='".$fetch['msgID']."'");  
mysql_close($con);  
}  
else  
{  
die("");  
}
```

## 6.5 Handling Flagged/Prioritized Email Messages

If you get large volumes of e-mail every day, you can keep from losing track of important messages by flagging them. Message flag lets one pin a virtual note to an e-mail message and reminds him or her to take a specific action later. Most of the email client software have the flag feature that users can enable and disable any time to mark email messages in their inbox that need an action to be taken on them after reading.

This study established that email notifications sent to email account owners' mobile phones should indicate the priority attached to the emails sent in the inbox. This would enable the users to identify urgent email messages that require urgent response from the SMS notification sent or further action



after reading. To address the issue of prioritizing emails in this study, email account owners were categorized into three levels depending on seniority in the organization working. It was assumed that staff in level one would be sending email messages with very urgent priority, those in level two will be sending emails messages with urgent priority while those in levels three will be sending emails messages with normal priority. The SMS notification received would indicate the urgency of the received email for immediate action, see **Figure 6.6**.

This study found that modifications can further be done on the email editing forms to add a field for holding the priority of emails from where the sender can choose the priority to be attached to the email messages on receipt, delivery or on reading. When the email is sent, the priority can be stored in the database as part of the received emails in the database from where it can be queried to be send as part of the notification SMS. However, in this study, an email editing tool was not developed.



## CHAPTER 7

### CONCLUSIONS AND RECOMMENDATIONS

#### 7.1 Conclusion

The motivation in this project was to improve the web-based e-government models where services to citizens are offered via the Internet using websites, blogs and Email. Improving the functionality, reliability, effectiveness and efficiency of the email communication tool used mostly for office communication in Government offices and agencies would ensure full interaction between the citizens or employees and Government or Government agencies. This is because the email tool remains the widely used tool of communication because of its inherent ability to virtually transfer any amount of data/information, unlike the SMS tool that has a limitation of the amount of data that can be send at a go. However, this study found out that SMS being a fast tool than email, it can be used for improving email tool through notifications whenever a new mail is received.

This study found that it is possible that once government agencies post new information on mail servers of their clients, alert messages can be send to the client as SMS irrespective of the type of mobile phone the client has and mobile service provider they are subscribed to. This would ensure that citizens who can afford the cheapest mobile phones can get a notification of new government communications posted on websites or e-mailed to them. After this, they can move to the nearest "digital village" (digital centre) to access the information and give the required responses almost in real time. This would greatly improve on information turn-around time within a Government, it agencies and clients/citizens.

#### 7.1.1 E-government models and Medium of Communication

From the literature review it was established that there are two broad categories of e-government models; Web-based and SMS-based, that are implemented either by the Government or Government Agencies like University of Nairobi which was the case study for this project. This study through the analyzed data indicated that website, blogs and email were widely used as communication tools in government agencies. This study established the truth that the widely used e-government models are the web-based models where services are offered over the internet. However, it was noted that SMS-based e-government models are becoming widely used as many people have mobile phones, SMS charges have become more affordable and that SMS is a faster tool of communication compared to websites and email.

### **7.1.2 Enhancing Web-based e-Government Model through Email-SMS Alert System**

This study established that owing to the fact that SMS is a faster tool of communication than email, it can be used to improve the reliability of email which remains widely used due to the fact that it can be used to transfer vast amounts of data. This can be achieved by ensuring that recipients of emails receive a SMS notification whenever a new email message is received in their inboxes. This will ensure that email users are constantly in touch with their inboxes anywhere they are. This means that urgent messages can be replied almost instantaneously as this study also established that email users have access to Internet either in cyber café, using WAP enabled mobile phones or GSM modems. This will improve email and website tools used in the interactive and transaction phases of the web-based e-government models. In this study, a prototype of the Email-alert System was developed and tested. The system proved that it is possible to notify website and email users whenever new information is posted to the Government websites or send to their inboxes.

### **7.1.3 Developing a Prototype to Test the Proposed Enhancement**

Using the relevant software in the study, a prototype was developed and tested to integrate email and SMS communication tools in order to reap from the benefits of both tools and thereby improve the web-based e-government models. The prototype was tested and it worked.

### **7.1.4 Implementation Framework of the Enhanced Model**

This study established that a government and its agencies can integrate the web-based e-government model and the SMS model to reap from the benefits of each. This can be by running both a mail server and SMS gateway to ensure that notifications on new emails or news posted on their websites are send to their clients for quick response. This was well established through system prototype.

