E-GOVERNMENT ARCHITECTURE MODEL FOR GOVERNMENT-TO-GOVERNMENT DEPLOYMENT OF INTEROPERABLE SYSTEMS,

(A CASE STUDY OF COUNTY AND NATIONAL GOVERNMENT IN KENYA)

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E-government architecture model for government-to-government deployment of interoperable systems,

(A case study of county and national government in Kenya)

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DECLARATION:

This thesis is my original work and has not been presented for a degree in any other university.

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This Thesis has been submitted for examination with our approval as university supervisors.

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DEDICATION

I dedicate the thesis to my entire family. Starting with my dear parents for loving me throughout, making me understand what I stand for, financial support, encouragement and commitment all through. My Brothers and Sisters not only for their determination and encouragement, but also being role models to my Education and a life to live, besides my comrades of all aspects. Let the Almighty Father bless them abundantly.

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LIST OF ABBREVIATIONS

ANSI	American National Standards institute
BRM	Business Reference Model
COK 2010	Constitution of Kenya 2010
DRM	Data Reference Model
FEA	Federal Enterprise Architecture
G2B	Government-to-Business
G2C	Government –to-Citizens
G2E	Government-to-Employees
G2G	Government –to-Government
IEEE	Institute of Electrical and Electronics Engineers
PRM	Performance Reference Model
SCRM	Service Component Reference Model
SGGA	Singapore government enterprise Architecture
TRM	Technical reference model
OG	Other Governments

ABSTRACT

Rapid advancement and innovation of new technologies have led to global revolution on how governments carry out their businesses. Information Communication Technology(ICT) tools used to re-invent the public sector, have led to unprecedented benefits to government, compelling most countries both developed and undeveloped to embrace e-government. Government agencies are deploying new ICT systems with specifications and solutions relevant to their particular requirements. However, they are not paying attention to the need to connect exchange and re-use data within systems leading to weak interoperability in government. To address the issue of weak interoperability, we developed e-government architecture to enable smooth deployment of interoperable systems between national and county governments. E-government architecture acts as an information management and planning tool to enable government optimize their ICT assets by rigorously analyzing and identifying strategic opportunities from its various lines of business and business information. This enables the development of appropriate software applications in-line with technology investments. The exploratory research design and case analyses were used. Once the new e-government architecture for a devolved government; county and national government was developed, a new e-govern project management system was developed based on the architecture to demonstrate how interoperability can be achieved between the county and national government. The system was validated to determine whether it is interoperable and if both governments can access necessary data seamlessly for decision making. Interoperability was achieved by calculating user satisfaction using Cronbach's Alpha of system users from county and national government by analyzing the data collected. The commonly accepted rule of thumb is that an alpha of 0.7 or 0.6 indicates user satisfaction or system reliability while very high degree like 0.95 indicates redundancy. Calculated Cronbach's Alpha for the new e-govern project management system is α=0.77869 which falls under the acceptable and good system reliability when rounded off to 0.8. This shows that the system users were satisfied with the system and it can be applied between county and national government in order to achieve interoperability since both governments'

needs were met and each government can access important data seamlessly for decision making.

CHAPTER ONE

INTRODUCTION

1.1 Background Information.

Information and communication technologies provide both developed and developing nations with an unprecedented opportunity to meet vital development goals, via the appropriate utilization of technological tools. There is increasing evidence that e-government, if well implemented strategically, can improve efficiency, accountability and transparency of government processes (Parrish, 2006; Signh *et-al*, 2010; Hassan *et-al,* 2011; Bhattacharya *et al,* 2011 and Haque *et al,* 2013). However, the full potential of e-governance applications and other ICTs remains to be fully harnessed by developing countries.

For ICT and e-government to work for development, information and knowledge need to flow seamlessly across agency borders and various levels of government, and ultimately different countries, across regions and continents without being locked into specific software packages. Eventually, this will lead to better and more informed decisions, better public service and better governance (Fong, 2007)

In e-government initiative, the key challenge is the existence of patchwork of ICT solutions in different government offices that are unable to talk or exchange data. In the process of digitization, government processes and systems are, in many instances, reinforced rather than transformed. As result, demand to visit different departments to access public services, even after the introduction of ICTs and broadband as systems are not interconnected (Fong, 2007).

Many researchers have defined e-government, but the best suits my area of research is; e-government is the use of ICT tools to re-invent the public sector by transforming its

internal and external way of doing things and its interrelationships with customers and the business community (Allen *et al*, 2010). The analysis of this definition allows one to identify the main issues and components that characterize an e-government framework such as; transformational areas (internal, external, and relational), e-government application domains (e-services, e-democracy and e-administration) and users, customers, actors and their interrelationships.

From (sahraoui, 2007; Signh *et-al*, 2010; Haque *et al*, 2013), the scope of major e-government interactions are; Government to Citizens (G2C), Government to Government (G2G), Government to Business (G2B), Government to Employee (G2E) and Other Governments(OG). In this study I will limit my discussion to Government to Government only (G2G). The G2G sector represents the backbone of e-government. Some researchers suggest that governments at all levels must enhance and update their own internal systems and procedures before electronic transactions with citizens and businesses are done. So, in my research I will focus to cover interoperability of internal systems of government.

Government to Government systems are types of e-government systems that support relation between different structures of government. It helps in sharing some basic information among different governmental bodies which avoids parallel data collections and reduces costs respectively (Haque *et al*, 2013). The government processes and procedures are simplified to cut the red tape, facilitate delivery of services, increase productivity of the bureaucracy, and increase savings. The transactions between central and local governments, department levels and attached agencies and bureaus, as well as government and its employees would be enhanced.

The internal strategic objective of e-government in government operations is to facilitate a speedy, transparent, accountable, efficient and effective process for performing government administration activities, significant cost savings in government operations.

Thus, information can flow much faster and more easily among different governmental departments (Parrish, 2006; Allen *et al* 2010).

E-governance can be designed to increase competition, reduce discretionary power, remove bottlenecks in routine transactions, increase reliability, and predictability of government actions, to ensure better and equal access to information and services and promote transparency and accountability (Signh *et-al,* 2010). E-government strategy of Denmark declared "joined up public service" better collaboration, digital exchange of data between agencies as basic objectives of e-government.

From e-governance of Singapore, ICT provide greater accessibility, facilitate wider muilt communication and dissemination of information, provide automatic record keeping features and generally enable better knowledge management and information sharing, increase government productivity(Signh *et-al,* 2010). It is argued that e-governance can provide a climate of honesty, integrity, trust and participation.

(Haque *et al,* 2013), discusses the grid technology has the potential to become a ubiquitous electronic services, which can improve infrastructure utilization, increase access and integration of huge amount of data and enable new levels of communication and collaboration between the different levels of G2G e-government system. The grid framework optimizes information process management at different levels of government systems and provides rapid access to various levels of data sources available over the network. This framework is applied in Pakistan to address challenges faced by the G2G e-communication and collaboration system i.e. addresses massive requirements of information processing capacity, reduces inefficiency and processing bottlenecks and improves poor utilization of information.

The scope of a grid technology could range from small departmental network to avast collection of resources and services running in multiple locations, spread across the organization, and owned by many organizational groups, government bodies, enterprise

or academic institutions (Haque *et al,* 2013). Much of the initial progress with respect to online initiatives focuses internally and externally, on information proving, connectivity and expanding a new internet based infrastructure to citizens, customers and communities. My argument is that before electronic services are expanded to citizens and Businesses the internal electronic administration infrastructure of an e-government should be in place.

In Canada the government is attempting to achieve the internal capacity for an intra-governmental conversation based electronically. Within government, IT fosters new horizontal opportunities by shifting away from traditional bureaucratic structures towards alternative delivery arrangements i.e. e-governance (Sahraoui, 2007; Bhattacharya *et al,* 2011; Kangu, 2011; Haque *et al,* 2013). The manner in which accountability is perceived and exercised by government leaders will determine the degree to which it embraces more collaborative models of governance.

