



UNIVERSITY OF NAIROBI

School of Computing and Informatics

**A Framework for e-Government Development
(A Case of Kenyan Government)**

By

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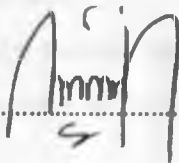
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August 12

*Submitted in partial fulfilment of the requirements of the Master of Science in Information Systems
in University of Nairobi*

Declaration

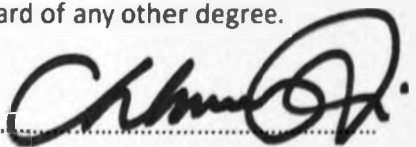
This is to certify that this Report which is submitted by me to the University of Nairobi School of Computing and Informatics, Chiromo campus in partial fulfilment of the requirement for the award of degree of Masters in Information Systems and comprises only my original work and due acknowledgement has been made in the text to all other material used.

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This is to certify that this Report which is submitted by **Mr Olal Ocholah Wilfred** in partial fulfilment of the requirement for the award of degree in Masters in Information Systems to University of Nairobi School of Computing and Informatics, Chiromo campus is a record of the candidate own work carried out by him under my/our supervision. The matter embodied in this research is original and has not been submitted for the award of any other degree.

Date: 29 Aug 2012 Supervisor Sign: 

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Dedication

This work is dedicated to the memory of my late mum Seline Ochola whose constant support and dedication enabled me to pursue my education, my dad Sylvan Ochola Olal who passed on the love of reading and respect for education and who has been instrumental in my life and provided a pillar that propelled us as a family. I also dedicate this work to my wife Stelah Kabuna and daughter Tansey Seline Hawi; they are the forces behind these achievements, especially when balancing between education, work and family became unbearable.

I can't forget my sisters Syprose, Caren and Alily, my brothers Maurice and Sam, thumbs up for you have made it possible for me to really appreciate the value of family especially after the demise of our late mum, guys I really appreciate you.

I also dedicate this work to my grand mum Nyar Aketch (Patricia Otuoma), this old lady made me believe in the power of possibilities especially if you take control of your life, it's amazing her life has been a case of you get what you want in life.

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Abstract

Global eGovernment is associated with providing opportunities to increase the connection, availability and modes of interactivity between governance at multiple levels and citizens. It is also associated with transforming current governmental services in ways to increase efficiencies, improve processes and automate tasks previously undertaken by governmental employee. In this paper, the researcher seek to present an integrated architecture framework for eGovernment Services that represents the alignment of IT infrastructure with business process management in public sector organizations and classify the barriers that might complicate the implementation of the proposed architecture framework. The study targets to help the IT practitioners in the public sector learn how to use and manage information technologies to revitalize business processes, improve decision making, and gain competitive advantage from the adoption of e-Service government.

The approach adopted by the researcher was to perform literature review of four existing frameworks, to get elements of a classical eGovernment framework, the questionnaires were then developed to highlight key interoperability elements with a view of seeking opinions of the policy makers to investigate how these elements would affect eGovernment implementation. The research findings were analysed to produce additional elements which were then added to produce the final framework which was then adopted.

The resulting framework therefore comprised of four layers with each layer advocating for an important attribute of interoperability implementation.

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List of Abbreviations

B2B	Business to Business
DES	Data Encryption Standards
DSA	Digital Signature Algorithm
e-GMS	e-Government Metadata standards
e-SDF	e-Service Development Framework
FTP	File Transfer protocol
G2B	Government to Business
G2C	Business to Citizens
G2G	Government to Government
GCL	Government Category List
GDSC	the Government Data Standards Catalogue
GIF	Government Interoperability Framework
GITO	Government Information Technology Officers Council
ICT	Information and Communication Technology
MISS	Minimum Information Security Standards
MIOB	Minimum Interoperability Standards
PGP	Pretty Good privacy
PKI	Public Key Infrastructure
S/MIME	Secure/Multipurpose Internet Mail Extensions
SITA	State Information Systems Agency
TSC	Technical Standards Catalogue
RDF	Resource Description Framework
XDR	External Data Representation
XML	Extensible Mark-up Language

CHAPTER 1 INTRODUCTION

1.1 Background

The advent of the information age and its acceleration effect on globalization are leading the world to a new economic order driven by information and knowledge based economies. In an increasingly globalized world, where information technology has become one of the key determinants of growth, many African countries are facing new challenges as a result of the emerging information age.

According to the e-Government Interoperability Framework for Mozambique, harmonizing decentralization of ICT solutions with centralized strategies, e.g. meant to favour reuse and optimization of resources, is a complex technical and organization challenge faced by many governments. If no particular attention is devoted to the interoperability of the solutions being developed in governments, the various ICT initiatives will rapidly become patchwork ICT solutions incompatible with each other. Interoperability therefore means the capability of (two or more) systems to exchange seamlessly data, information, and knowledge a central milestone of improving efficiency and effectiveness in government services. According to the Ghanaian Government e-GIF Implementation Plan, 2009, e-Government Interoperability Framework (e-GIF) serves as a strategic framework for implementing policies and technical standards across government. The main thrust of e-GIF is to adopt best practice standards such as Internet, Web Services, XML and XLS as the core standards for data integration and management.

The e-GIF also sets out policies for establishing and implementing metadata across the public sector which will help citizens find and share government information and resources more easily. However, stipulating policies and specifications is not enough in itself; successful implementation will mean the provision of support, best practice guidance, toolkits (Such as Web Site) and centrally agreed schemas.

This collaboration involves releasing efficiencies across the systems and support delivery more focussed on customer needs. According to the Department for Communities and Local Government: London, 2006, on Structures for Collaboration and Shared Services, shared services provide public service organizations with the opportunity to reduce waste and inefficiency by re-using assets and sharing investments with others. The term shared services therefore, means the

creation of sustainable, collaborative relationships with suppliers in the public, private, social enterprise and voluntary sectors to deliver services, carry out major projects or acquire supplies and equipment. The benefits of the partnering includes, better designed solutions, integration of services for customers, access to new and scarce skills, economies of scale and scope, investments and community benefits (including jobs and local economies effects). Collaboration on the other hand describes the various ways in which councils and other public bodies come together to combine their buying power, to procure and commission goods, works or services jointly or to create shared services.

Jordan e-Government Services was announced in 2001 by His Majesty King Abdullah II with a vision to provide access to Government e-Services and Information for everyone in the Kingdom irrespective of the location, economic status, ICT ability and education according to Jordan Ministry of Information and Communication Technology, May 2011. This culminated to the launch of e-Government Portal (*Jordan.gov.jo*) in Sept. 2006 with a 24-hr access to 49 e-Services among which Issuing Vocational License, Issuing non-Criminal Record Certificate, Digitizing National Library, Income and Sales Tax, Central Registry and Custom Services.

1.2 Problem Statement

We live in an increasingly interconnected society, where the Internet has spawned tremendous improvements in efficiency and customer service. People use the telephone and the Internet to get service 24 hours a day, seven days a week. However, in Kenya these services are silo-based and there has never been a mechanism to integrate and interconnect them so that they can share, interact and exchange information content. Interoperability at the national level in Kenya therefore will leverage on the service delivery and re-usability of e-Services and content sharing among the government agencies in the public sector.

This agreed interoperability framework will be required to underpin the fast and efficient development of e-Services; it will also address technology, procedures and content sharing. It will also give rise to the development of standard principles to be respected by any e-Government services set up and to guide service deployment across the public sector. It will also lead to the development of a policy framework to govern integrity of shared information and how such information can be protected so as not to injure the personal security of the citizenry.

1.3 Project Justification

In Kenya today, several government departments are striving to setup online systems in order to improve dissemination and access of shared government e-Services to the citizenry. The World Wide Web (WWW) infrastructure has tremendously grown in Kenya with a number of government agencies already operating online portals. Majority of Kenyans now have access to ICTs especially after the government's policy to zero rate taxes on the ICT equipment as part of its agenda towards realization of vision 2030 as a foundation of a knowledge economy. The government has also embarked on a policy to make ICT available to all citizens through various programs among which by promoting ICT in schools.

There has been a progressive trend towards the actualization of a digital Kenya with a number of key government services already deployed online including: Submitting Tax returns and Customs services, Applying for Public Service Jobs, Tracking status of ID and Passport, Exam result and candidate selections, Reporting corruption and Business Licensing and e-Registry

The mobile phone industry has also grown rapidly, with about 63% penetration ratio according to CCK and most Kenyans being able to afford online services on their mobile devices due to the introduction of cheap mobile phones and a progressive growth of data service.

1.4 Research Objectives

Overall Objectives

The overall aim of this project is to develop a holistic framework that will integrate the various government functions into one-stop government e-service platform and enable interoperability between government agencies; it will be tailored to suit the Kenyan e-Service situation.

Specific Objectives

- (i) To identify and review existing e-Service interoperability frameworks applicable to governments
- (ii) To propose a conceptual e-Service framework that would advocate policies to promote exchange and sharing of public data and also to provide an underpinning for extension to the existing research
- (iii) To establish and validate an e-Service Interoperability framework that will govern interoperability situation in Kenya

1.5 Research Questions/Hypothesis

The following questions and hypothesis will guide this research project towards the conceptualization of the framework to be proposed for e-Service management in Kenya:

Research Questions

- (i) What factors, trends, policies and conditions are most likely to shape the future of e-Services delivery in Kenya? What are the challenges and benefits of the e-Service delivery through interoperability?
- (ii) How can a government proceed when building and upgrading its IT infrastructure towards more interoperability? What is the role of architectures and other conceptualizations in such endeavours?
- (iii) How will interoperable e-Services delivery leverage government operations in the public sector in terms of e-Self Care, e-Governance, efficiency, e-Security and its relationship and interactions to citizens?
- (iv) What governance mechanisms are needed to oversee and assure the quality and integrity of a ubiquitous cyber infrastructure for e-Governance when essential governmental functions are integrated into single online systems?

Research Hypothesis

- (i) Trust perception of the e-Government services, and trust dynamics among individuals, groups, and organizations in the value chain of service provision can contribute to unwillingness of citizens to share personal information with the Government electronically.
- (ii) Legal, organizational and technological policy barriers to interoperable e-Service adoption, process orientation and diffusion in Kenya.

1.6 Assumptions and Limitations

- (i) The research requires good cooperation from government policy makers in the field. An assumption is therefore made at this juncture that the relevant government key players will cooperate and provide the required information.
- (ii) The research will be limited to information producers and consumers.
- (iii) That the crucial government documents and policy papers will be made available by the government agencies for study.
- (iv) The information which will be collected from the field during data collection phase will be valid and can therefore be used to validate the proposed framework.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter presents a series of related literature and relevant citations of what other scholars have written on the research topic with the aim of pointing out existing gaps.

The chapter also gives a conceptual framework from literature and validates this framework against the defined problem. The chapter starts by discussing the e-Service experience in Botswana, Canada, South Africa and United Kingdom which are the selected frameworks for study and proceeds to discuss the e-Service situation in Kenya with reference to what the government of Kenya has done towards realization of a one government framework. The chapter will also do a comparative analysis of the studied frameworks and thereafter propose a conceptual framework suitable for management of e-Service situation in Kenya.

The chapter will look at the existing e-Service legislation and ICT policy landscape in Kenya with a view of recommending an adoption and integration of e-Service development framework into the national legislation.

2.2 Classification of Information/Data Stakeholders

In the marketplace, the needs of producers and consumers are often at odds: producers want higher prices, consumers lower ones; producers want easy assembly, consumers want easy dis-assembly; producers want flexibility and rapid prototyping, consumers want reliability and long-term support.

The same competing needs exist in the world of data/information management where producers of data and consumers of data often operate in very different worlds with very different set of tools. The classification of information as a resource was adopted from the ministry of Information and communication as below:

Data Owners/Producers/Providers	Data Users/Consumers
Data producers are people or organizations that produce data/information as a product for the sole purpose of either selling to solicit monetary benefits or for dissemination without any intention of soliciting of benefits.	An object that's bound to a data provider that receives data in the form of collection. The data is used for query, analysis and reporting.
Data Regulators/Gatekeepers	Data Business/Info-Prenuers
A data/information regulator is a government agency, typically a statutory authority, which regulates, supervises and enforces competition laws, regulation and may sometimes also enforce consumer protection laws.	An Infoprenuer is someone who 'sells'/markets their knowledge, this can perfectly be done over the internet as it allows 'unlimited' downloads or purchases of the product without spending on printing or costs.

Table 1: Classification of information/data stakeholders

2.3 E-Service Experience in other countries

According to Botswana's National e-Government Strategy 2011-2016, the concept of e-Government was first introduced over fifteen years ago, and is now commonplace in lots of countries around the world. Many early adopters of e-Government, such as Singapore, Canada and New Zealand, have now placed most of their services online. The Government of Canada has closed down its Government On Line Project Office as all Canadian government services are online and viewed very much as "business as usual" by government departments and citizens.

There are countless examples of innovative use of e-Government, from all parts of the world. A popular trend has been to develop "citizen-centric" websites (or portals) that are focused on providing users with easy access to all government information and services; while downplaying the structure of government, or which ministry provides the service.

These types of interactive websites provide citizens, businesses and visitors with a convenient way to access all government information and services through a single online location. The government of UK's (<http://www.direct.gov.uk>) is a good example of a well designed, effectively laid out, and easy to use citizen-centric site.

New workplace pensions

From October millions of workers will be enrolled into a workplace pension. Find out what this means for you

- ▶ Enrolling into a pension at work

**Most popular**

- ▶ Job search
- ▶ Cold Weather Payment
- ▶ Student finance
- ▶ SORN
- ▶ Income Support
- ▶ Car tax
- ▶ Driving theory test
- ▶ Attendance allowance
- ▶ Jobseeker's Allowance
- ▶ Passports
- ▶ More online services

Claim JSA online

Apply for Jobseeker's Allowance online at a time that suits you

- ▶ Apply for JSA online

Straight to...

- ▶ **Motoring**
Car tax, Learners, Driving licence...
- ▶ **Education and learning**
Student finance, University, 14-19s...
- ▶ **Money, tax and benefits**
Benefits, Taxes, Benefits adviser...
- ▶ **Home and community**
- ▶ **Parents**
Preschool, Schools, Childcare...
- ▶ **Employment**
Jobs, Redundancy, Holidays, Pay...
- ▶ **Young people**
Money, Work and careers, Leisure...
- ▶ **Disabled people**

Figure 1: UK's online portal for e-Services

2.3.1 E-Service Framework in Botswana

Botswana has a dedicated agenda towards promoting e-Government because the leaders have understood the importance of e-Government to an appreciable extent (Bwalya et al, 2010). Quoting from Mmegi Newspaper (2009, September), the potential of e-Government on improving the governance value chains in Botswana is explicitly outlined. For the case of Botswana, e-Government delivers far greater stakeholder value when it is designed within the context of a broader service delivery reform agenda. This 'whole-of-government strategy' leverages infrastructure, reduces cost and improves the on-line experience for clients. This newspaper projected that by the end of 2009, all appropriate government services will be on-line by 2009. Has this been achieved? Although Botswana does not have a formal e-Government strategy as do Tanzania, South Africa, Mauritius it has scored positive gains on the e-Government Indexes (Bwalya, 2009). It is considered an emerging ICT-usage-powerhouse in Sub-Saharan-Africa (SSA). Recent endeavors have seen it successfully implement massive projects such as the construction of the Kgalagadi optical fiber network, full liberalizations of the telecommunications sector, putting in place sound ICT sector regulatory and institutional frameworks, dedicated ICT policy, setting up of Botswana IT hub, etc. These interventions have also been solidified with the convergence of wireless technologies which enable individuals of all statuses to use mobile

technologies such as mobile phones, personal digital assistant (PDAs) etc. to communicate, manage data and generally participate in the digital boom.

The government therefore developed a national e-government strategy 2011 – 2016 called 1 Gov (*One Government*) which outlines five major programs and approximately twenty five interrelated projects that will, collectively, move all appropriate government services online, significantly improve public sector service delivery, and accelerate the uptake and usage of Information and Communications Technology (ICT) across all segments of our society. This master plan was developed after a careful review of Vision 2016, NDP 10 and *Maitlamo* to ensure the e-Government Strategy is fully aligned with their national development efforts and important government priorities.

The NDP 10 started in the year 2007, is Botswana's National Development Plan which outlines short to medium-term development initiatives to guide the overall development of the country, it contains government strategies planned to be undertaken over a plan period and the specific programs and projects to be implemented to achieve such strategies. It also contains estimates of revenue over the entire period as well as expenditure and manpower growth projections.

Botswana National Vision Council homepage is intended to provide rich information on vision 2016 and to encourage all stakeholders to play their part towards the realization of the goals of the Vision.

Vision 2016 is Botswana's strategy to propel its socio-economic and political development into a competitive, winning and prosperous nation. Seven key goals have been developed to achieve this. The vision reflects the aspirations of Botswana about their long-term future and is a result of extensive consultations with a wide spectrum of individuals and institutions in the country. The year 2016 has been proposed to align the country development agenda with attainment of 50 years of independence.

The seven key goals include:

- an Educated and Informed Nation
- a Prosperous, Productive and Innovative Nation
- a Compassionate, Just and Caring Nation
- a Safe and Secure Nation
- an Open, Democratic and Accountable Nation

- a Moral and Tolerant Nation
- a United and Proud Nation

The MAITLAMO initiative is a true success as it has also raised interest and awareness all around Africa and not in Botswana alone. Maitlamo is an ICT Policy that provides Botswana with a clear and compelling roadmap to drive social, economic, cultural and political transformation through the effective use of Information and Communications Technology (ICT). This master plan is intended to transform Botswana through the effective countrywide use of information and communications technology.

In order to directly support the National e-Government strategy, the Botswana government produced four supporting documents, they are:

- (i) 2009 e-Government Best Practice Report;
- (ii) 2010 e-Services Assessment;
- (iii) 2010 Government Current State Analysis; and
- (iv) 2010 Technical Blueprint & Rationalization Plan.

It is envisaged in the e-Government strategy that by 2016, in excess of 300 services will be available through the government portal. Services delivered through the portal will be easy to locate and simple to complete. Online services will be “client-centric” – meaning that information and services will be written and presented around the needs of clients – and not the structure of government.

A common-look-and-feel will be introduced across the portal and all ministry sites to provide a “whole of government” or “1Gov” experience for users.

Botswana’s e-Government Framework Strategy has been based on the following main sections: stakeholder engagement framework, e-Government framework, interoperability standards and architectural frameworks. It considers three approaches to interoperability which are multidisciplinary, and multi-driven and assumes that government interoperability occurred in different layers of business/organization, knowledge, data/information and technology.

Below is the framework for Botswana e-Service portal.