### **7.1.5 Integrating SMS-based E-government Models with the Web-based E-government Models**

Susanto and Goodwin (2006), proposed a six-stage SMS e-government model. The Sixth and the last stage in their model is the Integration level. In this stage, they predicted a situation where integrated-SMS systems will be integrated with the Internet or web-based e-government systems so that citizens will have the option of accessing e-government services by sending SMS to one number or through the Internet at one web address. Similarly, Layne and Lee (2001), in their web-based model, they proposed two levels of integration, that is, vertical integration and horizontal integration. According to them, vertical integration should focus on integrating government functions at different levels, such as those

of local governments and state governments while the horizontal integration should focus on integrating different functions from separate systems so as to provide users a unified and seamless service.

However, the proponents of the two different e-government models, that is, SMS-based and the web-based e-government models, do not propose how the integration can be achieved.

It is in view of this that this study proposed a method of integrating web-based e-government model with the SMS-based e-government model through Email-SMS Alert System in order to enable citizens to reap on the benefits of both web-based systems (Internet systems) and SMS-based systems (Mobile systems). This was achieved through a successful design and testing of the email-SMS alert system which would enhance the web-based e-government models and actualize the integration phase of the SMS-based e-government model proposed by Susanto and Goodwin (2006). This study established that SMS and the Internet may complement each other in a government's digital service delivery, for example, a citizen may send a form or pay a public service electronically by Internet and get notification via SMS, or pay the services through SMS and get the receipt by email.

## 7.2 Challenges of the Study

- i) **Response from the sampled population:** It was noted that all the questionnaires distributed to the target population were not received back since some of the sampled staff did not cooperate with the process. This could have led to some bias on the samples.
- ii) **Time factor:** The study was carried out within limited time as were set milestones that had to be strictly adhered to. Due to time factor, prototype was developed instead of a full system and the prototype could not be tested on different platforms.
- iii) **Limited resources:** The mail server and SMS gateway were installed on the same computer instead of running the mail and web-servers separately, stretched the computer resources. This made the system to execute at a very lower speed than expected when the mail server and the SMS gateway run on different computers.

## 7.3 Recommendations

This study recommends the use of this system not only by government agencies but also by private sector for service delivery to its clients. This will improve on the information turn-around time in these organizations and hence the productivity of their employee and other clients. To address the issue of importance of emails depending on the sources, email administrators can make modifications on the

email editing forms to add a field for holding the priority of emails from where the sender can choose the priority to be attached to the email messages on receipt, delivery or on reading. When the email is sent, the priority can be stored in the database as part of the received emails in the database from where it can be queried to be send as part of the notification SMS. An email editing tool was not developed in this study.

#### 7.4 Further Research

This study recommends a bigger sample space covering more government agencies to be carried out. This will provide a bigger validity and high reliability of the data collected. It also recommends that more time to be provided for further study, a full system be developed and be tested on different platforms.

## APPENDICES

### APPENDIX A: REFERENCES

- i) Andersen, K.V. & Henriksen, H.Z. 2006, "E-government maturity models: Extension of the Layne and Lee model", *Government Information Quarterly*, vol. 23, no. 2, pp. 236-248.
- ii) Antonio, C 2007, 'E-Government: toward the e-bureaucratic form?'. *Journal of Information Technology*, volume: 22, No. 1, pp. 265 – 274, accessed on July 17, 2009 <http://www.palgrave-journals.com/jit/journal/v22/n3/full/2000105a.html> .
- iii) Backus, M 2001, "E-governance in developing countries". *IICD Research Brief*, Vol. 1. March.
- iv) Chava, F & David N 2005, *Research Methods in Social Sciences*, St. Martin's Press Inc, London.
- v) Dada, D 2006, "The Failure of E-Government in Developing Countries." *The Electronic Journal on Information Systems in Developing Countries*: 39-43.
- vi) Dalziel, D 2004, "Government Online - A multi-country Study of e-government usage", *The World Association of Research Professionals*, accessed on 28/09/2010, <http://www.tnsglobal> .
- vii) Decker, M 2006, "Generalized Notification Services: A Simple but Versatile Paradigm for the Implementation of Mobile Data Services", accessed on 27/09/2010, [.http://www.mgovernment.org/resurces/euromgvo2006/PDF/10\\_Decker.pdf](http://www.mgovernment.org/resurces/euromgvo2006/PDF/10_Decker.pdf).