Traditionalists invoke the underlying principle of ministerial accountability based on a clear and rigid view of vertical control and risk minimization, in order to serve and protect the interests of the publicly accountable political leader. The rise of e-governance, with its pressures for variety of initiatives introduces alternative models of decision making and service delivery promoting shared accountability (Allen *et al,* 2010). The need for collaboration, partnerships and joint ventures grows both within government and often between private and public organization.

(Allen *et al,* 2010) Asserts that shared accountability ensures better coordination of activities in a more flexible and more effective way, empower public servants and their partners allowing new solutions to come forward in a dispersed and open matter. The opportunities that come along with e-government include; cost reduction and efficiency gains, quality of service delivery to business and customers, transparency, anticorruption, and accountability, increase the capacity of government, network and

community creation, improve the quality of decision making, and promotes use of ICT in other sectors of the society. Traditional government is characterized by static and insufficient information that is infrequently updated, few interactive features, and non-existent online services.

In (Signh *et-al,* 2010) research on how e-governance can be used to fight corruption in India, Ethiopia and Fiji, identifies monopoly of power, discretion, and lack of accountability and transparency to be the key drivers of corruption. (Naz, 2009) emphasized that to tackle these three drivers, a viable anticorruption strategy must be designed as a muilt-pronged endeavor that includes a set of complex measures in different spheres of society and state organization. A pure e-governance solution removes discretion from the equation promoting corruption by dis-intermediating services and allowing citizens to conduct transactions themselves.

A number of analysts argue that to maximize the potential benefits from e-governance applications, transparency need to be consciously built into the public service delivery system beginning from the design and planning phase. The Thailand government uses the E-Thailand system to improve public administration and to support the economic and social development of the nation (Signh *et-al*, 2010). Use of ICTs in government sector is now well established and had been an integral part of how governments do business in countries like; Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, Korea, Mexico, Netherlands and the United states. There is scarcely an aspect of government activity that does not involve the use of ICTs (Haque, 2013; Fong, 2007).

According to the constitution of Kenya 2010 (COK, 2010), Kenya adopted a multidimensional approach to the organization of governance and management of state power. It combines vertical and horizontal dimensions and forms the foundation of the devolved system and structures of government. The two levels of governments can be

described as being distinct and inter-dependent and which conduct their mutual relations on the basis of consultation and co-operation (Kangu, 2011).

Kenyans, through Article 4 of the COK 2010, adopted republication as a key value foundation. In several other articles, the various other doctrines include; openness, transparency and accountability as opposed to secrecy in governance. Then one might wonder how? It is for this reason that Article 35 of the COK 2010 makes provision for the right of access to information held by state. According to Articles 6(2) and 189(1) (b) and (c), inter-dependence requires that the two levels of government liaise with each other for the purpose of exchanging information, coordinating policies and administration and enhancing policy.

Counties will compete and cooperate with and between themselves if they are to achieve the desired development outcomes. The effectiveness and efficiency with which public services are provided to support inclusive growth, economic innovation and competitiveness and maintaining quality places will be essential to the success of the counties (Kangu, 2011).

The promotion of various forms of development activities and goals, in one way or another, will require the inclusion and full integration of communication and information. (Kangu, 2011) information is power, and power to influence public policy decisions is the right to every citizen. For effective participation to benefit society it must rely on accessible, timely, accurate and user friendly information. Therefore, both national and county governments must embrace the central roles of communication and information in their broader meaning.

It is considered that both national and county governments can benefit in using the wider reach of effectiveness of both the print and electronic media in sharing extensively on various aspects of their government. (Allen *et al*, 2010) considers this means to have limitations because of their static and insufficient information that is infrequently

updated, few interactive features, and non- online services, especially with the advent of new technologies and broadband of higher speed.

Streamlined sharing of information between government agencies to conduct government –to-government (G2G) simplifies the navigation of government-to-citizen (G2C) and government-to-business (G2B) transactions (Haque *et al*, 2013). The role of communication and information remains a critical component of generating information needed for decision making processes, analysis and interpretation of core issues of governance (Kangu, 2011).

Dissemination of government information through e-governance is very crucial because it is a voice on behalf of the silent majority, by keeping governments on check, by comparing what government promise to deliver and the actual levels of government delivery. I propose a model that will harness important data, disseminate it between the national government and the county government in the most appropriate way and analyze to convert it to relevant knowledge that might be required for decision making. Internal e-government refers to the enablement of internal processes within the government body itself with ICT. The significant innovation is the integration of the back-office systems and processes.

1.2 Problem Statement;

The Kenyan constitution establishes two levels of government that are distinct and interdependent which conduct their mutual relations on the basis of consultation and co-operation to promote; openness, transparency and accountability. Deployment of new ICT systems with specifications and solutions relevant to particular needs of every county without adequate attention to the need to connect, exchange and re-use data with national government systems, has seen the government incur huge losses in terms of finance, lost opportunities for enhanced effectiveness and time. This proliferation of independent e-government systems has largely remained uncoordinated with limited coherence due to weak interoperability. If e-

government initiatives were to be implemented with focus on addressing interoperability, up to 85% of government budget could be saved (Janssen *et-al*, 2011).

1.3 Justification;

Since 2000 e-government programs around the world have rapidly moved from providing simple information and interacting on websites to more complex transactional exchanges. The integrated government focuses on developing cohesion services that provide cross government, nationwide, data integration and seamless transaction (Gatra, 2011). For governments to move to the next level challenges such as lack of detailed analysis of needs and demands from the e-government service users, interoperability issues between idiosyncratic systems, and a more comprehensive IT strategic planning must be addressed.

E-government is about transformation, turning today's conventional organizational designs into hyper efficient service models (Al-Khouri, 2011). Governments must increasingly begin to rethink in terms of e-government by placing greater emphasis on institutional linkages between and among the tiered government structures in a bid to create synergy for inclusive sustainable development for a transformative government towards cohesive, coordinated and integrated processes and institutions through which such a sustainable development takes place. (UNPAN, 2012).

The Delloitte research (2000) showed that, legacy systems are neither equipped to handle drastically increased transaction volumes nor designed with flexibility required for retrieving and processing data from many sources inside and outside the government walls. Moreover, e-government deployments oftentimes resemble patchwork of incompatible information and communication technology solutions, rather than flexible and reusable assets that would provide essential building blocks of service (UNDP, 2010).

The adoption of e-government is not straight forward and cannot be done in a limited period of time, it requires an interactive architecture approach to place government information and service online. Modernizing government structures, governance frameworks and processes to meet the e-government imperative, requires an evolutionary and comprehensive architecture.

Janssen *et-al,* (2011) Most governments create general interoperability frameworks rather than sectored architecture projects. He argues that interoperability goes beyond technical issues to include sharing of information between networks and reorganization of administrative processes to support government services.

Before service can be reached through channel and pervasive technology, the information foundation needs to be consolidated for the purpose of building up a master data. Today's technologies are quite capable and enable a high degree of integration and information sharing. The key is not in the picking the best technology but having viable blue prints that translate business needs into technical solutions. Establishing a common and interoperable information infrastructure is a critical success factor that is hard to achieve in government. With reference to the Kenyan case that is between county and national government there is lack of e-government architecture between the two levels of government and there are no parameters to support interoperability.

1.4 Objectives

1.4.1 **Main Objective**

To establish the use of e-government architecture as a means of addressing weak interoperability issues in e-government.