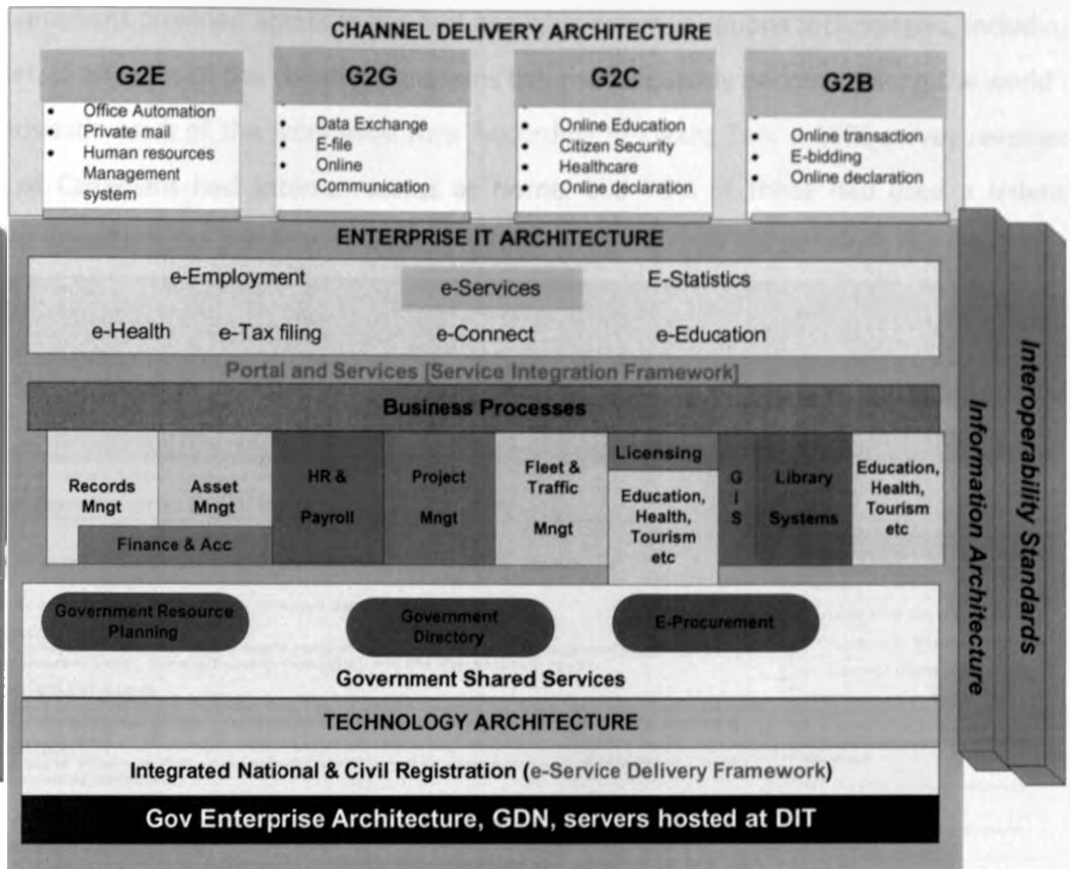


Figure 2: E-service framework for Botswana

2.3.2 E-Service Framework in Canada

Service Canada was announced by the Canadian on 23 February 2005 and touted as one of the biggest single reforms undertaken on a government-wide basis; Service Canada seeks service excellence for all Canadians. It envisions a transformation of how government serves its citizens, with the current complicated channels morphing over three years into a fully-integrated network with seamless, citizen-centric, multi-channel service.

Canada itself has been recognized internationally as a leader in e-Government. Nonetheless, Service Canada moves beyond e-Government to a broader agenda of change. It represents a second phase of service innovation for Canada, building on over a decade of earlier projects such as the Government Online (GOL) in the year 1999 to make the 130 most commonly used services available on-line, anywhere, anytime and Modernizing Services for Canadians (MSC).

According to Harvard university school of government, Canada announced its aim to become the most connected nation on earth in 1997. Through an initiative called "Connecting Canadians," the

federal government provided access to the best available communications technologies, including the Internet, in all areas of the country. Canadians have subsequently become among the world's most enthusiastic users of the worldwide web. According to Kwang Tan, a 2005 survey revealed that 72% of Canadians had Internet access at home, and 71% of these had used a federal government website in the previous 12 months



Figure 3: Canadian online portal

In defining interoperability perspectives, the framework assumes that interoperability is achieved through three domains: citizen centricity, whole of government approach and partnerships through a networked government.

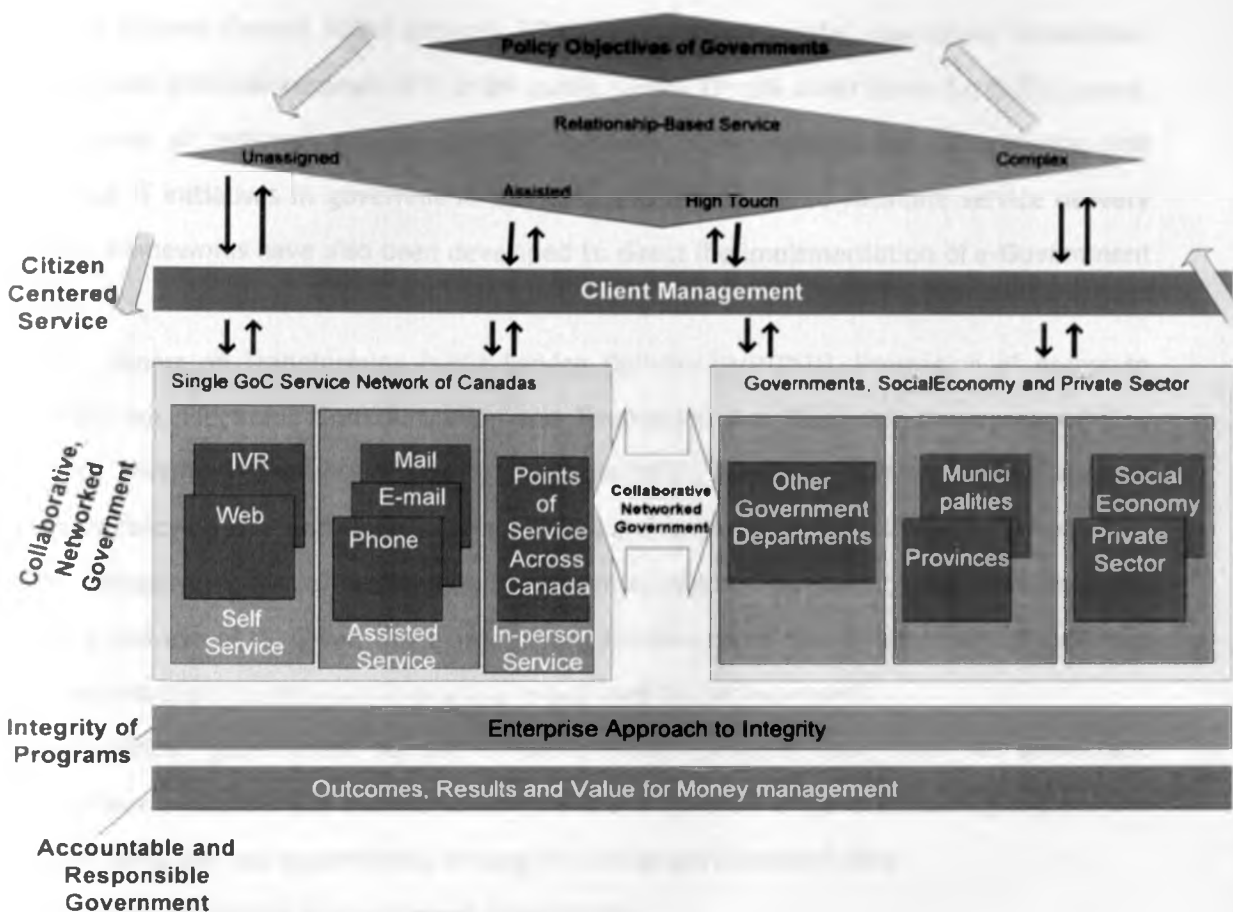


Figure 4: E-service framework for Canada

2.3.3 E-Service Framework in South Africa

According to Rangarirai et al, E-Government in Africa has been promoted by developed nations as a hypothetical remedy for poverty related problems (Ochara, 2008). Based on the fundamental human right to information access, the South African constitution places an obligation on the State to provide wide access to government information (CapeGateway 2009). In response to this obligation, the government, in partnership with private organisations, has launched numerous ICT initiatives in the country (Moodley, 2005).

Amongst the ICT initiatives are: Cape Gateway Project, Cape Information Technology Initiative (CITI), Tele-centres in rural areas in South Africa, SchoolNet South Africa Project, Mindset Network Organisation and the Khanya Project (Riordon, 2009; Evoh, 2007). The South African government has established statutory bodies to co-ordinate implementation of e-Government projects. Amongst these are the State Information Systems Agency (SITA) and Government Information

Technology Officers Council (GITO Council). SITA is responsible for the acquisition, installation, implementation and maintenance of IT in the public sector. On the other hand the GITO Council, which consists of national and provincial IT officers, is responsible for consolidating and coordinating IT initiatives in government, including e-Government, to facilitate service delivery. Regulatory frameworks have also been developed to direct the implementation of e-Government initiatives.

The white papers on Transforming Public Service Delivery (WTPSD), Promotion of Access to Information Act, Electronic Communication and Transaction Act, Electronic Government Policy Framework, Minimum Information Security Standards (MISS), Minimum Interoperability Standards (MIOB) and Policy on Free and Open Software (FOSS) are noteworthy. Collectively, the frameworks promote transparency, accountability, good governance, information security, and freedom in the acquisition and use of IT. Given this extraordinary attention paid to e-Government, it becomes essential to establish the situation in practice as opposed to that espoused.

The South African government set out a transformation program soon after the democratic changes where a presidential commission on the transformation of government highlighted the challenges facing the new government. Among the challenges identified were:

- Lack of co-ordination in government departments
- Incompatibility of infrastructure systems and architecture
- Wastage of government resources
- IT not business process driven

A comprehensive draft framework for a government-wide ICT strategy was crafted at the 2011 Government CIO Summit, which was attended by 120 senior government IT officials, SITA leadership and key ICT industry representatives. The Government CIO Summit, an initiative of the Government IT Officers (GITO) Council, was convened to bring government technology leaders together to debate, deliberate and map out the way forward for South Africa's public sector ICT (*GITO website*).

The council was able to identify six priority focus areas in support of government's strategic outcomes, from which the framework was established: Citizens access, Integrated service delivery, ICT governance and leadership, ICT cost management, ICT performance and Cross government business and ICT capability. The main assets of the South African interoperability framework are:

security standards and re-usability, cost/benefit considerations and interoperability. Interoperability domains are interconnection, data integration, information access, security and meta-data.

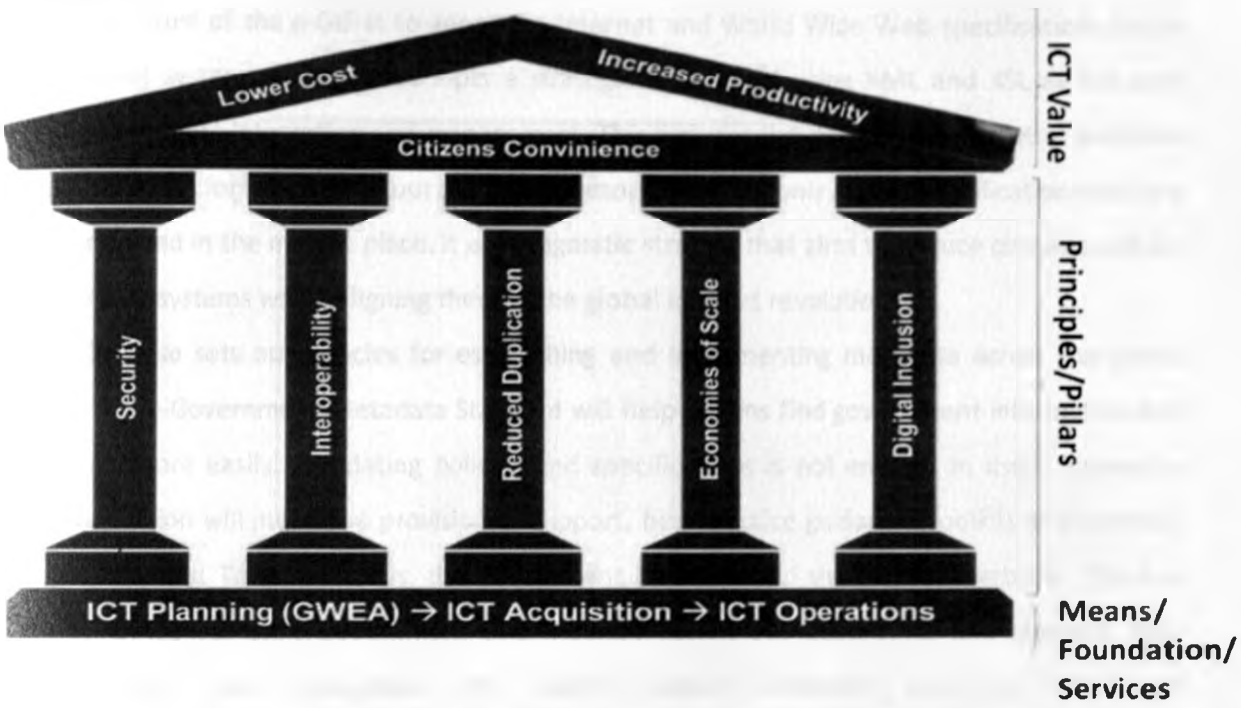


Figure 5: E-service framework for South Africa

2.3.4 E-Government Framework for United Kingdom

UK's government presents a framework for interoperability of governmental organizations named as e-GIF. The e-Government Interoperability Framework (e-GIF) was first published in September 2000 and sets out the government's policies and specifications for achieving interoperability and seamless flow of information across government as well as the wider public sector. Better public services tailored to the needs of the citizen and business, as envisaged in the UK online strategy, also requires a seamless flow of information across government. The e-Government Interoperability Framework (e-GIF) sets out the government's technical policies and specifications for achieving interoperability and Information and Communication Technology (ICT) systems coherence across the public sector. The e-GIF defines the essential pre-requisites for the joined-up and web-enabled government. It is the cornerstone policy in the overall e-Government strategy.

This framework is one of the main strategies to assure that information technology will support the government business. It consists of different components such as targets, principles, policies

and technical domains. This framework adjusts to government technical policies and parameters to achieve interoperability and integration of ICT in public sectors and defines necessary pre-requirements for integration of government enterprises.

The main thrust of the e-GIF is to adopt the Internet and World Wide Web specifications for all government systems. The e-GIF adopts a strategic decision of using XML and XSL as the core standards for data integration and management. This includes the definition and central provision of XML schemas for use throughout the public sector. The e-GIF only adopts specifications that are well supported in the market place. It is a pragmatic strategy that aims to reduce cost and risk for government systems whilst aligning them to the global Internet revolution.

The e-GIF also sets out policies for establishing and implementing metadata across the public sector. The e-Government Metadata Standard will help citizens find government information and resources more easily. Stipulating policies and specifications is not enough in itself. Successful implementation will mean the provision of support, best practice guidance, toolkits and centrally agreed schemas. To provide this, the government has launched the GovTalk website. This is a Cabinet Office-led, joint government and industry facility for generating and agreeing XML schemas for use throughout the public sector. Schemas can be found at <http://www.govtalk.gov.uk/schemasstandards/xmlschema.asp>. GovTalk is also used for wide consultation on a number of other e-Government frameworks and documents.

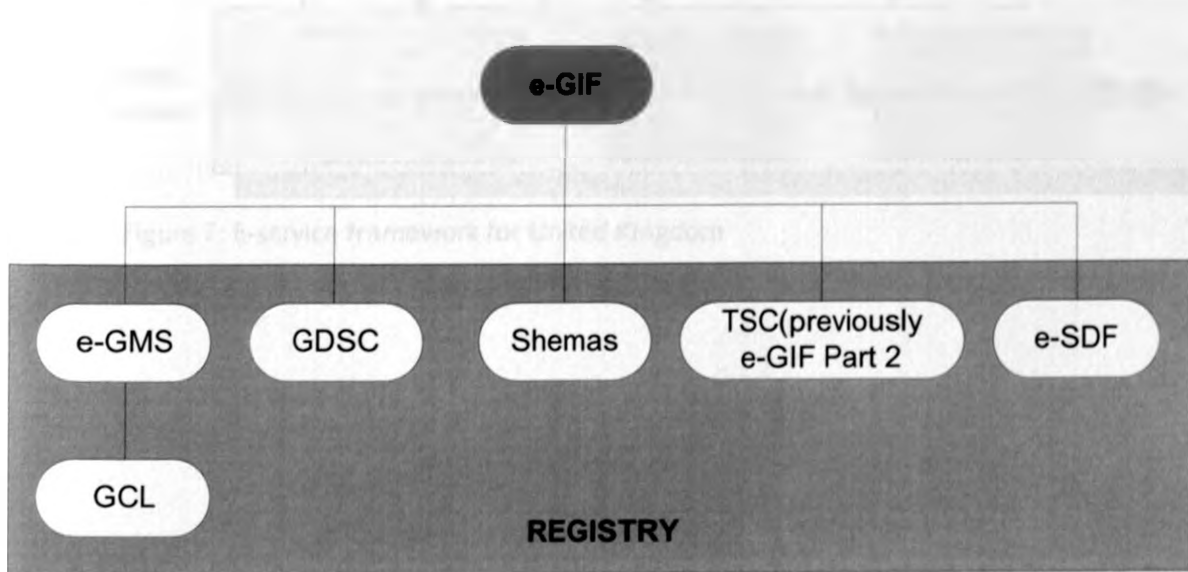


Figure 6: United Kingdom's e-GIF's architecture

The e-Government Interoperability Framework is an ambitious exercise intended to resolve and prevent problem arising from incompatible content of different computer systems. This cover interconnectivity, data integration, e-services access and content management. The framework comprise of the following major components:

- e-Government Metadata standards (e-GMS)
- Government Category List(GCL)
- the Government Data Standards Catalogue (GDSC)
- XML Schemas
- Technical Standards Catalogue (TSC)
- e-Service Development Framework (e-SDF)

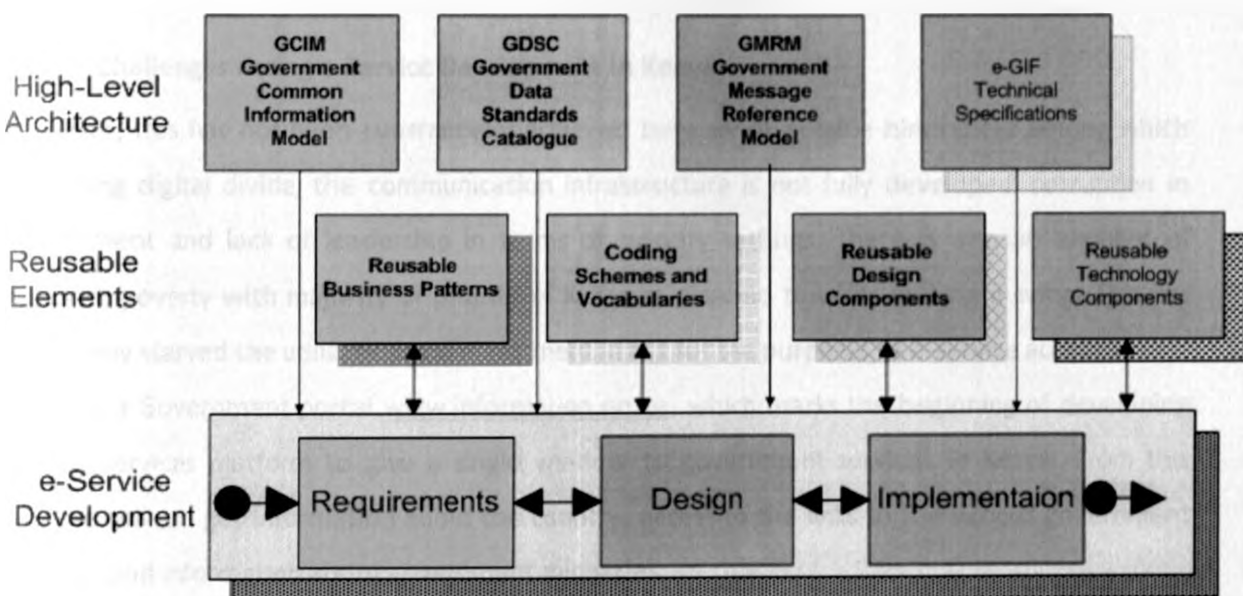


Figure 7: E-service framework for United Kingdom

2.4 E-Service Situation in Kenya

According to the Ministry of Information and Communications (e-Governance) the achievement of e-Government in Kenya has been one of the main priorities of the Government of Kenya towards the realization of national development goals and objectives for Wealth and Employment Creation, as stipulated in the Kenya Vision 2030.