- viii) Directorate of e-government, 2009, *Kenya e-government*, accessed on July 14, 2009 <http://www.e-government.go.ke> .
- ix) Emeka O 2010, "Bharti shakes up Kenyan mobile market", accessed on 23/02/1011, <http://www.telecomasia.net/content/bharti-shakes-kenyan-mobile-market>.
- x) Gregory, G 2006, 'Journal of E-Government', Haworth Press, Volume: 3 Issue: 3 2006, accessed on July 17, 2009, <http://www.haworthpress.com/store/product.asp?sku=J399> .
- xi) Gordon, M and Walsh, T 1997, "Outsourcing technology in government: owned, controlled, or regulated institutions". *Journal of Government Information*, Vol. 24 No. 4, pp. 267-283.
- xii) Heeks, R 2001, "Understanding e-governance for development". E-Government Working Paper Series, accessed on October 25, 2010, <http://idpm.man.ac.uk/idpm/igov11.htm>.
- xiii) Kothari, C 2004, *Research Methodology*, New Age International Publishers, New Delhi.
- xiv) Lallana, L 2004, "SMS, business and Government in the Philippines", *ICT4D.ph (a project of the Department of Science and Technology and IDRC)*, accessed on 22/9/2010 <http://unpan1.un.org/intradoc/groups/public/documents/Other/UNPAN024834.pdf>.

- xv) Layne, K. & Lee, J. 2001, "Developing fully functional E-government: A four stage model", *Government Information Quarterly*, vol. 18, no. 2, pp. 122(15).
- xvi) Macias, M 2009, *Nokia Messaging*, accessed on 25/09/2010, <http://www.n97fanatics.com/email-on-the-n97-part-1-nokia-messaging> .
- xvii) Moon, M. J. 2002, "The Evolution of E-Government among Municipalities: Rhetoric or Reality?", *Public administration review*, vol. 62, no. 4, pp. 424-433.
- xviii) Nokia Email and Messaging, accessed on 25/09/2010, <http://europe.nokia.com/services-and-apps/messaging>.
- xix) Nonyongo et al 2007, *Effectiveness of SMS Communication Between University and Students*, University of South Africa, South Africa.
- xx) Siau, K. and Y. Long 2005, Synthesizing e-Government Stage Models - A Meta-Synthesis Based on Meta-Ethnography Approach. *Indus. Manage. Data Syst.*, 105: 443-458.
- xxi) Susanto D, Goodwin, R 2007, "*Content Presentation and SMS-based e-Government*", International Conference on Electrical Engineering and Informatics (ICEEI), Bandung.
- xxii) Susanto D and Goodwin, R 2010, "*Factors Influencing Citizen Adoption of SMS-Based e-Government Services*", *Electronic Journal of e-Government* Volume 8 Issue 1 2010, (pp55 - 71), accessed on 28/09/2010, [http:// www.ejeg.com](http://www.ejeg.com) .
- xxiii) Susanto D and Goodwin R 2006, "*Implementing SMS-based e-Government Model*", 8th International Conference on Information Integration and Web-based Applications & Services, Yogyakarta.
- xxiv) Tony S and Robert G 2007, *Content Presentation & SMS-based e-Government*, accessed on July 17, 2009, [http://repository.gunadarma.ac.ke.id:800/1-24\\_1731.pdf](http://repository.gunadarma.ac.ke.id:800/1-24_1731.pdf) .
- xxv) Tony, S et al 2008, *A six-level model of SMS-based E-Government*, International Conference on E-Government (ICEG), Australia, Accessed July 16, 2009, <http://smsegov.info/images/smsegov.pdf> .
- xxvi) OZeki SMS Technology Manual, accessed on 28/09/2010, <http://www.ozekisms.com/index.php?owpn=159> .

## APPENDIX B: QUESTIONNAIRE



### UNIVERSITY OF NAIROBI

#### SCHOOL OF COMPUTING AND INFORMATICS

#### PROJECT RESEARCH QUESTIONNAIRE

#### INTRODUCTION

My name is Peter K. Mulwa, a Master of Science (Information Systems) student at the School of Computing and Informatics, University of Nairobi. I am conducting a research study on *Enhancing The Web-based e-Government Model Using Email-SMS Alert System*, for partial fulfillment of the award of Master of Science (Information Systems). Kindly take a few minutes and fill this questionnaire. The questionnaire consists of five (5) sections. It is purposely made for gathering data/information for academic research only. All information given will highly be appreciated and treated with the confidentiality it deserves. I thank you in advance for getting time from your busy schedule to fill the questionnaire.