1.4.2 Specific objective;

1. To review literature on e-government structure and e-government architecture.

2. To develop e-government architecture that supports interoperability between national and county government of Kenya.
3. To develop a database application for service delivery, showing how interoperability can be achieved based on the architecture

1.5 Research questions;

1. What e-government architecture is suitable for an integrated e-government?
2. How does e-government architecture support interoperability?
3. What integrated e-government architecture is suitable for supporting interoperability between national and county governments in Kenya?
4. What database application can be developed based on the developed architecture?

1.6 Scope of study;

The scope of the research is E-government, how governments can thrive in the culture of interoperability for government-to-government ease of e-administration.

CHAPTER TWO

LITERATURE REVIEW

2.1 E-Government Structure And E-Government Architecture,

E-government is about a large set of organizations including, many autonomous agencies having various levels of readiness and different circumstances; governed by democratic system and embedded in a certain institutional situation (Flak, Dertz, Jansen, Krogstie & Spjelkavik, 2011), this calls for more structured approaches for e-government implementation with a focus on public values. E-government setting is that there is more complex goal structure and strict legal norms; it would be unfortunate if governments adopt an architecture that limits its ability to respond to changing conditions.

Since 2000 e-government programs around the world have rapidly moved from providing simple information and interactions on websites to more complex transactional exchanges. The integrated government focuses on developing cohesive services that provide cross-government, nation-wide, data integration and seamless transactions (UNPAN, 2012).

More public administrations are supposed to work together and adapt continuously to rapid technology changes. Mature e-government can be achieved through a process of building organizational infrastructures that enable innovative action to thrive in the culture of interoperability. Lack of integration and interoperability of e-government systems among government departments and between governments and businesses is a major issue (Bishop, Haggerty, & Richardson, 2015; Al-Busady, 2010).

To achieve an interoperable government, the integration of government information resources and processes, and interoperation of independent information systems are

essential (Gupta, 2011). The impact and performance of e-government implementation is very low and far from success, it needs to be advanced to improve public services and minimize inefficiency of public sources (Gatra, 2011). This is quite evident from countries like Canada that has remained at a virtual standstill since 2005 after 130 of the most important government services offered electronically, also out of 150 Indonesian districts where there is electronic service delivery only 6 can be evaluated as good the rest are poor or very poor (Nurdin, Stockdale, , Scheepers, 2014). This calls for a detailed analysis on how e-government systems are implemented, what clients want and how they wish to be served across departments.

According to (Wafula, 2007) the potential for ICT for governance is fully leveraged in an interactive service model, which leads to greater objectivity and transparency in decision making processes. The model enables to establishment of interactive communication channels with key policy makers and members of planning.

The Mul-Net framework develops three key layers, organizational layer, governance layer, ICT architecture layer which recognizes and supports successful production and consumption patterns, and the reduction of traditional barriers, enabling opportunities in a more suitable manner. It is designed to support national and e-strategies to talk to both sub-regional and national e-strategies.

The functional representation of the three layers depicts clearly how governance layer and organizational layer are mirrored about ICT architecture layer as shown in Figure2.1. The elements of the architecture, how it can be used as an analysis procedure to implement electronic applications for e-government and how it can support interoperability need to be established. This forms a blue print for architecture in a successful e-government, and is the basis for the search and development of an

appropriate architecture for both county and national governments that can support interoperability and enhance analysis procedure of e-strategies for e-applications

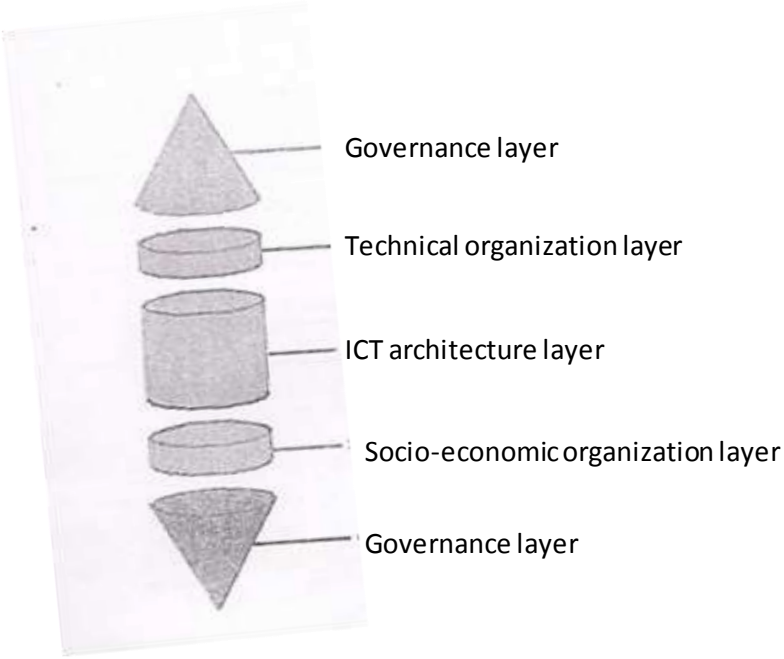

Figure 2.1: Functional arrangement of layers of the MUL_NET Framework

The definition of an architecture used in ANSI/IEEE std 1471-2000 is: the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution. From this definition one can envision, what an architecture should entail in order to meet its functions, it should state clearly how the system should be organized, thus capturing the analysis element of systems before development in order to establish how they should be organized, what kind of components should be part of the system, how the systems should relate to each other promoting interoperability and, under which environment should they be developed and deployed and how future changes should be taken into account for the success of e-government.

E-government requires muilt-agency collaboration and integration application of their disparate business processes and information systems (Janssen *et-al*, 2011). E-

government architecture is to enable government to optimize its ICT assets by rigorously analyzing and identifying strategic opportunities from various lines of business, business information, software applications and technology investments. Most governments create general interoperability frameworks rather than sectored architecture projects. Governments should rather develop contextual strategies that build on the understanding of the actual drift of infrastructure and employ developed architectures (Janssen *et-al,* 2011). Interoperability is not simply a technical issue concerned with linking up computer networks; it goes beyond to include sharing of information between networks and the reorganization of administrative processes to support the seamless delivery of government services. Therefore if processes are to be reorganized it calls for process re-engineering, that require a clear model that will enable efficient analysis and design.

The e-government issue is not merely caused by e-government architecture misalignment between business processes and IT, but that a special style of architecture is needed to cover non-technical areas in order to streamline business process implementation (Cheng-YI WU, 2007). Before service can be reached through channel and pervasive technology, the information foundation needs to be consolidated for the purpose of building up a master data. Government bodies need to interoperate with each other to a greater extent than has been the case to date by using a common architecture.

Government architecture is the instrument to ensure that interoperability can be achieved; there is no consensus about what constitutes government architecture and what elements should be included. Architecture and governance aspect influence each other and one cannot do without the other (Al-khouri, 2011). A set of artifacts that broadly lists business functions across government agencies, supported by relevant data standards, common systems and services and technology should be established.

The architecture should aim to achieve the following;

- Identify opportunities for end-to –end service integration for a seamless government, leading to greater synergy and efficiency.
- Identify shared systems that can be used by multiple government agencies to minimize duplication efforts.
- Improve clarity on application resilience requirements to achieve robust solution designs.
- Improve impact analysis on technology, adoption to attain better technology, planning and policy development.
- Improve transparency of whole-of –government initiatives and government agencies, various ICT investments, as well as their policy alignment with business goals to reach better investment decisions.

Architectures should focus on key business functions that span multiple agencies to identify inter-agency synergies and opportunities that promote interoperability.

2.2 E-Government Architecture And Interoperability,

According to (Al-khouri, 2013) Interoperability and architecture are intertwined in the execution of e-government services. He argues that e-government architecture should give attention to interoperability and integration. E-government development and the realization of its potential benefits have faced serious issues and challenges due to the complexity of the technology involved, the constraints of provider's capacity, and the limited uptake of e-government by citizens and institutions (Hassan & shehab, 2011). It is known that the failure of rate of e-government projects is generally high. The result of my review of the extant literature review show that although the underpinning reasons of failure vary from project to project, one of the commonly seen issues is lack of integration and interoperability of e-government systems among government departments and between governments and business (Al-Busaidy, 2009).