Several government agencies are currently using ICT to promote a more efficient and effective government by facilitating accessibility of government services through online portals, allow greater public access to information, and make the government more accountable to citizens. This has been achieved through enhancing ICT policies in the country, putting critical information online, automating administrative processes and interacting with their citizens through online services.

2.4.1 Challenges Facing e-Service Development in Kenya

However, this has not been substantially achieved because of notable hindrances among which prevailing digital divide, the communication infrastructure is not fully developed, corruption in government and lack of leadership in terms of priority settings. There is also an element of rampant poverty with majority of priority of Kenyans directed towards making a living. This has effectively starved the utilization and investment in ICT for the purposes of e-service access.

There is a Government portal www.information.go.ke which marks the beginning of developing shared services platform to give a single window to government services in Kenya. From this website we can get information about the country, access to the links to the various government services and information about government ministries.



Figure 8: Government of Kenya's ministry of information and communication portal

2.5 Comparison of the Referenced Frameworks

For this research work four different frameworks have been referenced from different selected countries based on their suitability to the subject area of study. These comparisons are intended to provide supplementary information for the development of a conceptual e-Service platform for the government of Kenya. This Review focuses on how GIFs in different countries were developed, the principles that animate them, the technical standards they mandated and/or recommend, the way they are managed, and the implementation and compliance mechanisms they have established. It also goes further to evaluate their strengths and weaknesses and based on these elements a conceptual framework for the e-Service management in Kenya will be proposed.

Below is an illustration comparing four main frameworks studied this far. The elements have been categorized as they appear in each of the framework.

### Elements Supporting the Frameworks Studied				
Botswana		Canada	South Africa	United Kingdom
1	Channel Delivery Architecture	Policy Objectives of Governments	ICT Value (<i>Lower Cost, Increased Productivity & Citizens Governance</i>)	e-Government Metadata Standards
2	Interoperability Standards	Collaborative, Networked Government	Interoperability	Government Category List
3	Stakeholders Engagement Framework	Citizen Centred Service	Security	Government Data Standards Catalogue
4	E-Government Framework	Client Management	Reduced Duplication	XML Schemas
5	Information Architecture	Integrity of Programs	Economies of Scale	Technical Standards Catalogue
6	Enterprise IT Architecture	Accountable and Responsible Government	Digital Inclusion	e-Service Development Framework
7	Technology Architecture			

Table 2: Studied framework elements categorizations

2.5.1 The Strengths of the various Frameworks studied

These elements were selected based on the key features they represented with regards to the realization of interoperable e-Government system in their countries. Different countries have different challenges when it comes to implementation of e-Government and each country tends to focus on different areas.

Evaluation of Strengths and Suitability of the Framework Elements Studied		
The prominent features of each of the studied frameworks are highlighted below:		
1	Botswana	<ul style="list-style-type: none"> - Technical aspects - Semantics (meaning of exchanged info between IS systems) - Message and data formats - Enterprise IT infrastructure: - Stakeholder engagement: Public, private sectors and the public
2	Canada	<ul style="list-style-type: none"> - Integrity of Programs: To build public trust and confidence - Collaborative, Networked Government: Improve public administration.
3	South Africa	<ul style="list-style-type: none"> - Security: To address challenges of forgery, identity theft & hacking. - Reduced duplication: Through reuse of technology, implementation efficiency & collaboration. - Digital inclusion: Incorporation of the public, central government, private sector and academics in the process - Economies of scale: Through large scale investment in ICT through partnership and collaboration of organizations.
4	United Kingdom	<ul style="list-style-type: none"> - Metadata Standards: By establishing semantics of data to ensure correct use and interpretation by owners and users. - Data Standards Catalogue: Adoption of XML and XML schemas to be used in the interchange process. - Technical Standards Catalogue: Touching on interconnection, data integration, Content management & e-service access

Table 3: Strengths of the framework elements studied

2.5.2 Assumptions for Conceptual Framework

The conceptual framework elements was suggested based on the key strengths of individual frameworks as has been outlined in the preceding table. A good e-Service framework must therefore advocate for the technical aspects of interoperability, information semantics (*meaning of what is being exchanged*) and data formats. An e-Service framework should also address integrity of programs and security so as to enhance public confidence and trust. It should also promote the establishment of standards across government.

Deriving the Conceptual Framework

The researcher decided to pick the key elements that define the studied frameworks; these elements were used by the researcher to propose a conceptual framework for the e-Service adoption by the government of Kenya. These elements were picked for adoption based on their relevance and suitability with reference to the Kenyans situation. The researcher decided to base the conceptual framework on three principle layers:

- i. Establishment of a firm foundation for ICT infrastructure development
- ii. Establishment of interoperability enablers/pillars
- iii. Benefits derived from successful interoperability implementation

Establishment of Firm ICT Foundation

This layer is critical as it is concerned with the laying foundation for the development of interoperable and integrated information sharing environment. This layer addresses those issues which are critical towards laying foundation for a successful interoperability implementation in developing countries where ICT infrastructure is at its rudimentary stages with vague ICT policies, no clear roadmap and strategy to facilitate uptake and adoption of strategic ICT infrastructure.

Principles/Pillars

This is layer 2 of the conceptual framework. This is where the various interoperability enablers are implemented with a strategic objective of addressing technical issues, standards and formats for data and information, adoption of reuse as a technology as well as interconnectivity of interoperability systems. Any government deploying e-Government services must heavily invest on ICTs to address those issues touching on security, duplication of investments, heavy capital investment due to lack of economies of scale and also to enhance public participation.

ICT Value

The layer 3 addresses the benefits that come with the adoption of e-Government as a service delivery vehicle in the public and private sector organizations. The benefits enjoyed by any government and its citizens when it realigns its operations to take advantage of ICTs includes reduction of bureaucracy in government processes, increased productivity, lower cost of production due to economies of scale hence lower cost to the consumers of goods and services, convenience and efficiency to the citizens.

2.5.3 Conceptual Framework and its Elements

In the previous sections, different interoperability frameworks and other countries' experiences were investigated. The strengths and weaknesses of the studied frameworks were thus analysed to propose an appropriate framework. The proposed framework will be comprehensive and cover weaknesses of each investigated framework and is represented as the figure 9 below.

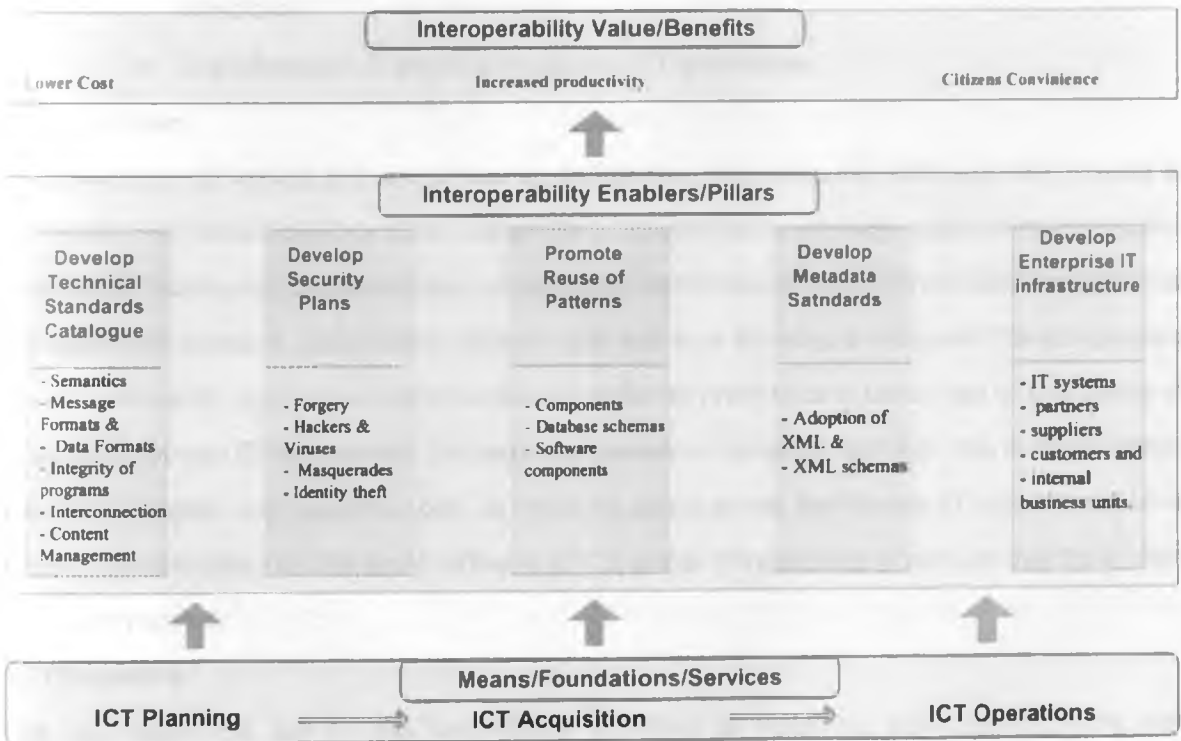


Figure 9: Conceptual Framework for e-Service Development

The proposed framework consists of three layers with different elements; each element will be described in the following.

ICT Planning

Information Communication Technology (ICT) planning ensures alignment of ICT objectives to e-Government needs to maximise value from ICT investments, satisfy legislative and government policy requirements and support whole-of-Government ICT portfolio analysis. It does not only provide a justification for specific ICT initiatives, but also provides a confidence that initiatives being taken are of utmost benefit to the e-Government dispensation process. When undertaking ICT resource planning initiatives, the government must:

- Use ICT planning methodology
- Establish and implement appropriate ICT planning processes
- Ensure alignment with target business priorities and support of e-Government directions
- Use effective ICT planning to support ICT governance

ICT acquisition

Investment in ICT covers the acquisition of equipment and computer software that is used in production. ICT acquisition has three components: information technology equipment (computers and related hardware), communications equipment and software. Software includes acquisition of pre-packaged software, customised software and software developed in house. The government should collaborate and partner with the private sector in order to take advantage of economies of scale when buying ICT equipment, Software and Licenses. This will effectively help in driving down the overall capital and operating cost. In order to assure public confidence of security and trust issues, Commercially-Off-The-Shelf software (COTS) are preferable simply because they have been thoroughly tested.

ICT Operations

This will cover the day to day operational activities of installing, updating/upgrading and maintaining ICT activities across the interoperability systems. Further, these activities will cover project management, vendor activity management as well as harmonization of different interoperability projects so as to help achieve the desired interoperability objective.

Develop Technical Standards Catalogue

A common standard catalogue targets all public sector ICT systems by focusing on standardising ICT infrastructure, design and implementation of citizens and business-oriented services. United Kingdom has a British Standards and Architecture Framework (SAF) which is a reference document which is part of other large set of documents surrounding and supporting the UK government strategy. Technical standards catalogue is an architectural framework of cross-Government Enterprise Architecture (xGEA) which describes how public sector ICT systems should be built. This is driven towards building a high-quality ICT infrastructure and also to support the existing core public sector goals by improving public service delivery, improving access to public services and increasing efficiency of public service delivery.

The technical standards catalogue aims to achieve the above goals through a common infrastructure, common standards and common capabilities.

Develop Security Plans

According to Kaisara et al (2009), security/trust dimension is an important concern, although different e-Governments have differing needs for the dimension. Portals at rudimentary stages are unlikely to invoke security concerns in citizens as mature e-Government initiatives where citizens can transact online. Mature e-Government systems require citizens to provide more information to the WWW Information Systems, thus exposing them to hackers and viruses. There is need for the government to foster a sense of trust by limiting the sharing of personal identity information with entities that the citizens did not furnish the information to.

Electronic Communications and Transactions Act (No. 25 of 2002:17) prohibits data collectors sharing citizens' personal information to third parties without express written or permitted by law (South Africa, 2002). Failure to cultivate a sense of security/trust could emerge as an impediment to a successful e-Government program. Systems and security requirements, such as integrity, secure payment mechanisms and promotion of security mechanism is pertinent to e-Government as well (Min-Shiang et al, 2004). Other security implications which can attract legal actions are networking crime, masquerades of unauthorized identity and computer forgery.

Promote Reuse of Patterns

According to Robert (2002), reusable patterns are found at both the implementation level in the form of EDI (Electronic Data Interchange) and XML libraries and also at the conceptual level in terms of libraries of models that describe business processes and the organization activities between the businesses. Reusing patterns therefore facilitates interoperability between technology implementations by providing a library of reusable data components, database schemas and software components.

Develop Metadata Standards

This involves setting up of a metadata cataloguing system which can recognize (support) the following three forms of metadata:

- i. The implementation form – within a database or a storage system
- ii. The export or encoding form – a machine-readable form designed for transfer metadata between computers
- iii. The presentation form – a format suitable to viewing by humans

XML which is a structured language with structural rules enforced through a control file (DTD – Document Type Definition) can be used to support the last two forms to validate the document structure i.e. conformance with a metadata standards DTD.

However, in order to maintain interoperability across related metadata standards, it is necessary to create software systems capable of providing crosswalk between metadata standards. A crosswalk therefore is a table that maps the relationships and equivalences between two or more metadata formats. Crosswalks or metadata mapping support the ability of search engines to search effectively across heterogeneous databases, crosswalk therefore help promote interoperability.

Develop Enterprise IT Infrastructure

Interoperability is central to any form of collaboration between organizations, as it enables information and knowledge sharing by cooperating entities within and across organizational boundaries. This is particularly important in the public sector where collaboration between public agencies is necessary to realize the notions of seamless services and one-stop government.

Developing enterprise IT architectures comprise developing models and tools to support decision making and development particularly related to ICT applications at different levels within an

enterprise. Additionally, they support planning and provide the necessary information to support interoperability within and between organizations.

Lower Cost

Since the capital investment and operating costs are shared, the cost therefore is much less due to economies of scale. The acquisitions of hardware, application software as well as the licenses are done under collaborations and partnering of organizations so that they enjoy economies.

Increase Productivity

With interoperable information systems, there is increase efficiency which leads to increased productivity since the costs are appreciable low.

Citizens Convenience

This is caused by efficiencies and reliability of interoperability systems.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Scope of the Study

Even though information players were earlier classified as producers, consumers, regulators and info-prenuers, for this research analysis the concept of e-Government was limited to the scope of information consumers and producers. This research scope was selected because the researcher wanted to investigate whether organizations which are in the business of capturing and storing data have a mechanism to organize this data using some form of standards as a guide using information technology tools. Further, the researcher was also interested in establishing whether there exists policy and governance structure to regulate the same. The research questions were also designed to try to answer the various concerns and challenges which may hinder the adoption of e-Service into the mainstream service delivery in Kenya.

3.2 Target Population and Sampling Technique

The target population for this research study were senior ICT professionals and domain experts in government and private sector organizations in Kenya who are/have been involved in the e-Service development project management within their organizations. The organizations selected for participation were situated in the Nairobi city and its environs as a representative group for the entire population of study. The intention was to sample respondents from the organizations which have adopted or are in the process of adopting e-Service delivery as a means to deliver services to their customers (either internally or externally).

The study area was selected due to the reason that the organizations were located within Nairobi area and therefore convenient in terms of time and cost for the researcher. A stratified random sampling technique was therefore adopted in the selection of the respondents from the entire population. The target population as mention in section 4.0 above was those organizations which produce information.

3.3 Sampling Design

According to C.R Kothari, 2004, a researcher must prepare a sample design for his study, i.e. he must plan how a sample should be selected and of what size such a sample would be. A sample design therefore is a definite plan for obtaining a sample from a given population. When time and resources allow, the sample size should be taken as big as possible, since this would ensure reliability of the results. The danger with smaller samples therefore is that they do not reproduce the salient characteristics of the accessible population to an acceptable degree, Mugenda & Mugenda (2003).

A stratified random sampling technique was therefore adopted for this research since the research was targeting some specific group of the populations in the selected organizations. If a population from which a sample is to be drawn does not constitute a homogenous group, stratified sampling technique is generally applied in order to obtain a representative sample, C.R Kothari, 2004.

3.4 Research Instruments

Different data collection methodologies were adopted in order to gain access and capture the required data depending on their suitability. For this research study two types of data were considered namely primary and secondary data. Primary data is data that a researcher collects directly on his/her own for specific purpose. The methods used to collect primary data were by dispensing the questionnaire, interviews and case studies. Secondary data is data collected by someone other than the user through documentation reviews.

Questionnaires

A pilot questionnaire was shared with the personnel at the Directorate of e-Government with a view of seeking an expansion of knowledge in this subject area of study. E-mail correspondences were also used to circulate the piloted questionnaires. The feedback received was used to help in expanding and refining the various questions proposed and also to identify problems as well as eliminating any vagueness in the proposed questions. The questions were then revised and corrected as per the various recommendations and suggestions obtained. The final questionnaire was then adopted which included questions touching on both the technical, management and policy regulations of interoperability situation.

The questions adopted included both open and closed ended questions which were published on an online webpage for ease of dissemination and accelerated feedback. The questionnaire was disseminated over the internet below is the online page.



Figure 10: Online research instrument page sample

Personal Interviews

Besides questionnaires, personal interviews were conducted for the ICT heads in some selected organizations. At the Ministry of Immigrations and Registration of Persons, the ICT Head of Department was interviewed while at KRA Senior Assistant Commissioner Information & Communication Technology was also interviewed. A senior ICT officer was also interviewed at the National Museums of Kenya. This methodology provided a platform to probe and seek additional information that may have not been included in the questionnaire and also to help understand the various policy guidelines and implementations. The selection of interviewees was based on their role and wide experience particularly in the subject area of policy implementations and interoperability.

Case Studies

This research methodology was employed basically to study existing information systems which are currently being used in selected organizations to promote the management of affairs within these organizations to leverage communication and sharing of information and data. Further, it was intended to study the elements within these information systems, their interface design and how they have been implemented to support the interaction between the data producers and consumers.

At the Ministry of Immigration and Registration of Persons, a study of the system (*Integrated Population and Registration Services* → *IPRS*) they use for capturing and storing both civil and biometric data of applicants as well as production of security documents (identity cards, alien and refugee certificates) was studied. The Ministry of Lands uses an Integrated Land Rent System (ILRS) to manage land rent records.

Documentation Study

To get a better understanding on the policy regulation, technology, security and infrastructures that is necessary for dissemination of e-Services a documentation study of the various policy documents were carried out. The Kenya ICT Policy document was studied; it provided a guiding principle to influence how decisions and actions were incorporated in the conceptual framework. The Kenya Open Data (<https://opendata.go.ke>), an online resource repository, provided a lot of insight on how data is organized based on certain unique keys which make it easy for reuse by the other organizations. This is a typical example of interoperability in use in Kenya today.

Different frameworks from selected countries were also studied as outlined in the literature review section to highlight the pertinent elements of an interoperable e-Service framework. The key elements were compared with what is currently happening in Kenya from where a conceptual framework was derived.