#### SECTION A: PERSONAL INFORMATION

Sex:  Male  Female      Highest Academic Qualification: \_\_\_\_\_

Highest Professional Qualification: \_\_\_\_\_ Area of specialization: \_\_\_\_\_

Department/School: \_\_\_\_\_ Designation: \_\_\_\_\_

#### SECTION B: E-GOVERNMENT AND MEDIUM OF COMMUNICATION

a) I am familiar with the terms e-government and e-governance.

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

b) If you are familiar with e-government and e-governance, do you think e-governance is implemented in your organization?

- Yes
- No
- I don't know

c) Which of the following are the common e-government medium of communication used in your organization?

- Website & blogs
  - E-mail
  - Short message Service (SMS)
  - Phone calls
  - Any other, specify:
- 

d) The communication medium used in my organization is effective and efficient.

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

e) The communication medium used in my organization is affordable.

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

f) The communication medium used in my organization is reliable.

- Strongly agree
- Agree
- Not sure



- Disagree
- Strongly disagree
- g) The communication medium used in my organization has a limitation of the amount of information that can be send at ago.
  - Strongly agree
  - Agree
  - Not sure
  - Disagree
  - Strongly disagree
- h) I would recommend my organization to retain the same medium of communication.
  - Strongly agree
  - Agree
  - Not sure
  - Disagree
  - Strongly disagree

**SECTION C: INFORMATION ON EMAIL ACCESS**

- a) Do you own an email account?
  - Yes
  - No
- b) If you have an email account, how often do you check your account for new messages per day?
  - Once
  - Twice
  - More than twice
  - Not at all
- c) Which **ONE** of the following techniques do you use to know when a new email message is received in your inbox?

- Pop up alert windows
- Beep sound
- Short Message Service (SMS) alert
- Opening my in-box
- Any Other: \_\_\_\_\_

d) Which **ONE** of the following notification techniques do you think would be effective to enable people to respond to new email messages anytime and anywhere?

- Pop-up windows
- Beep sound
- Short Message Service (SMS) alert
- Any other, state: \_\_\_\_\_

e) Other than in the office, where else do you check for your email messages?

- Cyber cafe
- WAP enabled mobile phone
- Use of modem on my computer
- Digital Village Centre
- Don't access at all

f) On average, how many urgent email messages do you receive per day?

- One
- Two
- More than two
- No urgent emails received

g) On a scale of 0% to 100%, how do you rate your timely response to all urgent email messages send to you?

- Above 75%
- 50% - 75%
- 25% - 50%

10% - 25%

Below 10%

h) Failure to respond to urgent email messages adversely affects decision making in my organization.

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

#### **SECTION D: INFORMATION ON MOBILE PHONE AND SMS**

a) Do you own a mobile phone?

Yes

No

b) Other than voice services, do you use your mobile phone for Internet and E-mail services?

Yes

No

c) According to the current trend in mobile phone service charges, SMS charges have become affordable.

Strongly agree

Agree

Not sure

Disagree

Strongly disagree

d) SMS has become a popular tool of communication owing to its affordable charges.

Strongly agree

Agree

- Not sure
- Disagree
- Strongly disagree

e) Does your mobile phone have a facility for notifying you when a new e-mail message is received in your inbox?

- Yes
- No
- I don't know

**SECTION E: E-MAIL VERSUS SMS COMMUNICATION**

a) E-mail is frequently used for office communication than SMS.

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

b) SMS is a faster and reliable communication tool compared to e-mail tool.

- Strongly agree
- Agree
- Not sure
- Disagree
- Strongly disagree

c) E-mail remains a better tool for communicating large amounts of data/information compared to SMS.

- Strongly agree
- Agree
- Not sure

- Disagree
  - Strongly disagree
- d) Use of SMS alert as a notification technique for new messages can improve reliability and effectiveness of the e-mail tool.
- Strongly agree
  - Agree
  - Not sure
  - Disagree
  - Strongly disagree
- e) Use of SMS alert for new e-mail messages can greatly reduce information turn-around time in my organization.
- Strongly agree
  - Agree
  - Not sure
  - Disagree
  - Strongly disagree
- f) Use of SMS alert for new e-mail messages will quite be useful for my organization.
- Strongly agree
  - Agree
  - Not sure
  - Disagree
  - Strongly disagree

-----END-----