Interoperability among government organizations has been identified as a central issue and critical prerequisite for achieving a one-stop government portal (Tripathi, Gupta, & Bhattacharya, 2011; Peristeras *et al*, 2007). To achieve an interoperable government, the integration of government information resources and processes, and the interoperation of independent information systems are essential (Gupta, 2011). But the big question is how and through which mechanism can this be achieved?

According to (Gouscos,, Kalikakis, Legal, , & Papadopoulou, 2007), Most integration and interoperation efforts face serious challenges and limitations as exchange of information and services are fragmented and complex, plagued by technical and organization problems. The mapping over stage models, show only few departments having achieved some type of integration (Gupta, 2011). Portal maturity will depend on the degree of integration among disparate systems, which is achievable only if the backend systems are interoperable.

One may wonder what interoperability is and why has it become of issue in e-governance? According to UNDP, e-government interoperability, in its broad sense, is the ability of constituencies to work together. At a technical level, it is the ability of two or more government information and communications technology systems to exchange and use the information that has been exchanged to improve governance.

E-government interoperability has become crucial issue because recent ICT investments have reinforced the old barriers that made government decision making difficult. In a number of government agencies are deploying new ICT systems with specifications and solutions relevant to their particular needs but without adequate attention to the need to connect, exchange and re-use data with agencies in ICT systems (Peristeras, Loutas, Goudos & Tarabanis, 2007; Tripathi *et al*, 2011).

According to (Al-khouri, 2013), Interoperability at technical level can be categorized and addressed in three levels, which include; organizational, semantic and technical

interoperability. Organizational interoperability is concerned with the coordination and alignment of business process and information architectures that span both intra and inter-organizational boundaries, semantic is concerned with ensuring that the precise meaning of exchanged information is understandable by any person or application receiving data. And, technical is concerned with technicalities of connecting computer systems for the purpose of exchanging information, but is quite evident that most countries concentrate only on technical interoperability because it is easier to achieve thus making the objective of achieving e-government or the evolutionary of e-government hit a deadlock.

2.2.1: Challenges And Limitations Of Integration And Interoperation

- Exchange of information and services are fragmented and complex, plagued by technical and organization problems.
- Backend systems are not interoperable
- Reinforcement of old barriers that make government decision making difficult.
- Concentration to technical interoperability that is easy to achieve at the expense of organizational and semantic interoperability.

According to (Kumar & Vijaykumar, 2011), Failure to foresee implementation challenges will cost the government as inferred from the data; a single cancelled e-government project on smart cards resulted a loss of 698 million pounds to the British government. The national program for IT overran in cost by 450% approximately $17 billion. The libra courts management system overran by 237% to 341 million pounds. In the study conducted by the United States government, it was identified that 585 e-governance investments out of 810 were problematic and were placed under watch list.

Creation of architectures must be focused and represent the business objective, which is producing an added value of delivering a better and more reliable service for users of

those services. Architectures facilitate the alignment of administrative procedures with the technical systems, which contributes to interoperability at the organizational level between administrations. The objective government architecture is to enable the government to optimize its assets by rigorously analyzing and identifying strategic opportunities from its various lines of business, business information, software application and technology investments.

Architecture is a path to interoperability in e-government, since it attributes to align business of government that can interoperate. (Janssen *et-al*, 2011) define e-government architecture as an umbrella to explain the relationships among government's ICT projects and for managing change.

Many models have been used in literature to describe e-government architecture. (ECLAC, 2007) proposed a template for e-government architecture layout of four layers; network layer, middleware layer, data layer and application layer. Figure 2.2 shows a general architecture layout for e-government.

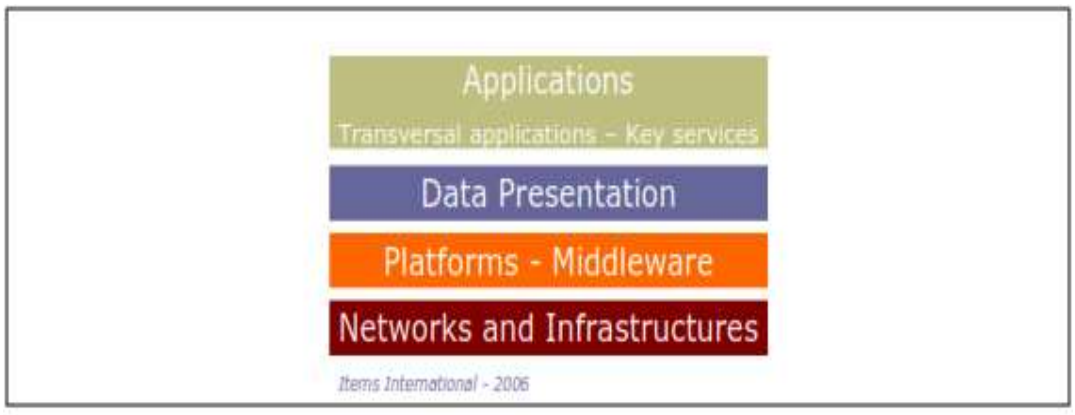

Figure 2.2: General e-government architecture Layout

The network layer focuses on the technical constraints necessary to allow the other layers to communicate. Middleware focuses on the system architecture and the necessary components allowing the system to exchange together. Data layer facilitates data exchange and communication among systems. Application layer since one of the main objective of defining e-government architecture is to permit applications to "talk" to each other; this layer meets the objective of interoperability, this model is quite too general and needs to be broken down to the excitant elements of each and every layer.

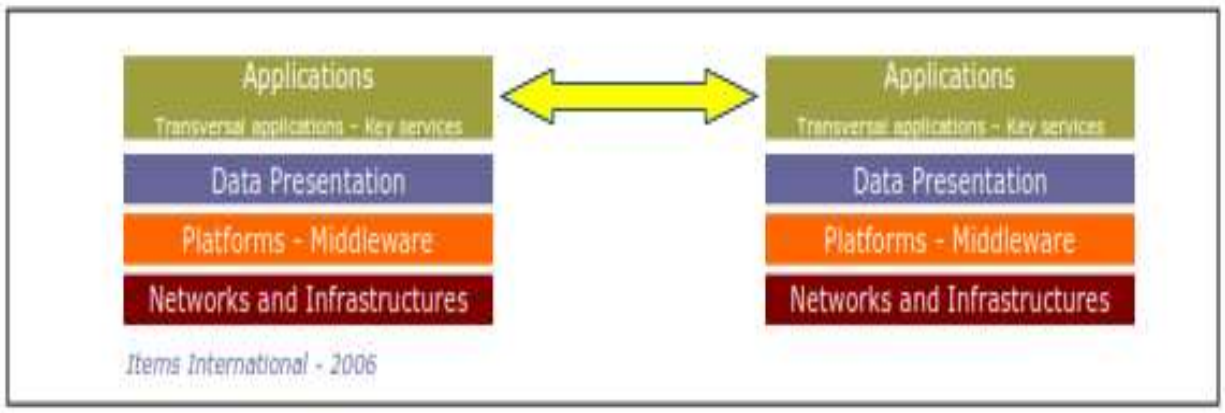

Figure: 2.3 Architecture layout-interoperability.

Ebrahim and Irani, (2005), proposed an architecture framework of e-government, which is divided into four layers; access layer, e-government layer, e-business layer, and infrastructure layer. Access layer involves the channels that government's users can use to access various government services; e-government layer involves integrating digital data of various agencies into government service portal. E-business layer is focused on integration of government data and knowledge, and infrastructure layer focuses on network and communication infrastructure required for offering reliable and effective service to citizen, it does not state clearly how information should be analyzed and process re-engineered for successful integration of systems. As shown in Figure2.3.