Observations

A visit was arranged for MIRP, National Museums and Safaricom labs for a demonstration of how information sharing is realized, a study of the various metadata standards deployed helped to understand how the philosophy of reuse of data elements is key in data and information sharing across networks.

3.5 Research Instrument Testing

Reliability Testing

The first step in data analysis was to test for reliability and validity of the data collection instruments. While reliability is the consistency of measure, a test is considered reliable if we get similar results reproduced under similar methodology. Kirk and Miller (1986) identified three types of reliability referred to in quantitative research, which relate to,

- i. the degree to which a measurement, given repeatedly, remains the same
- ii. the stability of measurement over time; and

iii. the similarity of measurements within a given time period

This means that the research questions should yield consistent responses when asked multiple times – this signifies reliability.

Validity Testing

According to Golafshani (2003), if the validity or trustworthiness can be maximized or tested then more “credible and defensible result” may lead to generalizability. Therefore, the quality of a research is related to generalizability of the result and thereby to the testing and increasing the validity or trustworthiness of the research. This researcher therefore targeted technology experts and ICT professionals because they possess vast knowledge in the subject area of using ICTs to leverage e-Service dispensation. The researcher was also cautious to select organizations to participate in the research study based on level of strides they have made towards implementation of e-Services so that the actual scenario can be reproduced.

Validity is also concerned with the questions of stability and consistency. It is the extent with which what was being measured and its suitability to the research objectives.

Mapping of Research Objectives and Questions onto Research Methodology

	Research Objectives	How they were met
1	To identify and review existing e-Service interoperability frameworks applicable to governments	Through Literature Review of existing interoperability frameworks (Botswana, SA, Canada and UK were studied)
2	To establish policy frameworks that will govern interoperability situation in Kenya	Performed Interview sessions with officers at the MIRP, KRA and Nation Museums
3	To propose a conceptual e-Service framework that would advocate policies to promote exchange and sharing of public data and also to provide an underpinning for extension to the existing research	Through a comparative study of the referenced frameworks on interoperability by identifying common elements
4	To validate the conceptual framework with respect to Kenyan e-Service management	Through analysis of data collected from the field through questionnaires, interviews and case studies
5	What factors, trends, policies and conditions are most likely to shape the future of e-Services delivery in Kenya? What are the challenges and benefits of the e-Service delivery through interoperability?	Performed Interview sessions with officers at the MIRP, KRA and Nation Museums

Table 4: Mapping of research objectives onto methodology

3.6 Hypothesis Testing

The stated hypotheses were tested using the z-parameter scores. The range for z-scores which defined the acceptance region was -1.96 and 1.96 and this was based on the value of the Alpha used which was 0.05. The hypothesis was not considered if the z-factor of each factor was falling within the critical region but was considered if the z-score fell within the acceptance region.

3.7 Data Analysis

Since the raw data from the field cannot be used to derive meaning, it prompts for processing and analysis for it to make sense of interpretation. After data has been collected from the field, the raw data was arranged in a manner that could enable analysis to take place. These involve editing of data to detect errors, omissions, corrections and classification of data in order to come up with meaningful relationships and tabulate the data to facilitate analysis. Both qualitative and quantitative methods of data analysis were used to analyze the data. Data analysis tools such as SPSS and spreadsheet tools were used to do the analysis.

Qualitative Analysis

Qualitative analysis was used to analyze data that could not be quantified; these were basically questions where the researcher was interrogating the respondents' opinions on the subject under study. These types of questions were the open-ended questionnaires and interviews. This was very useful as it gave the respondents the opportunity to give an elaborate opinion on the subject based on their experience and expertise. The phrases of words from different respondents were studied to identify similarities and differences to establish a pattern.

Quantitative Analysis

These were used to analyze closed-ended questions, these were questions which had multiple choices or pre-defined responses and could be assigned numerical values. This made it easier to come up with statistics that would assist in designing distribution of scores.

CHAPTER 4 RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents analysis and discusses findings from the field based on the research activity conducted between May and June 2012 to ascertain the level of interoperability situation in Kenya. The research targeted those organizations which have adopted the use of information and communication systems (ICTs) to manage both internal and external interactions in enhancing service delivery to their customers and also to improve their service processes. The researcher focused on how these ICTs have been used to promote sharing and exchange of information and data between these organizations and the guiding policies which advance them. For this research, the researcher employed a blend of qualitative and quantitative research methodologies to get feedback from the respondents.

4.2 Research Demographics

The data was obtained from the field by use of questionnaires, interview notes, case studies, policy document reviews and online documentary repository reviews. The data so obtained was therefore cleaned and then grouped as per research questions before analysis. Below is the breakdown of how the various strategies were applied to aid in data collection. A total of 255 questionnaires were dispensed using different methodologies, out of this number 197 questionnaires were found to be valid after doing data cleaning and validation.

	Method of Dispensation	Number of Questionnaires		
		Sent	Received	After Cleaning
1	Soft copy - Online	127	101	89
2	Hard copy - Paper	87	80	67
3	Phone Interviews	27	27	27
4	Face-to-face Interview	14	14	14
	Total	255	222	197

Table 5: Table showing how the research questions were distributed to the respondents

The number of questionnaires received was less by 33 because the researcher did not receive feedback from some respondents; this was attributed to the fact that the respondents did not have the requisite understanding of the subject area and so they were not comfortable giving their opinions for fear of being wrong. The other set of 25 questionnaires were discarded during data

cleaning because they did not pass the validation criteria as some of the responses were incomplete, some respondents gave contradicting responses while others were vague and lacked consistency. The percentage of the total questionnaires received was 87.06% out of which 12.94% of the total questionnaires were not received while 11.26% of the received questionnaires were discarded as explained above.

The questionnaires were dispensed to both the public and private organizations and the distribution was as below.

Respondents Distribution Table						
	Private Companies		Public Companies		Total Before	Total After
Gender	Before Cleaning	After Cleaning	Before Cleaning	After Cleaning	Data Cleaning	Data Cleaning
Male	31	24	152	114	183	138
Female	11	9	61	50	72	59
Total	42	33	213	164	255	197

Table 6: Respondents distribution table

The figure 11 below shows a bar graph of how the questionnaires were distributed between the private and public organizations. It further shows the percentage of the valid and invalidated questionnaires. The questionnaires were invalidated because some of them were either incomplete, had conflicting responses and others lacked consistency and so they were not considered for further analysis.

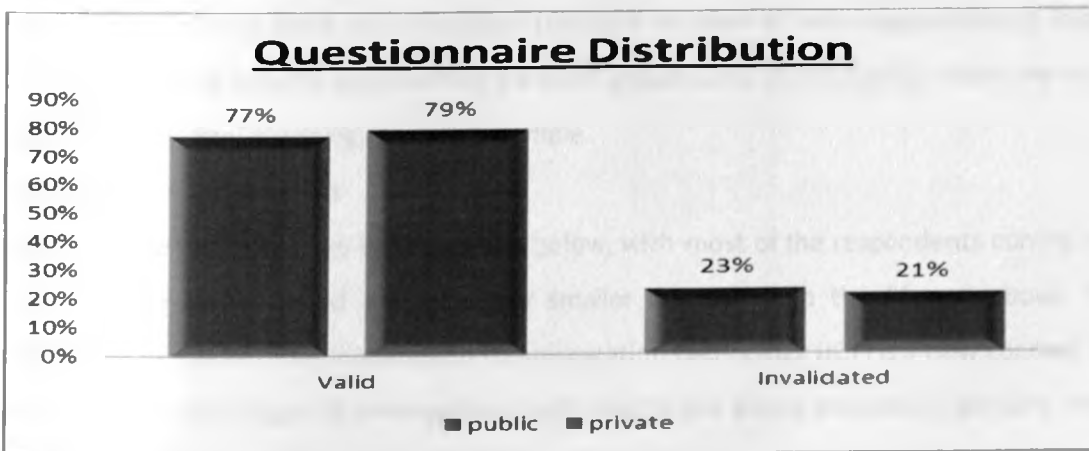


Figure 11: Valid and invalidated questionnaires

Data processing involves editing and coding of raw data. The output of these processes are classified and tabulated in order to generate patterns and relationships among data groups. The

multiple choice questions were coded numerically and fed into SPSS for statistical analysis. However, the other set of questions which were meant to interrogate the respondents opinions were also analysed and grouped together. Data obtained from interviews and documentary studies were reviewed, sorted into some textual patterns. These patterns were then analysed using thematic analysis schemes using SPSS and spread sheet software tools.

Each section of the questionnaire was analysed individually to extract patterns of similarities and disparities.

Gender Distribution

First the gender distribution was extracted from the collected data to identify if there were any disparity or bias in the way the questionnaires were distributed, this was also meant to help the researcher understand the gender pattern in this subject area.

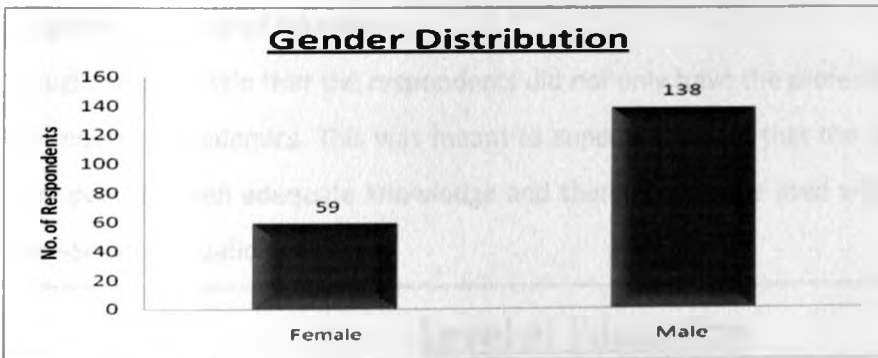


Figure 12: Gender distribution pattern

It was observed that there was more than twice the number of male respondents as female with 71.1% of the respondents representing the male populations, signifying that there are more male populations in this technology area than female.

Respondent's Age Brackets

The respondents' ages were distributed as below, with most of the respondents coming from the 36 – 45 age brackets and a significantly smaller number from the 61 and above. This was attributed to the fact that information communication technology (ICT) is a new concept in Kenya and is at its early stages of development with mostly the young generation actively involved in technology related projects.

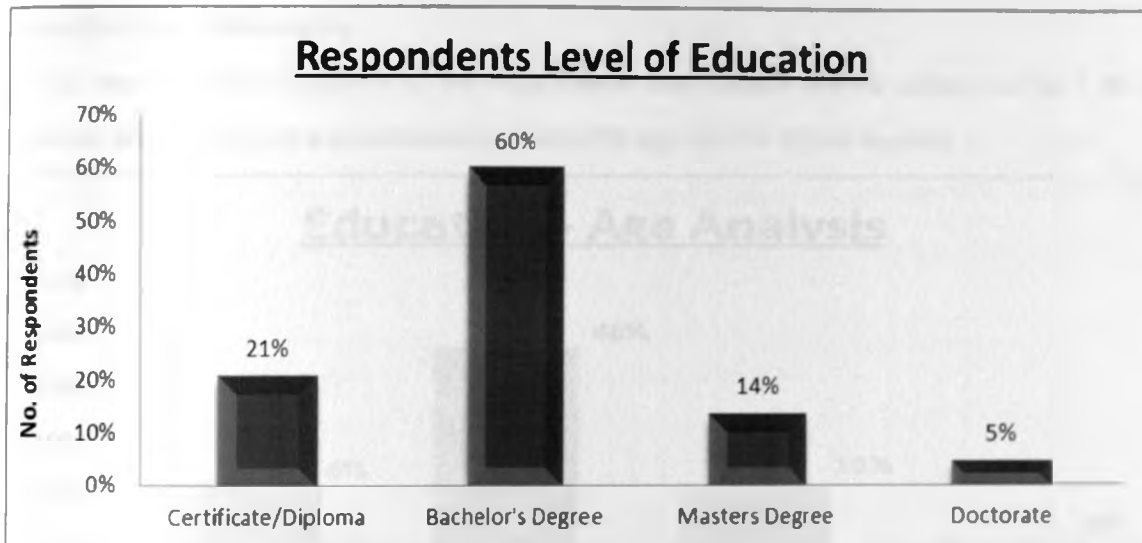


Figure 13: The age distribution pattern for the respondents

Respondents Level of Education

I sought to ascertain that the respondents did not only have the professional background but also the requisite academics. This was meant to support the fact that the information was collected from persons with adequate knowledge and therefore can be used with confidence in assessing the e-Service situation in Kenya.

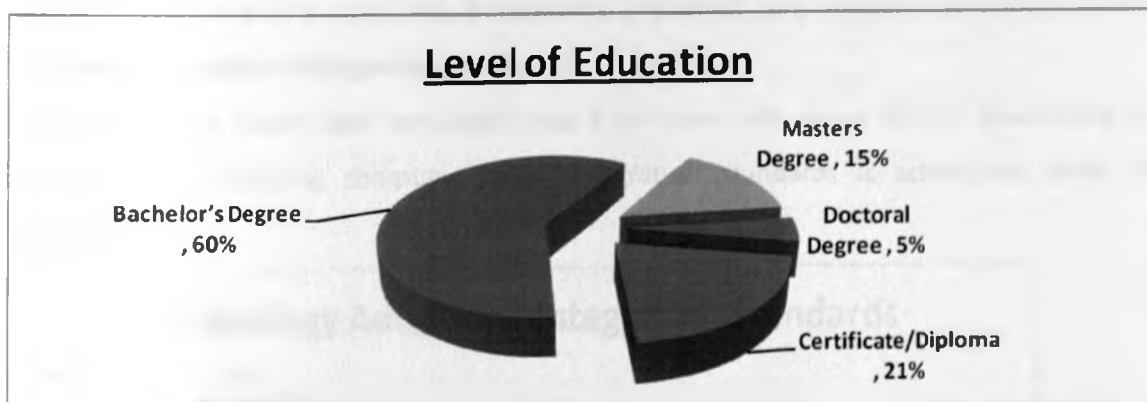


Figure 14: The respondent's level of education

There was fair representation across the education levels, so the nature of response obtained reflects the nature of experience at each level of education and thus dependable.

Education/Age Relationship

It was observed that majority of the respondents who possess degree belong to 36 – 45 age brackets while 15% of the respondents between the age of 46 – 60 had masters.

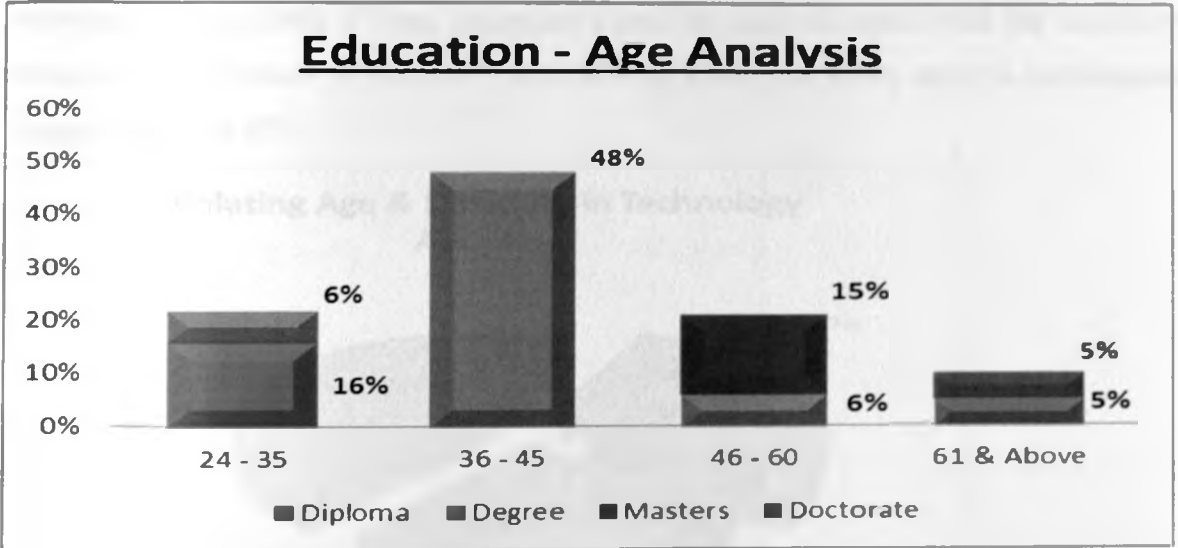


Figure 15: Education – Age Analysis

4.3 Data Processing and Analysis

Here the collected data is processed, analysed and presented using graphical tabulations as below:

Technology Adoption – Integration Standards

The respondents' views were tabulated using a bar chart with about 58% of them being quite optimistic that adopting computer based integration standards is achievable within their organizations.

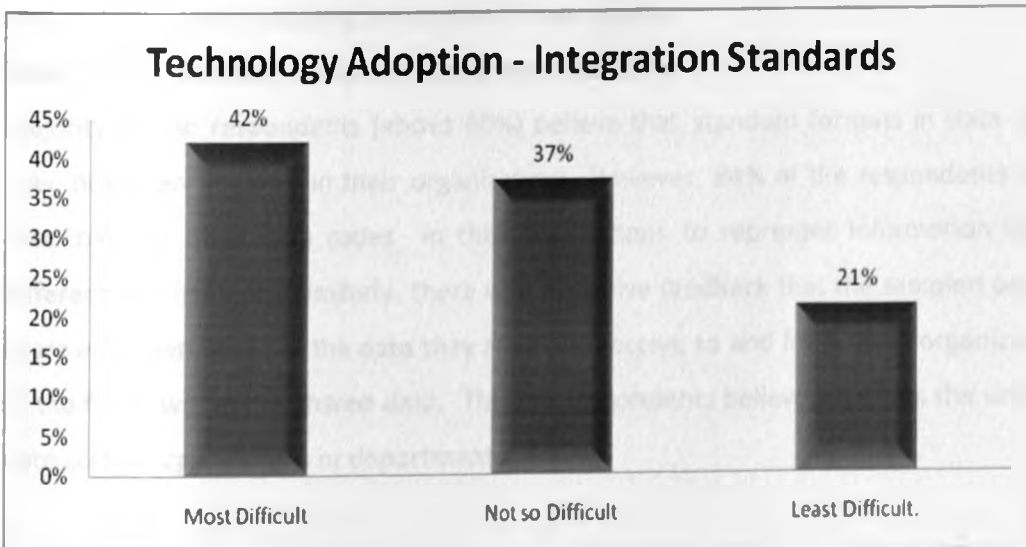


Figure 16: Technology adoption – Integration Standards

The pie chart below relates the respondent's age group and the difficulty in technology adoption. It is evident therefore that out of the 42% of those who felt that technology adoption is a challenge, majority (54%) of those respondent's were 46 years and above. This the researcher attributed to the level of difficulty with which this age group can quickly adapt to technological changes relating to ICTs.

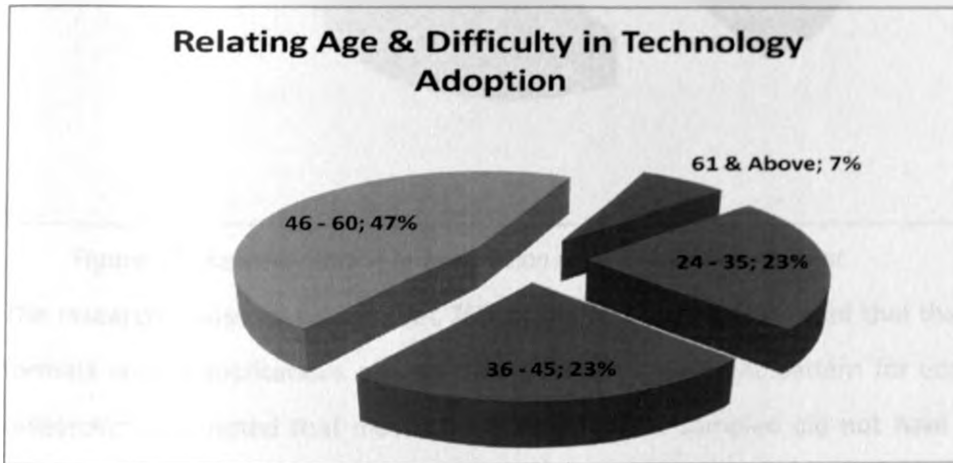


Figure 17: Relating Age & difficulty in technology adoption

A drill down on the individual questions revealed that about 80% of the respondents reported that in computer based data sharing, getting connected would be a challenge with most of them attributing this to the fact that our infrastructure is still at in development stage. Another 87% indicated that guaranteeing security and privacy of shared information and data would pose a serious challenge in adopting integrated infrastructure.

Usage of Standardized Formats in Data Representation

Majority of the respondents (about 60%) believe that standard formats in data representation have not been adopted in their organizations. However, 84% of the respondents acknowledged that they use their own codes in their applications to represent information that cut across different departments. Similarly, there was a positive feedback that the sampled organizations do share information about the data they send and receive to and from other organizations in terms of the fields within the shared data. This the respondents believe improves the understanding of data across organizations or departments.

Perception on Standard Data Format Usage

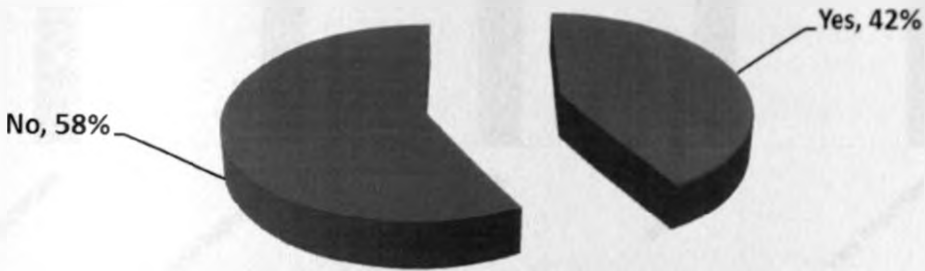


Figure 18: Representation of perception on standard data format

The researcher also found out that 76% of the respondents indicated that they don't reuse data formats across applications and so they generate a different pattern for each application. The researcher also noted that most of the organizations sampled did not have a well established procedure for implementing and documenting the change processes in the data formats and harmonizing the various codes they used in their applications.

Development_new_coding_schemes_for_each_project

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	69	35.0	35.0	35.0
No	128	65.0	65.0	100.0
Total	197	100.0	100.0	

From the frequency table above, it is evident that majority of the respondents, about 65% of whom reported that they develop new coding schemes for each project.

Barriers to Usage of Interoperable Information Systems

When the respondents were asked to give their opinions with regards to the importance of the barriers to organization's decision's to use interoperable information systems for online data sharing or integrated service delivery, about 17% of the respondents surveyed believe that the suggested barriers to interoperability were not important.

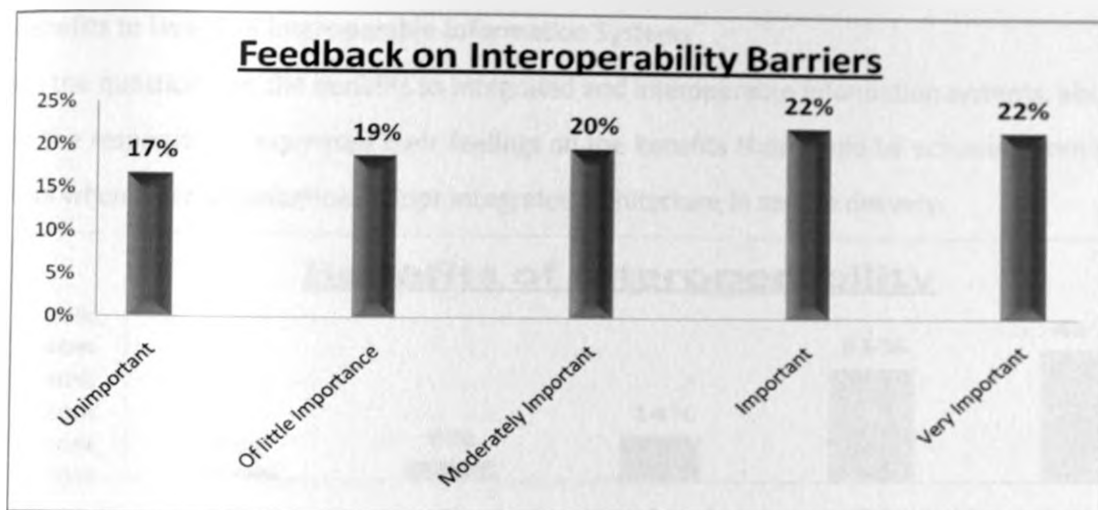


Figure 19: Representation of feedback on interoperability barriers

Among the suggested questions, lack of policy framework and clear directives, security and confidentiality concerns as well as lack of standards, common architecture, guidelines were flagged as the greatest barriers to organizations decisions to use interoperable information systems for data sharing (with an average of 94% response rate).

The other barrier registered by most respondents was on the issue of confidentiality of data with about 69% of the respondents expressing that this can be a major hindrance in the implementing of integrated information systems. Most concerns in this area were noted to be touching on misinterpretation or misuse of shared information by third party organizations. They fear that this may affect their businesses and the organization's reputations and so most organizations prefer to transact their businesses internally.

Concern_of_misuse_of_shared_info

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	32	16.2	16.2	16.2
Un-Important	11	5.6	5.6	21.8
Little-Important	14	7.1	7.1	28.9
Moderately-Important	35	17.8	17.8	46.7
Important	64	32.5	32.5	79.2
very-Important	41	20.8	20.8	100.0
Total	197	100.0	100.0	

Benefits to Usage of Interoperable Information Systems

On the questions on the benefits to integrated and interoperable information systems, about 97% of the respondents expressed their feelings on the benefits that would be achieved from ICT as a tool when their organizations adopt integrated architecture in service delivery.

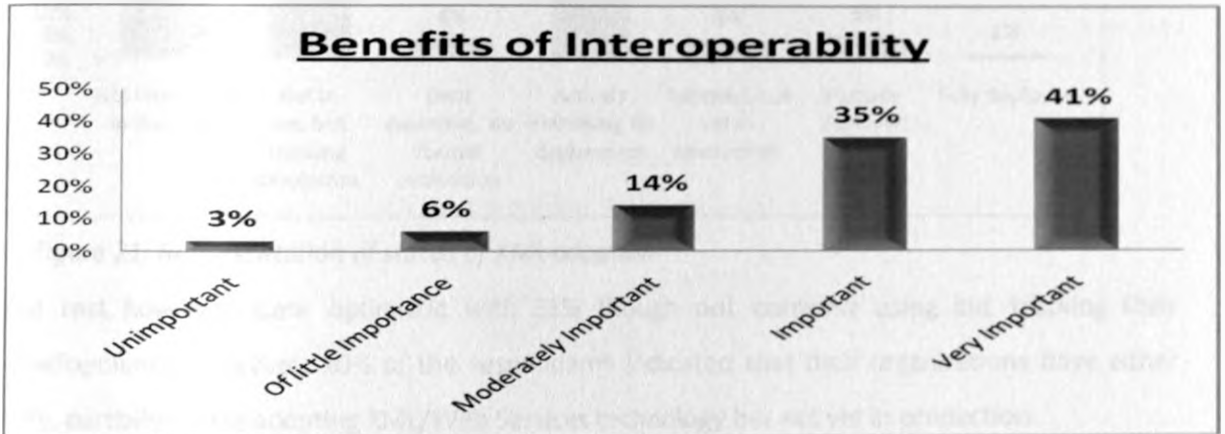


Figure 20: Representation of feedback on interoperability benefits

Many respondents (over 53%), strongly believed that interoperable information systems will reduce overall cost of operations, reduce duplicate data collection, storage and processing, facilitate integrated citizen services and improves productivity. However, about 31% of the respondents were adamant that interoperable information systems would improve information comprehensiveness. Others also showed positive sentiments that the use of interoperable information systems would improve intra and inter-agency information integration, better coordinated programs and improve accountability in service delivery.

Status of applicability of XML/Web Services Adoption

The questions on the adoption of XML and Web Services as a standard for defining data interchange standards revealed some interesting views 37% respondents saying that their organizations are not currently interested in the adoption of XML/Web Services as a standard based interoperable technologies.

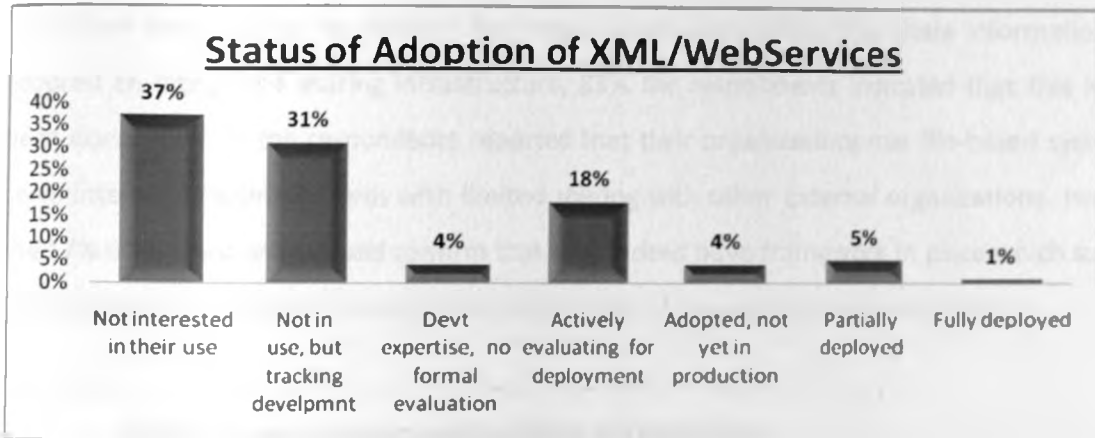


Figure 21: Representation of status of XML adoption

The rest however were optimistic with 31% though not currently using but tracking their developments. However, 10% of the respondents indicated that their organizations have either fully, partially or are adopting XML/Web Services technology but not yet in production.

Existence of Legislation and Policies on Interoperability

On the issue of implementation of adequate formal policies or statutory guidance on data sharing, most of the respondents indicated that a lot has not been done, with about 72% of the respondents expressing their dissatisfaction on what has been done on this area to promote integrated data sharing between agencies.

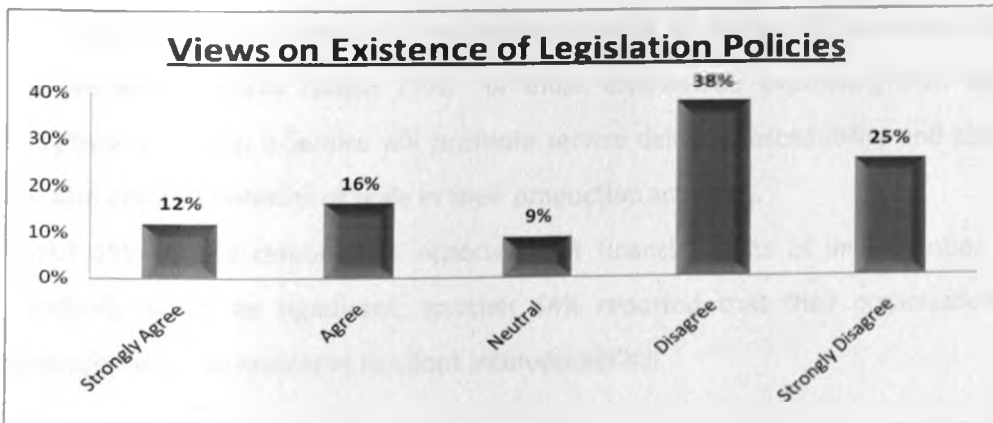


Figure 22: Representation of existence of legislation policies

Majority of the respondents also expressed that there is no adequate technical guidance on technology and data standards. This the respondents attributed to the fact that this subject area is at its infancy stage and is also evidently seen in the chart above when 9% of the respondents chose to remain neutral when ask about existence of legislation.

On further interrogation on whether the organizations with which they share information have adopted an integrated sharing infrastructure, 83% the respondents indicated that this has not been done. Most of the respondents reported that their organizations use silo-based systems to serve internal e-business needs with limited sharing with other external organizations. However, the 17% of the respondents did confirm that they indeed have framework in place which supports the integrated collaborations and partnering in terms of supporting e-services delivery.

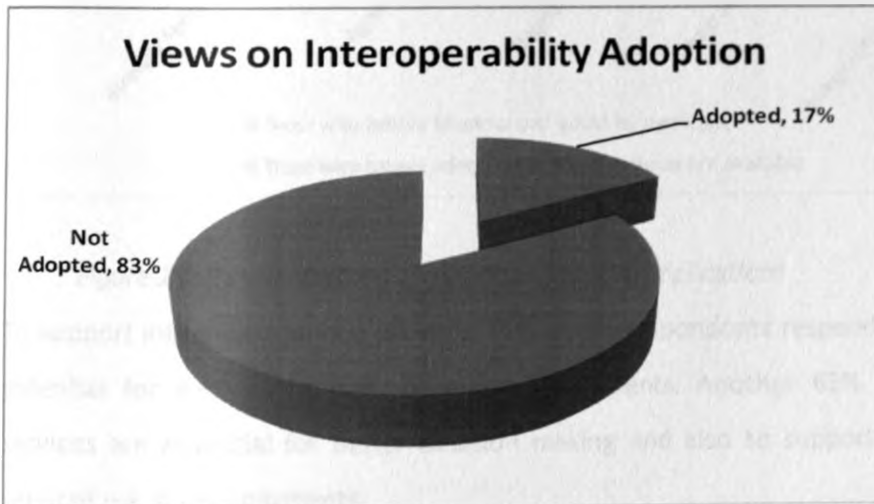


Figure 23: Representation of views on interoperability adoption

The expectations of citizens and businesses towards an integrated one-stop e-Service was very positive with majority (about 77%) of those interviewed expressing their optimism that an integrated one-stop e-Service will promote service delivery, accessibility and also the businesses will also enjoy economies of scale in their production activities.

About 65% of the respondents reported that financial costs of implementing interoperability standards would be significant; another 64% reported that their organizations do not have adequate financial resources to adopt interoperability.

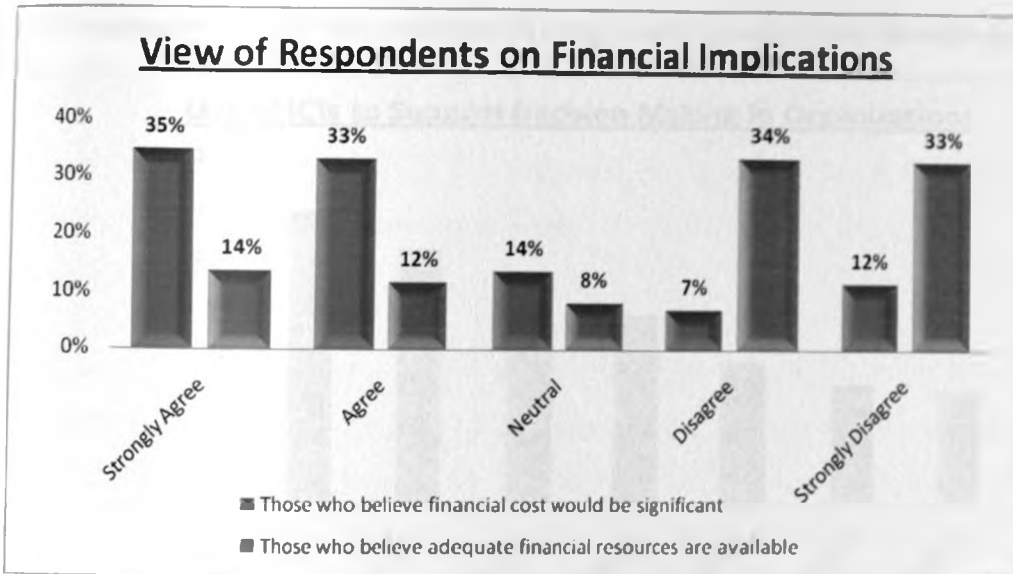


Figure 24: Representation of views on financial implications

To support integrated service delivery, 71% of the respondents responded that interoperability is essential for exchanging data between departments. Another 63% believed that integrated services are essential for better decision making and also to support delivery of value added services e.g. online payments.

How ICTs have been used to Support Business Decision Making

The questions were asked to gather the respondents' opinions on the factors which affect organizations implementation of ICTs to support its business decision making and day-to-day operations. The responses obtained were categorised and clustered based on their similarity and commonality and the table below was created.

How organizations use ICTs to Support Business Decision making	Frequency of Response
Presence of internal Application System	117
Network Communication Protocols	102
Email and Email Security	78
File Transfer Protocols	76
Transport Protocols	57
Directory Protocols	48
Transport Protocols	45
Encryption Algorithm	32

Table 7: Frequency representation of use of ICTs to support business

The frequency responses were represented using a bar chart resulting in the following chart.

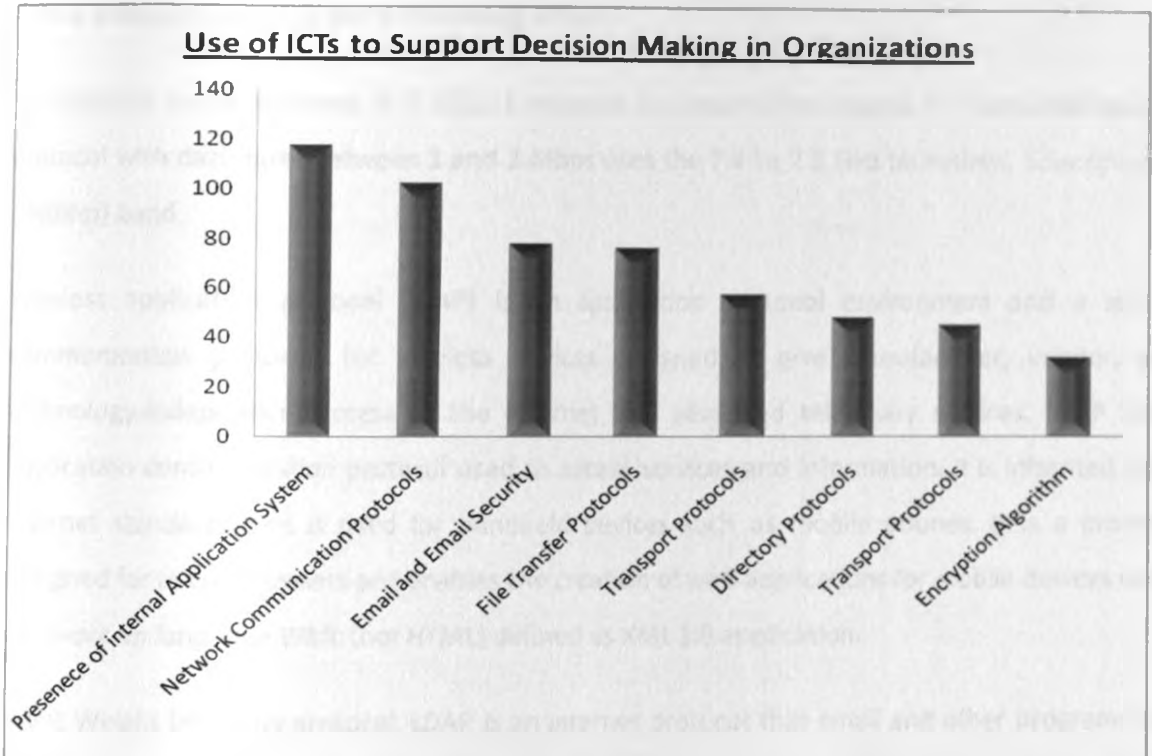


Figure 25: Representation of ICTs in decision making

Comments on the use of ICTs to Support Business Decision Making

The researcher observed that most of the respondents' reported that adoption of application software as a tool to assist in running the business processes is very important towards supporting decision making within these organizations. These applications ought to be mature with proper security so as to guarantee privacy and confidentiality of user information. To facilitate interconnection and communication between agencies, the respondents reported that SMTP and POP3 protocols are required for out and inbound email transfers while HTTP, SOAP, Telnet, FTP, SFTP are also some important transport protocols highlighted.