Sharma and Gupta (2003) proposed a four layer e-government architecture having networks and technical infrastructure, digitization and data integration, internet and web-enabled e-government service and user access layer. The UNDP review of government interoperability frameworks, found five layers as foundation of clustering standards, interconnection, information and presentation, data integration, metadata and security.

Gulla, Dash and Gupta (2011) proposed a six layered e-government technical architecture. The constituents of the architecture are; presentation, content management, application integration, data exchange, interconnection and security layers. Technologies adopted at each layer have different implications for different types of government interaction. None of them has addressed the issue of interoperability in detail.

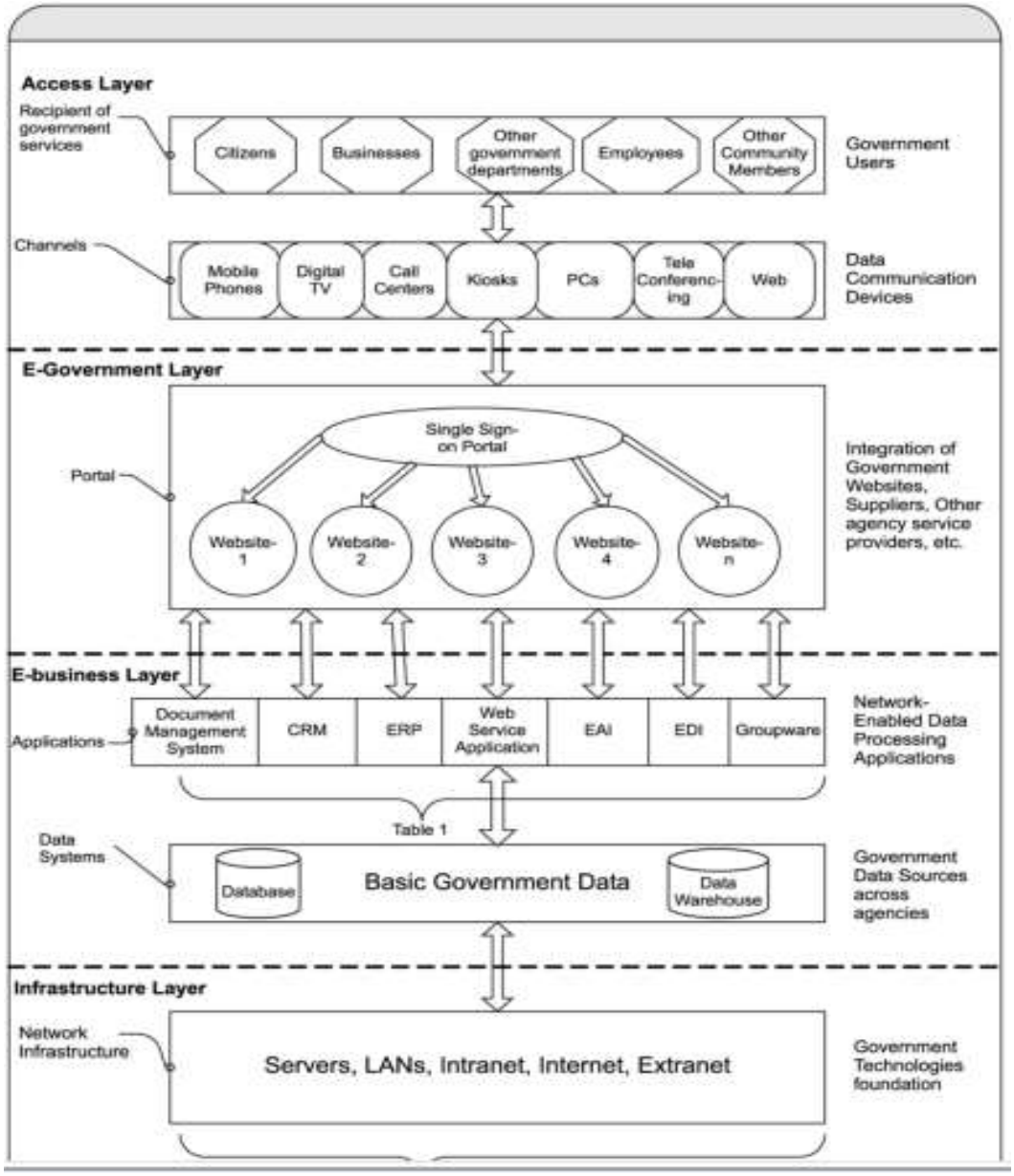

Figure2.3: Ebrahim and Irani, e-government architucture

Many countries across the globe have embraced different e-government architectures. The government of U.S.A has adopted the Federal Enterprise Architecture (FEA) whose goal is to transform the federal government to one that is citizen-centered, result oriented and market based as well as to maximize technology investments to better achieve

mission outcomes to encourage collaboration and resource sharing across agencies (ECLAC, 2007). It enables the government to identify opportunities to leverage technology and alleviate redundancy. The FEA facilitates horizontal (cross federal) and vertical (federal, state and local government) integration of information technology resources, and establishes the "line of sight".

The FEA is defined in terms of five interrelated reference models designed to facilitate cross-agency analysis and the identification of duplicate investments, gaps, and opportunities for collaboration within and across federal agencies as per Figure 2.4.

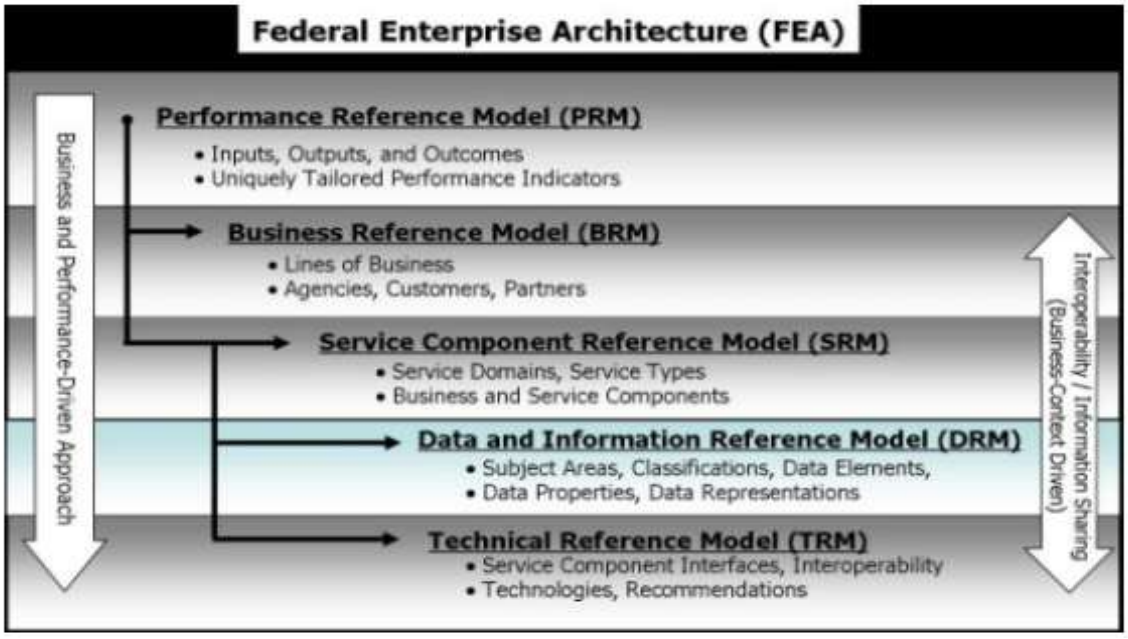

Figure 2.4: Federal Enterprise Architecture of U.S.A

The consolidated reference model include; the performance reference model (PRM), the business reference model (BRM) provides an organized hierarchical construct for describing the day to day business operations of the federal government. The service component reference model (SCRM) is intended for use to support the discovery of

government wide business and application service. The data reference model (DRM) describes at an aggregate level, the data and information supporting government program and business line operations. The technical reference model (TRM) is a component driven, technical framework used to categorize the standards, specifications, and technologies. From the study conducted by the United States government, it was identified that 585 e-governance investments out of 810 were problematic and were placed under watch list. A clear indication that even though they have the FEA architecture in place, the issue of interoperability and how the architecture should be enhanced and utilized in a positive manner need to be addressed.