Internet protocols are open-system (*non-proprietary*) protocol used to communicate across any set of interconnected networks and are equally suited for LAN/WAN communications. They consist of a suit of communication protocols, of which the two best known are the *Transmission*

Control Protocol (TCP) and the Internet Protocol. Examples of transport protocols include TCP/IP, Frame Relay, RIP, IPX/SPX and ATM among others.

For wireless communication, IEEE 802.11 protocol is adopted, the original 2.4 GHz wireless LAN protocol with data rates between 1 and 2 Mbps uses the 2.4 to 2.5 GHz (*Industrial, Scientific and Medical*) band.

Wireless application protocol (WAP) is an application protocol environment and a set of communication protocols for wireless devices designed to give manufacturer, vendor, and technology-independent access to the Internet and advanced telephony services. WAP is an application communication protocol used to access services and information. It is inherited from internet standards and is used for handheld devices such as mobile phones. It is a protocol designed for micro browsers and enables the creation of web applications for mobile devices using the *mark-up language WML* (not HTML) defined as XML 1.0 application.

Light Weight Directory protocol, LDAP is an internet protocol that email and other programs use to look up information from the server. LDAP servers index all data in their entries, and "*filters*" may be used to select just one person or group you want, and just return the information you want.

FTP on the other hand is allows users to transfer files to/from a remote network site. The transfer mode is either ascii or binary modes.

Among the security standards that are pertinent are email security using S/MIME, PGP and PKI, transport protocol using SSL, network protocols IPsec and encryption protocols – RSA, DSA, DES and 3DES.

Suggestions on Technology Adoption to achieve Integrated Standards

Questions were posed to the respondents' to interrogate their opinions towards how organizations can take advantage of ICTs as a means of achieving integrated and collaborative systems. Their responses were analysed, correlated and tabulated as shown below.

Technology Adoption Element	Frequency
Middleware technology	121
XML/Web Service technology	116
Resource Description Framework - RDF	98
Metadata Standards Adoption	120
Adoption of Web content format	79

Table 8: Frequency representation on technology adoption

The frequency responses were then represented in a bar chart.

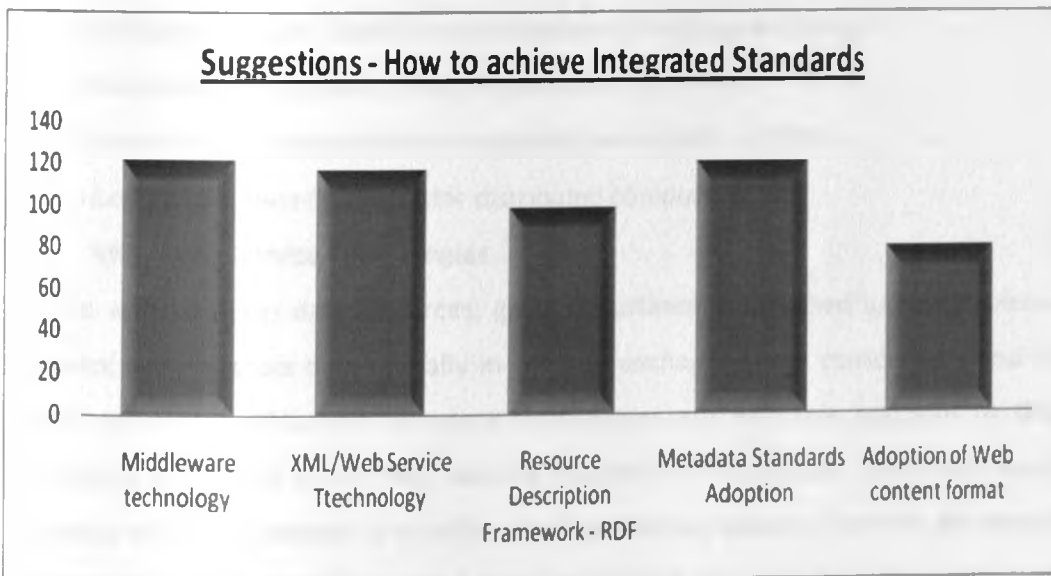


Figure 26: Representation of suggestions on how to achieve integrated standards

Comments on Technology Adoption to achieve Integrated Standards

The chart above represents the various elements that the respondents believed are key towards a successful integrated e-Service development.

i. Middleware Technologies

Middleware technology is a field in computer science which encompasses of many technologies to connect computer systems and provide a protocol to interact with each other to share information between them. According to Zeeshan (2006), the term middleware carries the meaning to mediate between two or more already existing separate software applications to exchange the data. Middleware technologies reside inside complex, distributed and online application by hiding their self in the form of operating system, database and network details.

The different categories of middleware are:

- Transactional supporting distributed transactions
- Message-oriented (MoM) communication via message exchange
- Procedural for example remote procedural calls – RPC
- Object-based communication via distributed objects – CORBA
- Component-based support for distributed components

ii. XML/ Web Service Technologies

Faced with so many data resources, great importance is attached to the problem of how to present and integrate data formally in order to exchange them conveniently and make use of them efficiently. XML and metadata technologies are effective solutions to this problem. According to Zha et al, an XML schema describes the structure of an XML document. The purpose of an XML schema is to define the legal building blocks of an XML document. It defines elements/attributes that appear in a document, which elements are child elements, default and fixed values for elements and attributes.

Using XML schema to model metadata has some advantages:

- XML schema is written in XML, can use XML editor to edit schema files, use the XML parser to parse the schema files, manipulate the schema with the XML DOM
- XML schema has support for Data Types, it is easier to describe permissible document content, to validate the correctness of data, to define data facets (restriction on data) and to define data patterns (data formats).

- XML schemas are extensible, so they can be reused in other schemas, create our own data types derived from standard data types, reference multiple schemas from the same document.

iii. Resource Description Framework – RDF

Resource description framework is an XML-based language for describing information contained in a Web resource. Where a resource can be a Web page, an entire Web site, or item on the web that contains information in some form. RDF enables the encoding exchange, and reuse of structured metadata. It's allows for metadata interoperability through the design of mechanisms that support common conventions of semantics, syntax and structure.

RDF can be used in a variety of application areas including:

- Resource discovery – RDF will enable search engines to more easily discover resources on the Web.
- Cataloguing – RDF will enable users to better describe the content and content relationships available at a particular web site, page or digital library.
- Intelligent Software Agents – RDF will facilitate knowledge sharing and exchange and allow software agents to more intelligently find, filter and merge data.
- Content Rating – RDF will allow content to be rated
- Intellectual Property Rights – RDF will allow users to more easily express and enforce intellectual property rights of web sites.
- Privacy Preferences and Privacy Policies – RDF will allow users to and web sites to express privacy preferences and site-wide privacy policies that can be interpreted by applications.
- Digital Signatures – RDF will be a key to building the “Web of Trust” for e-commerce, collaboration and other applications.

An RDF model consists of schemas, components, statements, containers, statements about RDF statements as well as XML namespaces.

iv. Metadata Standards Adoption

This is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use or manage an information resource. It is also often called data about data or information about information.

The three types of metadata are:

- Descriptive metadata – which describes a resource for purposes such as discovery and identification. It can include elements such as title, abstract, author and keywords.
- Structural Metadata – indicates how compound objects are put together for example how pages are ordered to form chapters.
- Administrative metadata – providing information to help manage a resource, such as when and how it was created, file type, and other technical information and who can access it.

There are several subset of administrative data, two that sometimes are listed as separate metadata types are:

- i. Rights management metadata – which deals with intellectual property rights and
- ii. Preservation metadata – which contains information needed to archive and preserve a resource.

Metadata is key to ensuring that resources will survive and continue to be accessible into the future. In addition to resource discovery, metadata can help organize electronic resources, facilitate interoperability and legacy resource interrogation, and provide digital identification and support archiving and presentation.

v. Adoption of Web Content Format

Computer browsers provide users with a range of choices about privacy, security, language and content when they request a web page. In some cases, potential users of a website will be unable to gain access to the website simply because it does not convey the right information to make it accessible.

vi. Videos and images

There are times when videos and images offer the best form of expression. For example a video clip might show some people having a picnic while a single image might be provided for those who cannot run video.

vii. Sound files

Sound files are often used as alternative to images or text with the expectation that they will make it easier for people to interact with the webpage.

viii. PDF files

Portable Document Format (PDF) is a platform-independent means of exchanging visually rich documents. PDF documents are rich in visual layout, and are popular among users capable of appreciating high-fidelity visual presentation.

ix. Applets

Most screen readers, for start are not Java savvy. Many low-end computers which people use to browse the web are similar. Alternatives should be provided where these performs functions – e.g. if a form can be replace and applet.

Suggestions on the Barriers to Interoperability

The researcher designed some questions to gather the respondents' views towards what they believed are the factors they consider to be the barriers, threats or hindrances towards adoption and implementation of interoperable and integrated information systems. The resulting views were analysed, categorised and tabulated as below.

Barriers to Interoperability	Frequency of Response
Lack of Policy on data sharing	97
Lack of Standards & Common Architecture	107
Security & Confidentiality Concerns	121
Mismatch of Objectives	68
Lack of Technical skills	63
Incompatibility of Data Standards	55
Lack of Trust	60
Concern of Misinterpretation of data	46
Concern of Quality of data	78
Data sharing reduced full control	32
Disharmony in Legislation	81
Economic Restrictions	143
Absence of National Joint effort	93
The people Factor	67

Table 9: Representation of suggestions on interoperability barriers

The responses above were then plotted in a bar graph to show their relationships as below.

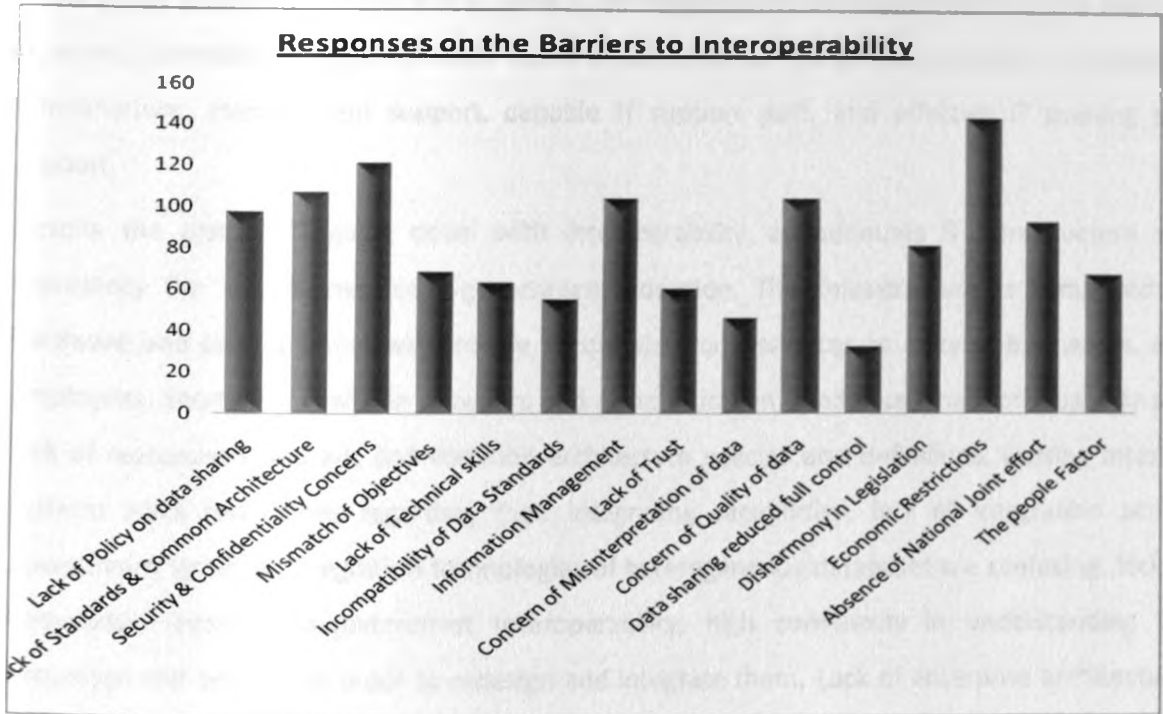


Figure 27: Interoperability barriers representation

Comments on the Barriers to Interoperability

The following principles form the basis for data sharing for interoperability implementations and organizations ought to adhere to these policies for successful implementations.

- Access – data should be put in publicly accessible repositories which offer rapid access.
- Ethical considerations – there is need to protect the confidentiality and privacy of personal information also access to certain data sets should carefully be managed and granted in a transparent manner to all appropriate qualified agencies.
- Rights of data providers – the government should recognize the need for data producers to be appropriately credited for their contribution and investment in data generation.

The other barriers were summarised by the researcher to include the following, those experienced in the public sector organizations that prevent the realization of anticipated benefits and degrade successful adoption of e-government. Those which relate to insufficient resources, inadequate infrastructure, management support, capable IT support staff, and effective IT training and support.

Despite the cost of IT going down with interoperability, an adequate IT infrastructure still represents the key barrier for e-government adoption. The infrastructure is composed of hardware and software that will provide secure electronic services to citizens, businesses, and employees. Shortage of reliable networks and communication, inadequate network capacity and lack of resources standards and common architecture policies and definitions. Existing internal systems have restrictions regarding their integrating capabilities, lack of integration across government systems; integration technologies of heterogeneous databases are confusing, lack of knowledge regarding e-government interoperability, high complexity in understanding the processes and systems in order to redesign and integrate them. Lack of enterprise architecture, availability and compatibility of software, systems and applications.

Concerning security and privacy, lack of knowledge for security risks and consequences, threats from hackers and intruders, threats from viruses, worms and Trojans, absence of privacy of personal data, high cost of security applications and solutions, assurance that transaction is legally valid, lack of security rules, policies and privacy laws, inadequate security of government hardware and software infrastructure, lack of risk management security program and unsecured physical access to building or computer rooms.

IT skills are also important towards achieving successful interoperability implementation; some of the barriers include lack of IT training programs in government, shortage of well-trained IT staff in market and lack of employees with integration skills. Organization coordination and cooperation between departments, effective leadership support and commitment amongst senior public officials, unclear vision and management strategy, complex of business processes and politics and political impact.

Shortage of financial resources in public sector organizations, high costs of IT professionals and consultancies; IT cost is high in developing countries, cost of installation, operations and maintenance of e-government systems, cost of training and system development.

Suggestions on the Benefits to Interoperability

The respondents were further interrogated to seek their views on what they believed are the benefits that organizations and citizens can obtain when public systems are integrated. Their responses were analysed and combined to produce the table below.

Benefits of Interoperability	Frequency of response
Reduce Overall cost	156
Reduce Duplication of data	163
Improves Productivity	98
Improves Accuracy	67
Improves Information Comprehensiveness	56
Improves Information Accessibility	102
Increase Responsiveness	99
Improves decision and policy making	171
Improves Inter & Intra agency Comm.	120
Better coordinated programs	78
improves public image	70

Table 10: Interoperability benefits representation

The graphical representation of interoperability benefits is as shown below.

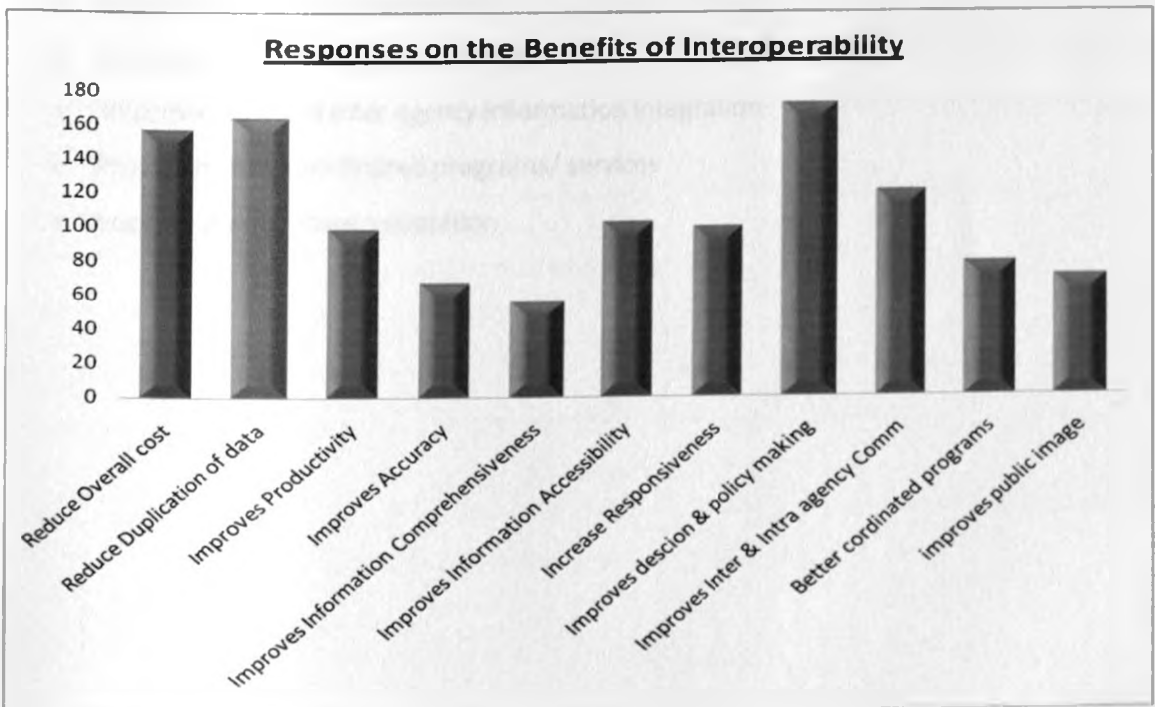


Figure 28: Interoperability benefits representation

Comments on the Benefits of Interoperability Adoption

The motivation for developing an interoperability system lies in added efficiency of distribution and increased reliability of e-Services, both from the point of view of the organization and the customer. People are increasingly demanding services of higher quality, limited downtime and lower prices. The organizations are looking for ways to reduce their expenditures maintain system stability, and offer customized services.

Achieving this quality, reliability, service and price demands will become increasingly beneficial in the following manner when interoperability is adopted:

- Reduce overall costs of operations
- Reduce duplicate data collection, processing and storage
- Facilitate integrated citizens services
- Improve productivity
- Improve data accuracy
- Improve Information comprehensiveness
- Improve information accessibility
- Improve decision and policy making
- Improve intra and inter agency information integration
- Provide better coordinated programs/ services
- Improve public image/reputation

4.4 Framework Testing

The proposed framework consists of elements which define it and which the research was set out to validate to make it devoid of constraints and any undesirable impact which may hinder its validity. Framework was divided into four layers to addresses different levels of interoperability development, with the first and the fourth stage being very key. The first stage addresses interoperability foundations which involve laying foundation for interoperability development in terms of policy formulations and governance framework. The third layer deals with the important pillars which support interoperability.

To validate the framework, data was collected from different sources including the government and private sector organizations. The data collected was therefore analysed and the new elements were then incorporated in the framework.

4.5 Testing Reliability of Measure

Measuring Reliability Measure for interoperability Barriers

The specific responses to the items were combined so that individuals with the most favourable attitudes will have the highest scores while individuals with the least favourable (or unfavourable) attitudes will have the lowest scores. The research data was analysed using SPSS tools to generate reliability statistics table that provides the actual value for Cronbach's Alpha, as shown below:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.722	.716	14

It can be seen from the above SPSS calculations that Cronbach's alpha is 0.722, which indicates a high level of internal consistency based on the research specific samples.

Item Total Statistics

The Item-Total Statistics table presents the Cronbach's alpha if Item deleted in the final column, as shown below. The individual elements have been represented here with variables VAR00001, e.t.c but then the actual elements can be found in the appendix I under interoperability barriers questions:

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
VAR00001	40.0000	49.378	.354		.704
VAR00002	39.9091	49.242	.368		.702
VAR00003	40.0848	50.054	.355		.704
VAR00004	42.1576	56.414	-.050		.746
VAR00005	39.8606	54.657	.068		.734
VAR00006	41.2667	49.002	.374		.702
VAR00007	40.8606	48.974	.440		.695
VAR00008	40.3455	46.081	.544		.679
VAR00009	40.3455	46.081	.544		.679
VAR00010	41.3636	48.404	.370		.702
VAR00011	40.2606	48.962	.409		.698
VAR00012	40.8364	50.089	.399		.700
VAR00013	41.9030	51.234	.246		.717
VAR00014	41.8606	51.450	.240		.717

Table 11: Item-Total Statistics for the Cronbach's alpha if Item Deleted

This shows what the Cronbach's alpha would be if that item were deleted from the scale. It is observed that removal of any question except VAR00004 and VAR000045 would result in a lower Cronbach's alpha. Therefore we would not want to remove these questions. Removal of VAR00004 and VAR000045 would lead to a small improvement in Cronbach's alpha and we can also see that the Corrected Item-Total Correlation value would be low (-0.050) for VAR00004. This should lead us to consider whether we should remove this item.

Measuring Reliability Measure for interoperability Benefits

The same was calculated for those elements proposed as interoperability benefits and the following results were obtained. The Cronbach's alpha so obtained is as below:

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.923	.918	13

From the two calculations above, it is evident that the Cronbach's alpha coefficient for the barriers and benefits to interoperability are: **0.722** and **0.923** respectively. From statistics, if the value of Cronbach's alpha coefficient is to 1.0, the greater the internal consistency of the items in the scale. Therefore the value of Cronbach's alpha obtained for the research elements gives a high reliability of measure.

4.6 Testing of Hypothesis

The research hypotheses were used to test the elements of the proposed framework. The detailed analysis of the test are contained in the in the Appendix IV & V but the summaries of the findings are illustrated as below.

###	Null Hypotheses	Decision	
		Accept H ₀	Accept H _a
1	Legal, organizational and technological policy factors will not hinder e-Service adoption, process orientation	NO	YES
2	Proper IT infrastructure does not need to be built and upgraded to support more interoperability in Kenya	NO	YES
3	Interoperability will not benefit the citizens through promoting efficiency in service delivery.	NO	YES
4	Successful adoption of e-Service does not require a structured governance mechanism to oversee and assure quality and integrity.	NO	YES
5	Trust perception of the e-Government services, and trust dynamics among individuals, groups, and organizations in the value chain of service provision do not contribute to unwillingness of citizens to share personal information with the Government electronically.	NO	YES

Table 12: Testing research hypothesis

4.6.1 Correlation Coefficient of Interoperability Factors

The correlation coefficient r represents the linear relationships between variables and measures the strength of association between two variables in this research denoted as *not important* and *important* or simply (x & y). The researcher is seeking to establish relationship between factors which have been proposed to affect interoperability implementation. From statistics, the correlation coefficient should be between -1.0 and $+ 0.1$, and if the correlation is positive we have a positive relationship while if it is negative we have a negative relationship.

Applying the formula shown in the Appendix IV, the resulting correlation co-efficient for the elements which define the barriers to interoperability was found to be a positive coefficient $r = 0.547$. This means that the variables have a positive correlation and implies that a change in one element will affect the other elements in the same direction.

The same computation was done for those elements which defines the benefits and the resulting correlation co-efficient was found to be positive with $r = 0.713$, signifying that the variables have a high positive correlation. This value represents a linear relationship between the proposed factors.

4.6.2 The Level of Significance of each factor

This is a very important concept in the context of hypothesis testing. It is always some percentage (usually 5% or 1%) which should be chosen with great care. For this research, the value of Alpha as stated earlier was chosen to be 5% to be used to design the decision rules to validated the proposed framework factors, this means that H_0 will be rejected when the sampling result (i.e. observed evidence) has a less than 0.05 probability of occurring if H_0 is true. This means that the researcher is willing to take as much as 5% risk of rejecting the null hypothesis when it (H_0) happens to be true.

The z-statistics was used to compute the significant factor of each element; the resulting factors were therefore checked against a two-tailed z-score chart shown in the figure 29 below.

A two-tailed z-score chart was used because each element has equal chance of either affecting interoperability negatively or positively. The researcher therefore constructed a z-score chart as shown in figure 29 below based on the alpha which was chosen to be 0.05. The outside regions are called **rejection regions** since if the value of z falls in these regions, the null hypothesis is very unlikely so we can *reject the null hypothesis*.

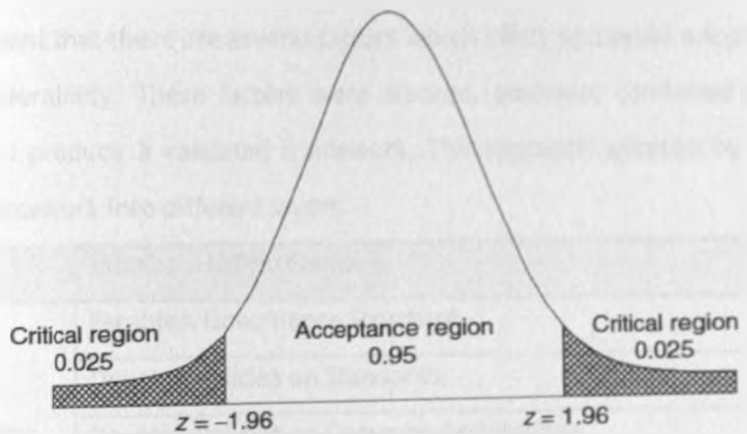


Figure 29: Two-tailed z-score chart

The set of z-scores inside the range -1.96 to 1.96 is thus called **the region of acceptance** of the hypothesis, or the region of **non-significance**. On the basis of the above remarks, we can formulate the following decision rules (or test of hypothesis or significance):

Illustration Example: Taking Lack of Policy on data sharing as an example:

$$S = 32.79; \mu_S = 13; \sigma_S = 1.96$$

$$z = (32.79 - 13)/1.96$$

$$= \underline{10.1}$$

As explained above, since the value of z is so high and falls within the critical regions, the probability that H_0 is true is so small that we decide to reject H_0 and accept H_a . Therefore, we can conclude that lack of policy on data sharing is a significant factor and will affect interoperability implementation. The z-score was further calculated for the other factors using the formula in Appendix VI and the results tabulated as shown in the Appendix VI.

From the resulting z-score table it is evident that all the calculated z-scores fall outside the acceptance region (critical regions) a part from element 7. This implies that the null hypothesis will be rejected for all the elements with exception of element number 7.

Using the same formula, the z-scores for benefits was calculated and the results were tabulated again as shown in the Appendix V.

From the z-scores table, it was observed that there is no factor which falls within the region of non-significance and so the null hypothesis is rejected in every case. Thus the elements that affect interoperability were extracted from the factors presented since they were significant.

4.7 Validated Framework Elements

From the study above, it is evident that there are several factors which affect successful adoption and implementation of interoperability. These factors were studied, analysed, combined and correlated by the researcher to produce a validated framework. The approach adopted by the researcher was to divide the framework into different layers.

	Interoperability Layer	Interoperability Elements
1	Interoperability Foundations	Establish Governance Structure
		Develop Policies on Standards
		Develop Policies on Common Architecture
		Match Policies and Objectives
2	Information Management Principles	Manage Information Asset as a strategic resource
		Standardize information Management Practices
		Generation Information to support decision making
		Collect Quality Information
		Reuse Information from single Authoritative source
		Promote trust and confidence
		Achieve social Benefits
3	Information Lifecycle	Plan, Create/Collect, Organize/Store, Access, Use, Maintain and Reuse
4	Interoperability Enablers/Pillars	Partnerships and Collaborations
		Common Business Language and Standards
		Appropriate Governance Structure
		Security & Confidentiality Plans
		Information Sharing Tools
		Policy Legislation & Governance
		Authoritative Data Repositories

5	Interoperability Vision	Collaboration across public service and businesses
		Easy Information flow across agencies and service providers
		Privacy, intellectual property and associated security protected
		Clear roles for providers, custodians and users of Information
		Information managed to promote reuse and integration.

Table 13: Validated framework elements

4.7.1 Final Validated Framework

The final validated framework is represented below.

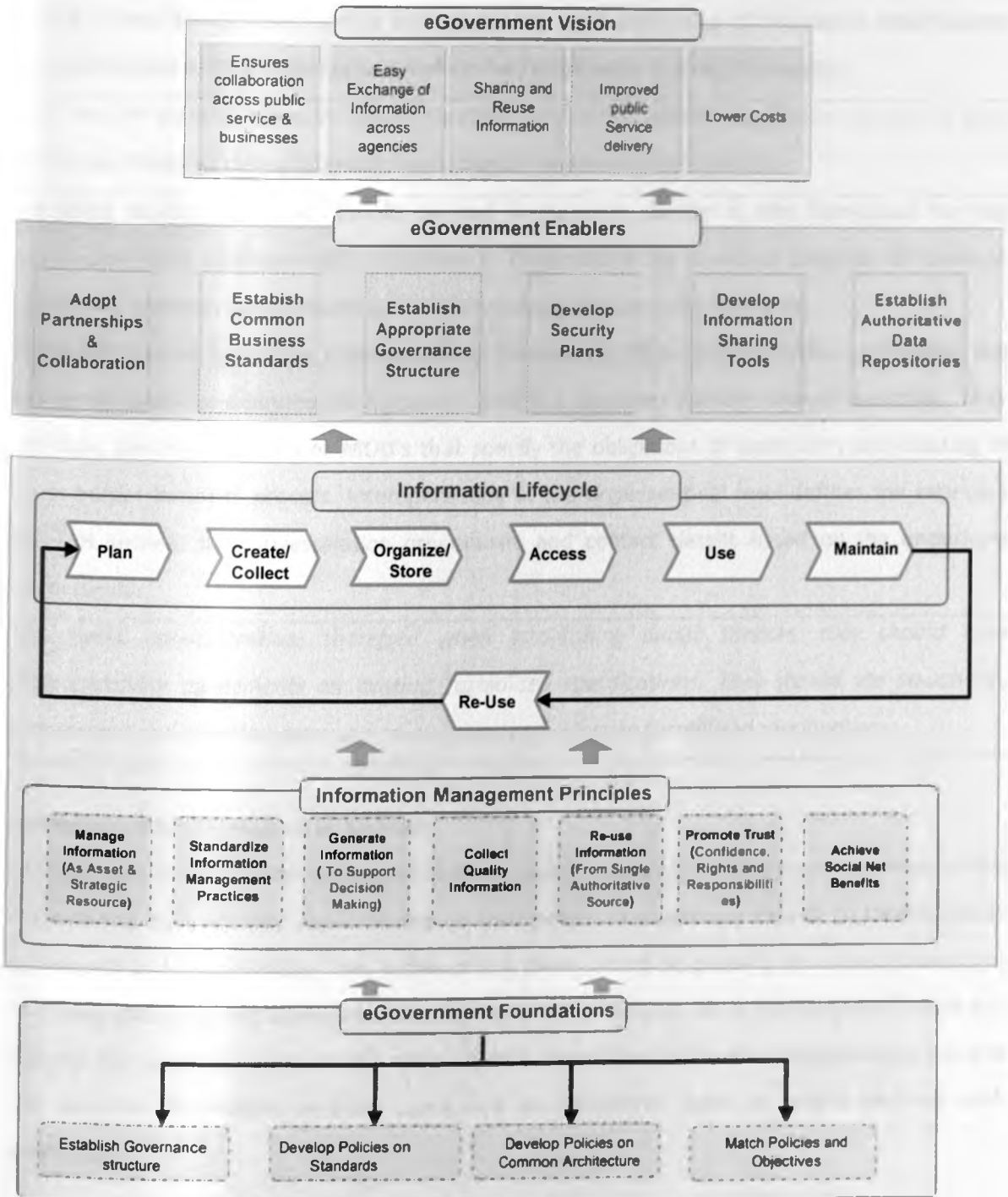


Figure 30: Refined framework

4.7.2 Discussion of Validated Framework Elements

eGovernment Foundations

There is need for agencies to fully understand the legal, policy and administrative requirements and restrictions in their organizations before they could begin sharing information.

Tip: The participating agencies should carefully consider all relevant legislations relating to data exchange, including data protection, when seeking to establish an e-Service.

Requisite policies and laws should be put in place to provide a firm foundation for the establishment of interoperability framework. There should be a serious adoption of common standards, common architectures as well as matching objectives for businesses.

According to the European Interoperability Framework (EIF), interoperability agreements are rendered specific and binding via legislation, including directives into the national legislation. They can take the form of SLA's or MOU's that specify the obligations of each party participating in cross-border business process. Interoperability at the organizational level defines the expected level of service, support/escalation procedures, and contact details based on the underlying agreements.

Tip: Public administrations therefore when establishing public services, they should base interoperability agreements on existing formalised specifications. They should use structured, transparent and objective approach to assessing and selecting formalised specifications.

Management of Information as an asset

Management of information as an asset and a strategic resource should be promoted. Most of the respondents believed that expenditures on information management should be treated as an investment and not a liability. They believed that there should be properly developed procedures to initiate change of the elements within the information lifecycle. With the concept of reuse and sharing, the agencies must consider not only their immediate information requirements but also the value of information to other users and the respective rights to access and use such information.

Establishment of Standard Information Practices

Information management practices should be standardized across government to share and improve processes for accessing information. There is need to manage information from generation to consumption and also be transferable across organizations subject to requirements for privacy and confidentiality.

In cases where agencies find no standardized procedure already developed, they may develop the specification themselves and put forward the result for standardization or request a formalised standard to be developed by the developing organizations. There should be active government participation in the standardization process.

Tip: The government should lead and actively participate in the standardization process and also helps in aligning formalised specifications with the public sector needs to keep pace with technology innovation.

Generate Information to Support Decision Making

Accurate, timely and relevant information should be available to share with others who have an appropriate business requirement. This principle is based on the need to continually work towards optimised agency and whole-of-government service delivery and organisational capability, supported by evidence-based decisions.

Quality Information Management Repositories

Collection of information should be aimed at being accurate, relevant and timely and reliable. Duplication should be minimised at all levels. Citizens and businesses should have the right to track the public services provided transparently and give feedback about the quality of the services offered so that they can contribute to their improvements and implementation of the new services.

Tip: Public administrations should ensure they adhere to the quality standard attributes that affect system design and user centric issues e.g. user experience. Such attributes as usability, performance, reliability and security indicate success of a design and the overall quality of the application.

Reuse of Information from a Single Source

Information should be collected and stored in a single authoritative repository. The principle of reuse where information is created once and is available to be used for different purposes with confidence is necessary.

With the principle of reuse, public administrations may seek to benefit from the work of others by looking at what is available, assessing its usefulness or relevance to the problem at hand, and deciding whether to use the solutions. There must be a culture and willingness by the public administrations to share with others their solutions, concepts, frameworks, specifications, tools and components. This can be promoted by promoting a culture of openness between the participating agencies.

Tip: Public administrations are encouraged to reuse and share solutions and to cooperate on the development of joint solutions when implementing public services.

Achieve Net Social Benefits

The net social benefits should be derived from the government and agency specific information holdings. This should be firmly based on service delivery and satisfying of important goals of value creation. The adoption of interoperability should create equal opportunities for all citizens and businesses through inclusive services that are publicly accessible without discrimination.

This allows everybody to take advantage of the opportunities offered by new technologies to overcome social and economic disadvantages and exclusion. Therefore inclusion and accessibility must be part of whole information development lifecycle of public services in terms of design, content and delivery based on agreed standards.

Inclusion and accessibility can also be improved by the ability of a system to allow third parties to act on behalf of the citizens who are unable to make direct use of public services.

Tip: Public administrators should ensure that public services are accessible to all citizens, including persons with disabilities and elderly based on some agreed standards and specifications.

Information Lifecycle

Interoperability requires greater sharing and reuse of information and data between and within agencies where doing so will help improve whole of government or inter-agency business objectives. Therefore there is need for information custodians to consider the management principles during each stage of information lifecycle.

The information lifecycle therefore covers planning, creating, storing, accessing, using and maintaining information. It also involves reusing and sharing this information within and outside the agency.

Tip: To address interoperability through a lifecycle approach public administrations should identify the potential uses of new information collections, particularly any potential for use by other agencies and citizens and any long term storage requirements, and address these issues at the planning and design stage.

Adopt Partnerships and Collaborations

There is need for agencies to work in clusters in order to achieve inter-related objectives. This is especially possible where agencies have common policy approach, business processes and clients then they should consider forming clusters to manage information sharing.

A culture of trust, collaboration and partnership will encourage the sharing and management of information so it can be used across agency boundaries. There is also need to establish a shared understanding of information needs, business drivers and legal and policy constraints, adequate funding and clear lines of responsibilities.

Tip: In order to promote partnerships and collaborations, public administrations should develop plans and agreements with other agencies for information management and exchange; they should also foster trust and promote awareness of information management principles.

Establish Common Business Language and Standards

For information sharing to be meaningful, there is need to document it in such a way that users can understand its meaning, accept its format and have some confidence in its quality. This is possible when agencies adopt standards definitions and formats of information that they share

with other agencies. These standards are useful as they promote information sharing, help reduce cost and confusion, reduce the risk of information misuse and improve integration

Tip: To adopt common business language and standards, the public administrations should establish data and information management policies and processes that encourage compliance with standards. They should also identify and adopt appropriate existing standards wherever possible.

Develop Security Plans

The cooperating agencies should ensure that privacy, confidentiality and security as well as other obligations are met during the information sharing process and at no point should this get compromised. There is need to conduct audits and reviews of security, quality, accessibility and compliance with access and use conditions. There is need to implement and enforce rights at different access levels, this ought to be respected by all the participating agencies in order to promote trust and confidence.

Citizens and businesses must be assured that they interact in an environment of trust and in full compliance with relevant regulations e.g. on privacy and data protection. The public administrators therefore must guarantee the privacy and the confidentiality of information provided by businesses. The citizens and businesses should be allowed to have the right to verify the information that the administrations have collected about them and to be consulted whether this information may be used for the purposes other than those which it was originally supplied.

Tip: Public administrations should consider the specific needs of each public service and the information which has been entrusted to them by the public and only use them within the context and confines of a common security and privacy policy.