Architecture is an information management and planning tool (Seifert, 2011). Information to be managed efficiently and effectively, analysis of the requirements that will manage the information need to be identified and taken into account. Planning represents a business driven approach to IT management that emphasizes interoperability and information sharing. It is a planning and management tool to guide government information technology investments, with a specific focus on improving efficiency and identifying common applications that can be used government wide.

According to the Government Act (P.L 107-347), tasks the administrator of the office of the E-government overseeing the development of FEA, both within and cross agencies; architecture is a means, a strategic information asset base, which defines the mission, information necessary to perform the mission and the transitional processes for implementing new technologies in response to the changing missions that includes a baseline architecture, target architecture and a sequencing plan. This implies a strategic information asset base, which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing business needs.

2.3:The Proposed County And National E-Government Architecture

With regard to the second objective, The COK2010 establishes two levels of government; the county and national government, of distinctiveness, interdependence and intergovernmental relationships. The basis and framework for distinctiveness, interdependence and intergovernmental relationships are statutory and by best practice. The provisions of section 6(2) and 189 of COK 2010 provide lead in this regard. Whereas section 6(2) lays emphasis on distinctive and interdependence, Section 189, demand close liaison, consultation and exchange of information, this is necessary for appropriate working of structures of governance.

The need for a framework to govern the intergovernmental relations is premised on the provisions of section 6(2), 187 and 189 of COK2010. The framework has been consolidated in the intergovernmental relations Act, 2012, whose principles and objective among others include; consultation and co-operation between the national and county governments, and among county governments, providing a forum for sharing and disclosing necessary data and information. This is conceptualized in Figure2.5.

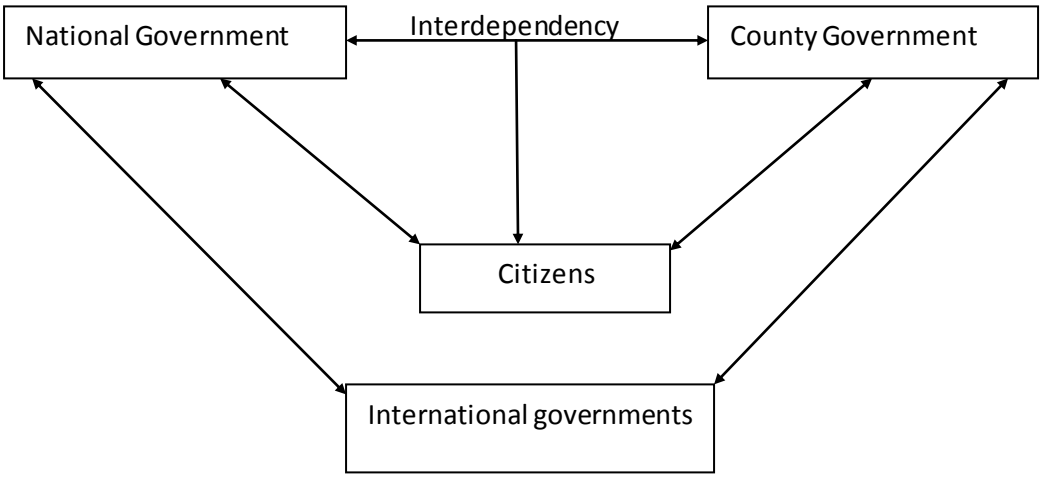

Figure 2.5: conceptual service interactions of county and national

The Kenya e-government architecture is informed substantially by the following literature surveyed: MUL_NET conceptual framework (Wafula, 2007), giving an insight of how government can achieve great success by letting ICT play the role of an enabler rather than facilitator in e-government. Architecture framework of e-government (Ebrahim & Irani, 2005), and the Federal Enterprise Architecture of U.S.A (ECLAC, 2007), an ideal government with two distinct but interdependent governments, which operate by cooperation and collaboration through consultation; require that its systems should be interoperable in nature so that there can be seamless flow of information that can be required for decision making.

According to (Kangu, 2011), the role of communication and information remains a critical component of generating information needed for decision making processes, analysis and interpretation of core issues of governance. To realize such intents, we propose a five layer e-government architecture as shown in figure: 2.6. This architecture attempts to build a need-based and innovative action to thrive in the culture of interoperability, where both governments will be enabled to create, access, utilize and share information and knowledge they need for their own wealth creation and development.

The Kenyan E-government architecture takes a structructed approach, which is rated the best according to (Flak et al, 2009). This is because interoperability and architecture are intertwined in the execution of government services, thus care and attention must be given to each and every detail of the architecture, bearing in mind that e-government is about a set of organizations including; many autonomous agencies having various levels of readiness and different circumstances, governed by a democratic system and embedded in a certain institutional situation.

ICT provide greater accessibility, facilitate wider muilt communication and dissemination of information, enable better knowledge management and information

sharing, increase government productivity once the processes have been transformed. In order to achieve this; the Kenyan E-government architecture aims at overcoming the observed limitations in e-governmet such as;

- Exchange of information and services being fragmented and complex, plagued by technical and organizational problems.
- The habit of reinforcing of old barries that make government decision making difficult rathe than transforming them through proper use of ICT as an enabler.
- Concentration to technical interoperability that is easy to achieve at the expense of organizational and semantic interoperability.
- Backend systems not being interoperable in nature due to legacy sytems and new systems that are sectored with specific solution, to only specific agencies

2.3.1 The County And National E-Government Architecture Building Principles

The Architecture is based on the following principles;

1. Establishment of good governance and organizational structures.
2. Interoperability being the state of the art for successful e-government.
3. Development of administrative environment that enables better and equal access to information and service, promote transparency and accountability.
4. Capacity building for enabling creation and customization of services and applications due to increased diversity and choices of information, sources, products and services.
5. Creation and fostering of enabling environments for the success of ICT initiatives.
6. Consistent processes with clear collaboration to the other service consumers.
7. Capacity building of stable systems that are efficient and easy to maintain guided by use of standard technology.

2.3.2 The County And National E-Government Architecture Structure;

The county and national e-government architecture marks a shift from the conventional hard-coding way of implementing business processes, which led to inflexible systems that were hard to modify and maintain, to a new five layered architecture for e-government as shown in Figure2.6**,** in which the process of transforming government processes is conceptualized in an integrated and structured approach.