Develop Tools to Support Information Sharing

Agencies will have to adopt tools which have been created for use; this may include information, standards, policy and procedures which are the prevailing guidelines which have been put in place for the whole government and businesses to use. Therefore, there is need to establish best practice guides, information sharing rules and MOUs.

The business 'transaction manager' tool allows businesses and individuals to create information once and use it many times. It also allows user to discover, manage and complete online transactions over online forms.

Tip: An important step to achieve seamless delivery of services across government is making sure that the tools we use to do business are compatible. Technical interoperability therefore ensures that common standards are adopted to provide this collaboration.

Establish Authoritative Data Repositories

Where there is a repeated need for the same information across agencies, a 'create once, use many' approach should be adopted. The use of single authoritative source of information therefore will ensure that the most reliable and current information can be accessed and reused. This in turn reduces the cost and burden of information collection and storage. There is need for agencies to also agree on who holds the role of being the custodian of the information, the other agencies can reliably use this data to address their business needs.

Most importantly is the development of base registries to provide reliable sources of basic information on items such as persons, companies, vehicles, licences, building, locations, and roads. The common feature of all the implementations of basic registries is the fact that they are authentic and authoritative and form, separately or in combination, the cornerstone of public services. The content is not static but they also reflect information lifecycle.

Tip: Public administrators should make their authentic sources of information available to others while implementing access and control mechanisms to ensure security and privacy in accordance with relevant legislation.

eGovernment Vision

The vision of interoperable and integrated information systems refers to the gains and benefits that an agency, government or citizens stand to reap as a result of adoption and implementation of information sharing and reuse. These gains includes but not limited to collaboration and development of partnerships across agencies, continuous improvement of services leading to efficiency and effective service delivery, protection of privacy, confidentiality and other security

requirements and improve responsiveness of agencies to meet individual, business and government requests.

The interoperability solutions should serve businesses and citizens in the most effective and efficient manner and provide the best value for the tax payer. The other ways of taking stock of the value brought about by public service solutions include considerations such as return on investment, increased flexibility, reduced administrative burden, increased efficiency, reduced risk, transparency, simplification and improved working methods.

CHAPTER 5 CONCLUSIONS AND ACHIEVEMENT

5.1 Achievements

In this chapter we finalize our analysis by bringing together the main arguments of our study. This report presents an e-Service framework proposed for use to streamline government e-Service operations in Kenya. The implementation builds on previous work done by some selected governments as a starting point for the present study and proceeds to look into the intrinsic policy objective encompassing a series of democratic, economic, social, and environmental and governance related objectives.

There have been many initiatives by the Kenyan government to integrate online services within the mainstream service delivery. However, there has been many challenges ranging from improper priority settings, the digital divide gap is very wide and also lack of clear and concise policies with no roadmap among other factors to guide the implementation plan. The overall objective of this research was to holistically develop a framework with defined policy and governance structures which can support and guide the implementation of e-Service development in Kenya. This framework is meant to help identify priority areas and also highlight key interoperability enablers by successfully identifying those barriers which could hinder its adoption. Several other specific objectives were also stated and research questions for each formulated to assist in achieving each objective.

Objective 1: To identify and review existing e-Service interoperability frameworks applicable to Governments

This objective assisted the researcher to build literature of the subject under study and helped in developing a concise understanding of the problem statement. To achieve the above objective, the researcher developed the following questions: a) Are there frameworks which have been developed to guide the e-Service implementations in other countries? b) What factors define these frameworks? c) How relevant are these frameworks to e-Service solutions to the Kenyan situation? d) What challenges are faced by these countries towards e-Service dispensation?

Four frameworks studied under literature review are e-Service frameworks for the governments: Botswana, Canadian, South African and United Kingdom to produce generic elements for e-Service development. The key elements which were picked from these frameworks were interoperability

foundations, pillars and the benefits as envisaged by these implementations. Other important factors were security, standardizations, technology etc.

Objective 2: To propose a conceptual framework that would advocate for policies to promote exchange and sharing of public data and also to provide an underpinning for extension to existing research

In order for the researcher to achieve these objectives, the following questions were developed: a) what are the important factors for consideration in implementation of e-Services in developing countries? b) What factors define e-Service situation in mature implementations? c) What governance structures and polices would promote information exchange and data sharing while at the same time protecting personal security?

The various elements which define the frameworks studied in the literature review were studied and a selection was made based on their suitability to the Kenyan interoperability needs. The comparisons were however intended to provide supplementary information from which a generic framework was realised. These elements were looked at as barriers or benefits to implementation and adoption of e-Services. Among the factors which stood out were security, standardization, development of enterprise IT infrastructure, and integration of reuse in the design processes as well as developing a standard catalogue similar to information registry. The major barriers to interoperability adoption were technological barriers, lack of proper IT infrastructures and concerns about security of information being shared.

Objective 3: To establish and validate an e-Service interoperability framework that will govern interoperability situation in Kenya

The research question which assisted in answering this objective was: Is the developed framework suitable for assessing and directing development of e-Services in Kenya?

To answer the above question, the researcher collected data which was then analysed to test the stated hypothesis. The findings confirmed that the elements proposed for the conceptual framework and the additional elements added after research study were suitable and so were incorporated to be part of the framework for e-Service development for Kenya. This has been shown in the table in the appendix VI.

5.2 Limitations of the Study

The e-Services implementations which are currently on-going in Kenya are still at their infancy stages with several silo-based e-Service implementations by the various government agencies. Therefore, there has been no clear roadmap developed to promote its development, harmonization and integration of these services into one complex, robust and integrated system. There is need therefore to evaluate these silo-based implementations and how they contribute to the subsequent delivery of one government system with one portal where e-Services can be dispensed. Secondly, e-Services development being an on-going initiative mostly in developed and mature governments, Kenya being a developing nation the researcher observed that some respondents were not willing to participate and give the required information, while some preferred to withhold information for fear of being victimised.

5.3 Research Contributions

The research has contributed to the development of a framework for managing the eGovernment service development in Kenya. More research topics can be developed from the product of this research study; the researcher has therefore contributed by expanding the space for more research. The research has also proposed useful elements and strategies which can be incorporated within the Kenya's eGovernment strategic plan.

5.4 Research Recommendations

It's evident from the research findings that a development framework is necessary if successful adoption and implementation of e-Services is to be realised in Kenya. Even though there are several barriers which significantly affect interoperability implementations based on the research findings, when properly managed there is potentially several benefits which can equally be enjoyed when successfully adopted. Lastly, proper strategies and governance structures need to be put in place in order to realise successful implementations. I therefore recommend that the department of eGovernment adopt this framework for eGovernment service development in Kenya.

5.5 Further Research

Today, e-Service and e-Government has become a research domain with governments turning to a modernized ICT-enabled government acknowledged as a key condition in promoting the growth and competitiveness of public service dissemination and knowledge society. In Kenya this is a new development which is still at its infancy stages, therefore there is still more room for more developments and improvements, also even with its full implementations, human needs keep changing with the changing ICT technological inventions and innovations, this provides a good platform for further research and recommendations. The framework can therefore be modified to incorporate the new technological inventions and innovations.

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APPENDIX I: QUANTITATIVE QUESTIONNAIRE

Date:

Serial Number

Dear Sir/Madam,

This questionnaire is an invitation to participate in the research which attempts to ascertain the level of reuse and standardization of shared information and data in government and private sector organizations by ensuring that the various Information Systems can interoperate to share information and effectively minimize duplication. This questionnaire is therefore designed to collect data to help ascertain the level of interoperability within the various organizations in Kenya. The aim of the project is to propose a suitable framework which can be used to manage how the various systems can interoperate so as to share information and data.

The framework will therefore be used to help create and manage the standardised communication layer by laying the foundations for a more coherent organisation of metadata and rights information through industry standards. It will work to create interoperability and commonality within government of Kenya by seeking to harness and co-ordinate the energies of existing standard initiatives.

Thank you.

Regards,

Olal Wilfred.

E-mail: olal.ochola@gmail.com

Student University of Nairobi

PART A

PART 1 DEMOGRAPHIC DATA

1.1 Your Name: {Optional}

1.2 Your Contact Address (Phone, E-mail):

1.3 Gender Male Female

1.4 Age Bracket 24-35 36-45 46 - 60 61 & Above

1.5 Level of Education Certificate/Diploma Bachelor's Degree Masters Degree Doctoral Degree

1.6 Would you mind being contacted if additional information maybe required from you to support the research? Yes No

1.7 Please indicate if you are working for public or private organization.

Public Private

PART B

TECHNOLOGY ADOPTIONS – INTEGRATION STANDARDS

Please rank the following three statements. (1- Most difficult, 2 - not so difficult, 3 - least difficult.

In computer based data sharing, most difficult is to -	Rank
- Getting connected	
- The problem of difference in data standards	
- Collaborating with the department we want to share data	
- Guaranteeing the security/privacy of shared information and data	

USE OF STANDARDIZED FORMATS IN DATA REPRESENTATION - Please tick the appropriate boxes

	Yes	No
We use well defined data format for elements like name, address to capture information		
We reuse data formats across applications		
Data formats evolve each time a new applications is developed		
Whenever there is a change in standard data format, it is recorded and notified to all person concerned with in the organization		
We have established procedure to initiate change in standardized data format used by our organization		
We have established mechanism to add new entries to the standardized data format used by our organization		
We use the same standard codes in our applications to represent State/District/Ministry/Departments names as used by all other government departments		
We use our own codes in our applications to represent State/District/Ministry/Department Names		
For each project we develop new coding scheme		
While sharing data with other agencies we tell them what each data field stands for		
When we get data from other agencies we ask them what each data field stands for		
We add metadata tags with each webpage created by us (e.g. <meta NAME="description" content="...">)		
We tag each webpage using Dublin Core metadata (e.g. <meta NAME = "DC.Title" content="...">)		

BARRIERS TO INTEROPERABILITY IMPLEMENTATIONS - Please tick the appropriate boxes

Please rate the importance of each of the following barriers in terms of the organization's decisions to use interoperable information systems for online data sharing or for integrated service delivery. For each item below, please place a checkmark in the box that best describes your view.

	Unimportant	Of little Importance	Moderately Important	Important	Very Important
Lack of Legal/Policy framework for data sharing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of clear directives to share data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of standards, common architecture, guidelines to follow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laws/Regulations Prohibiting data sharing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Security and confidentiality concern	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mismatch of objectives and goals of participating agencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of relevant technical skills among the employees	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Incompatible data sharing standards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of Trust among departments want to share data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concern that after sharing our data would be subject to scrutiny/criticism by outsiders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concern for misinterpretation or Misuse of Shared Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Concern about quality of data collected by other agency	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data sharing threatens organization's importance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data sharing reduces full control over information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

BENEFITS OF INTEROPERABILITY IMPLEMENTATIONS - Please tick the appropriate boxes

Please rate the importance of the following benefits of interoperability in terms of the organization's use interoperable information systems for online data sharing or for integrated service delivery. For each item below, please place a checkmark in the box that best describes your view.

	Unimportant	Of little Importance	Moderately Important	Important	Very Important
Reduces overall costs of operations.					
Reduces duplicate data collection, processing and storage.					
Facilitates integrated citizen services					
Improves productivity.					
Improves data accuracy.					
Improves information comprehensiveness.					
Improves information accessibility.					
Increase responsiveness (allow to act faster).					
Improves decision- and policy-making.					
Improves intra- and inter-agency information integration.					
Better coordinated programs/services					
Improves accountability.					
Improves public image/reputation.					

ADOPTIONS OF XML/WEB SERVICES - Please tick the appropriate boxes

Please indicate the status of applicability of adoption of Standard based Interoperable Technologies (XML/Web Services) by the organization. [Put a X in the appropriate box]

Not interested in their use	<input type="checkbox"/>
Not currently in use, but tracking their development/progress	<input type="checkbox"/>
Developing expertise, with no plan for formal evaluation	<input type="checkbox"/>
Actively evaluating for deployment	<input type="checkbox"/>
Officially adopted for information/data interchange but not yet in production	<input type="checkbox"/>
Partially deployed in a production environment	<input type="checkbox"/>
Fully deployed	<input type="checkbox"/>

ADOPTIONS OF XML/WEB SERVICES - Please tick the appropriate boxes

Please indicate your level of agreement or disagreement with each of the following statement regarding adoption of XML/Web Services by the organization. Please note that information sharing could be within same department or across departments. [Put a X in the appropriate box]

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Use of XML/Web Services for exchanging data/information with other department(s) would enable us to provide services to citizens which are not possible otherwise.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The direct operational benefits (e.g. response times, through-put capability, cycle time) derived from utilizing applications based on XML/Web Services are greater than our existing solution of exchanging data /information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utilizing XML/Web Services based solutions would reduce cost of operation than our existing solution of exchanging data /information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
These technologies are difficult to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
These technologies are difficult to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Developing applications using them are difficult	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
XML/Web Services based solutions are consistent with our existing Network infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

XML/Web Services based solutions are consistent with our existing information systems					
XML/Web Services based solutions are compatible with our existing technical skill sets					
High importance is given by our top management in data/Information sharing with other department/ministries					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Our top management is aware of the potential of interoperability for data /Information sharing					
Our top management has encouraged the use of XML/Web Services					
Our top management is committed to making available resources required to use XML/Web Services technologies for data/Information sharing					
XML/Web Services based solutions are consistent with our organization's need					
XML/Web Services based solutions are consistent with our organization's future goals					
XML/Web Services based solutions conforms to our operating procedures					
For delivering Integrated service we need to exchange data with other departments					
For better decision making we need data from other departments					
For delivering value added service (e.g. online payment) we need to integrate our information systems with others					
Our organization has access to network of decent bandwidth					
We have web based information systems encompassing different functional areas					
We use database oriented applications regularly					
Our organization has strong Technical Support					
Financial cost of implementing interoperability standards					

would be significant					
Our department has adequate financial resources to adopt interoperability standards					
All other departments we know have adopted XML/Web Services technologies					
If we do not adopt XML/Web Services technologies we would be considered as laggards.					
Implementation of Interoperable information systems in government is inevitable and essential					
Government bodies put pressure on us on adopting XML/Web Services technologies					
In government it is mandatory to use XML/Web Services technologies for all new developments					
Government recommends various interoperability standards to be followed					
Citizen's expect integrated one-stop service from us					
Businesses expect integrated one-stop service from us					
We receive regular publications on Technological advancement in the area of e-Government					
Our staff members regularly attend conference/seminars on e-Government					
Departments with whom we share information have adopted interoperability standards					
Departments who share information with us has adopted interoperability standards					
Business with whom we interact (e.g. Banks for online payment) have adopted interoperability standards					
Data we need to exchange requires secured communication medium					
Security is major concern deciding data interchange with other organizations					
Adequate legislation or formal policies exist to on data sharing between government departments					
Explicit statutory guidance on data sharing exists.					

APPENDIX II: QUALITATIVE QUESTIONNAIRES

1. Please briefly explain how your organization uses Information and related ICTs to support business decision making in day-to- day operations?

2. Briefly explain how your organization manages information as a resource or asset?

3. What is information lifecycle and how has your organization managed information in its different stages?

4. How has your organization addressed the trust relationship with other stakeholders with whom you interact and share information? Is this a hindrance to successful information sharing?

5. In your own view how can interoperability affect our society, assume when its* fully implemented?

6. What do you think in your opinion are the most probable benefits and barriers to adoption of information sharing within any organization?

7. What do you think are the major pre-requisites to successful implementation of interoperability by any government?

APPENDIX III: HYPOTHESIS TESTING

Correlation Co-efficient Formula:

$$\text{Correlation}(r) = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

where

N = Number of values or elements

X = First Score

Y = Second Score

$\sum XY$ = Sum of the product of the First and Second Score

$\sum X$ = Sum of the First Score

$\sum Y$ = Sum of the Second Score

$\sum X^2$ = Sum of the square First Scores

$\sum Y^2$ = Sum of square of Second Scores

Proposed Elements (Barriers)	Not Important(X)	Importance(Y)	X*Y	X*X	Y*Y
Lack of Policy on data sharing	13	184	2392	169	33856
Lack of Standards & Common Architecture	12	185	2220	144	34225
Security & Confidentiality Concerns	11	186	2046	121	34596
Mismatch of Objectives	114	83	9462	12996	6889
Lack of Technical skills	5	192	960	25	36864
Incompatibility of Data Standards	30	167	5010	900	27889
Information Management	31	166	5146	961	27556
Lack of Trust	18	179	3222	324	32041
Concern of Misinterpretation of data	18	179	3222	324	32041
Concern of Quality of data	39	158	6162	1521	24964
Data sharing reduced full control	13	184	2392	169	33856
Disharmony in Legislation	13	184	2392	169	33856
Economic Restrictions	82	115	9430	6724	13225
Absence of National Joint effort	73	124	9052	5329	15376
The People Factor	81	116	9396	6561	13456
SUMMATION	553	2402	72504	36437	400690

Proposed Elements (Benefits)	Not Important(X)	Importance(Y)	X*Y	X*X	Y*Y
Reduces overall costs of operations.	15	182	2730	255	33124
Reduces overall costs of operations.	14	183	2562	196	33489
Reduces Duplication of data	14	183	2562	196	33489
Facilitates integrated citizens services	15	182	2730	255	33124
Improves Productivity	48	149	7152	2304	22201
Improves Accuracy	134	63	8442	17956	3969
Improves Information comprehensiveness	64	133	8512	4096	17689
Improves Information accessibility	71	126	8946	5041	15876
Increase responsiveness	48	149	7152	2304	22201
Improves decision and policy-making	47	150	7050	2209	22500
Improves intra- and inter-agency integration	48	149	7152	2304	22201
Better coordinated services	47	150	7050	2209	22500
Improves accountability	38	159	6042	1444	25281
Improves public image/reputation	43	154	6622	1849	23716
SUMMATION	646	2112	84704	42618	331360

APPENDIX IV: CALCULATION OF THE Z-SCORES

The formula for calculating the z-score is:

$$z = (S - \mu_s) / \sigma_s$$

Where S is the mean sample to be standardized,

μ_s is the population mean and

σ_s is standard deviation

Number	Proposed Factors for Interoperability Barriers	μ_s	S	z-score
1	Lack of Policy on data sharing	13	32.79	10.1
2	Lack of Standards & Common Architecture	12	32.79	10.61
3	Security & Confidentiality Concerns	11	32.79	11.12
4	Mismatch of Objectives	114	32.79	-41.43
5	Lack of Technical skills	5	32.79	14.18
6	Incompatibility of Data Standards	30	32.79	1.42
7	Information Management	31	32.79	1.43
8	Lack of Trust	18	32.79	7.55
9	Concern of Misinterpretation of data	18	32.79	7.55
10	Concern of Quality of data	39	32.79	-3.17
11	Data sharing reduced full control	13	32.79	10.1
12	Disharmony in Legislation	13	32.79	10.1
13	Economic Restrictions	82	32.79	-25.11
14	Absence of National Joint effort	73	32.79	-20.52

Factors affecting interoperability benefits	z-score
Reduces overall costs of operations.	15.89
Reduces overall costs of operations.	16.4
Reduces Duplication of data	16.4
Facilitates integrated citizens services	15.89
Improves Productivity	13.85
Improves Accuracy	6.7
Improves Information comprehensiveness	11.81
Improves Information accessibility	16.4
Increase responsiveness	10.79
Improves decision and policy-making	17.93
Improves intra- and inter-agency integration	14.87
Better coordinated services	12.83
Improves accountability	15.38
Improves public image/reputation	13.34

APPENDIX V: Z PARAMETER TABLE

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990