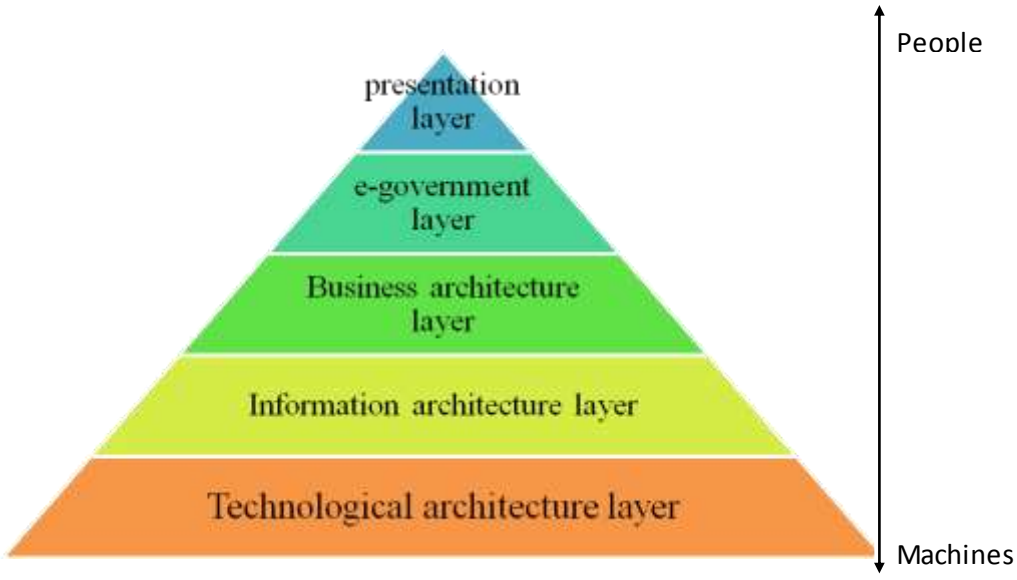

Figure: 2.6. Basic representation of the Kenyan E-government Architecture

The pyramidal representation of the architecture Figure2.6, describes the structural relationship of the layers, where lower levels comprise the material of higher levels and it's integrated in nature. Typically, e-government is influenced by new and able ICT technologies that can act as an enabler in the re-engineering of government business processes and sustain an accountable and transparent government. The kind of infrastructures or technology required is informed by the kind of government information available and how it is accessible to relevant agencies on time. Business process redesign depends on the information from the information architecture to depict

a clear picture as-is and to be. Successful Business redesign will lead to an integrated e-government with fully interoperable systems, which can be accessed by users, stakeholders and organization in the government.

In simple terms one can conclude from the figure: 2.6 that, e-government is influenced by technology, business architecture in terms of information architecture layer, e-government layer in terms of business architecture layer and finally presentation layer by e-government layer. According to the Kenyan E-government architecture, before reaching at the apex of the pyramid, the information must have been processed in such a way that the information has relevance for specific purpose or context and is therefore meaningful, valuable, useful and relevant, as shown in Figure2.7

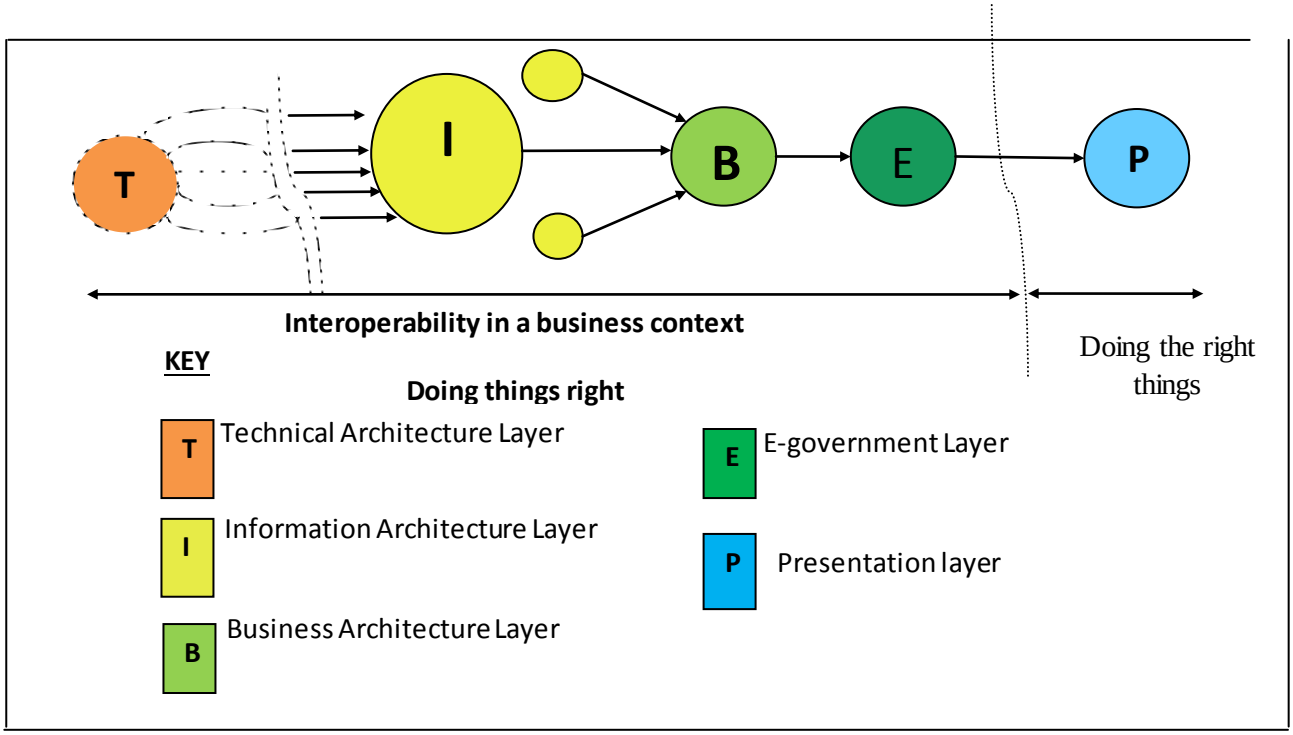

Figure: 2.7, Functional representation of e-government architecture.

The dotted link between the technology architecture layer and the information architecture layer shows the instability of e-government influenced by ICT capabilities and its availability (technical approach) rather than data that are the only stable elements. The solid links between the, information architecture layer, business architecture layer, e-government layer, and presentation layer shows the necessity of each and every action taking place if integration and interoperability is to be achieved in interoperable systems.

According to the Figure2.7; before service could be reached through channel and and pervasive technology, the information foundation needs to first be consolidated for the purpose of building up a master data as a single source of truth that is established through, data identification, consolidation, cleansing and validation process that information can follow both a global-local structure and principles such as a single point data manipulation and channel communication elimination. This means that the information architecture layer, business architecture layer and e-government layer shown figure: 2.7**,** plays a very important role in the alignment of business processes to the appropriate technology, and defining the best means of access needed information.

Figure: 2.8, shows the overall structure of figure: 2.6, describing its functions in detail at each and every layer

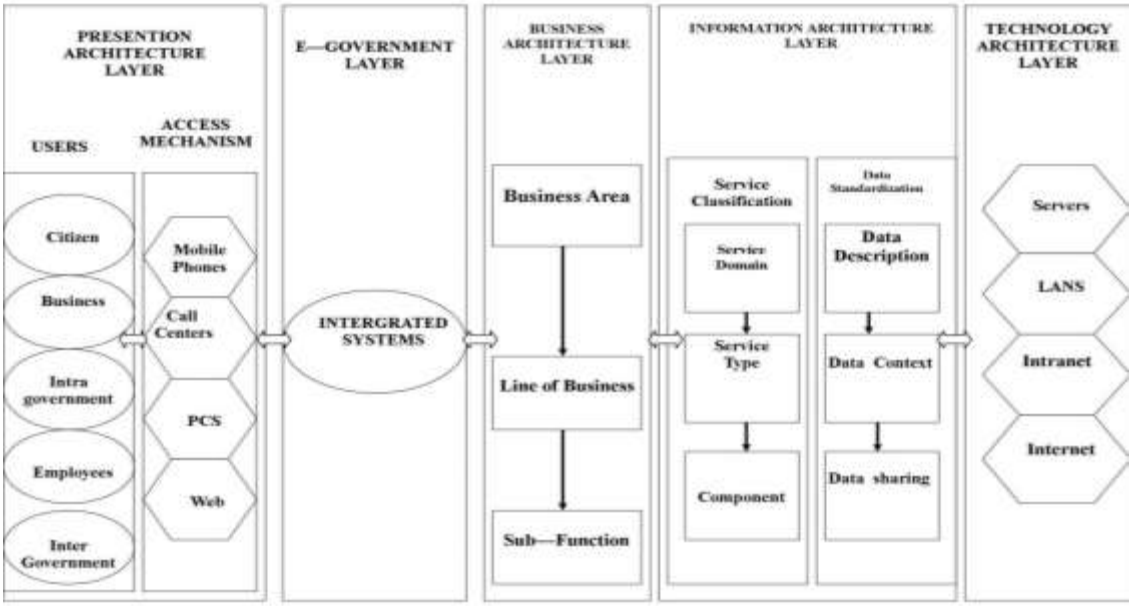

Figure 2.8: Overall E-government architecture structure with its functionalities

Presentation layer:

The presentation layer identifies and describes the system users, who require access to government information at different capacities, and the channels through which information can be accessed. During system development, one is required to explicitly identify the government user, the system is intended to serve and also the means through which this information is to be accessed, so that the system can be tailored to meet these requirements.

It manages the user's interface with the system. When an e-governance project fails to identify the stakeholders correctly, it puts itself in the path of failure. One such project in India was aimed at creating management information system; it failed as it lacked user involvement right from the beginning, after years of existence it was prematurely terminated. If a project is to be successful, different stakeholders need to be identified in

the beginning, involved in the initial stages, and kept involved throughout development and implementation (Kumar & Vijaykumar, 2011).

E-government layer:

E-government public services utilize very specialized applications that are only available to certain agencies and not all agencies participating in the consortium. To ensure interoperability some countries have implemented XML schemas with web service interfaces e.g. Danish e-government, but this creates a barrier for inter-organization services between public agencies of different domains outside that boundary. The lack of semantics causes data exchange to be impossible. Semantic relatedness scores (SRS) and semantic web-rule language (SWRL) is to be used as a semantic mediation approach to provide the semantic necessary for resolving schema heterogeneity.

The main goal of e-government layer is to achieve a government that;

- does not ask for information it already has
- Is focused on better services towards counties and national governments
- Will not allow its facilities to be misused
- Is well informed
- Is efficiently organized and in control of its internal affairs.

According to the Kenyan E-government architecture; with databases only in place semantic interoperability could not be realized due to the coherence between semantics within a more decentralized approach. This has been the greatest hindrance on the initial e-government initiatives; since public agencies develop their own systems independently from each other, and the granularity of how information is expressed differ greatly thus making seamless information flow a nightmare. Semantic interoperability should be at the core on all levels between databases and documents, processes and life events as can

be seen in the subsequent layers. Therefore, e-government layer is the culmination of the one source point of truth between the integrated national and county services.

Business architecture layer:

The first-step toward a successful e-governance initiative is process re-engineering. This aims to simplify the existing processes and procedures, reduce the manual touch points and make the entire transaction cycle friendly. For e-governance to succeed, it is imperative that processes are simplified and understood by all stakeholders.

The business layer provides a functional rather than organizational view of the government's lines of business; including its internal operations and services for citizens, independent of the agencies, bureaus and offices performing them.

The business layer describes the devolved government around common business, thus promotes agency collaboration and serves as the underlying foundation for government process redesign and e-government strategies. Each business function is analyzed for potential for streamlining in order to facilitate optimization via collaboration and sharing.

The whole government agrees on which domains there are to uniquely identifiable and how they are going to identify them. Both governments need to decide to which domain their process relates. Also, analysis of processes that might be affected or need to be integrated with legacy systems for efficient delivery of services, thus in this layer it not only touches organizational interoperability but also semantic and more insight to technical interoperability due since legacy systems are to be a factor of consideration for effective integration.

Information architecture layer

This layer can be divided into two;

Service classification sub-layer;

The service classification sub-layer classifies service components according to how they support business and performance objectives e.g ERPS,CRMs. It serves to identify and classify horizontal and vertical service components supporting government and their IT investments and assets.

It is organized across horizontal service areas independent of the business functions, providing a leverage able foundation for reuse of applications, application capabilities and business services.

Data standardization sub-layer;

The data standardization sub-layer is flexible and standard based to enable information sharing and reuse across the government via the standard description and discovery of common data and the promotion of uniform data management practices.

It provides a standard means by which data may be described, categorized and shared. These are reflected within each of the three standardized areas;

a) Data descriptions;

Data descriptions, provides a means to uniformly describe data, thereby supporting its discovery and sharing.

Data context;

Data facilitates discovery of data through an approach to the categorization of data according to taxonomies.

b) Data sharing;

Data sharing, supports the access and exchange of data; where access consists of ad hoc requests (such as a query of data access asset) and exchange consists of fixed, recurring transactions between parties, enabled by capabilities provided by both the data context and data description standardization areas.

It provides guidance for implementing repeatable processes to enable data sharing in accordance with government-wide agreements encompassing national, county as well as other public and private non-governmental institutions. The intent is to mature, advance and sustains their data agreements in and iterative manner.

Technology architecture layer:

The technology architecture layer categorizes the standards and technologies that support and enable the delivery of service components and capabilities. It also unifies existing agency technologies and e-government guidance by providing a foundation to advance the reuse and standardization of technology and service components from a government wide perspective

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design,

Exploratory research;

The research involves a broad literature review from archival records, documents and journals to gather information on e-government and get an insight to e-government architecture and how interoperability can be achieved through architecture. The relevant materials were accessed by subscribing to online electronic databases such as the one provided through collaboration of JKUAT and the Emerald Group publishing Ltd.(see Figure3.1.), enabling access to current journals and publications in the fields for instance; Management, library and information science, Engineering and computer science.

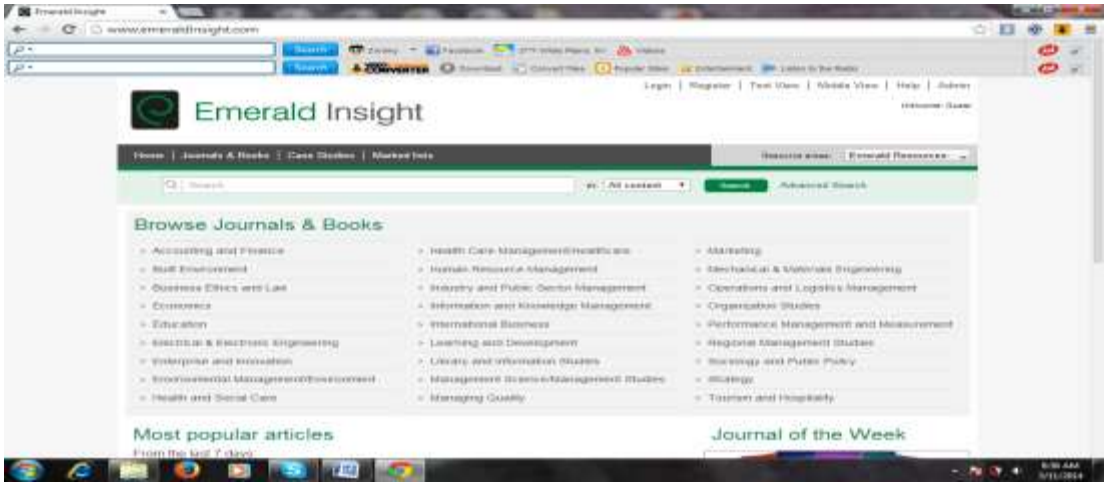

Figure: 3.1. Emeralds Group publishing ltd.

3.2 Methods Of Data Collection

Data

Secondary data was collected from secondary sources such as the Emeralds group publishing. This data was used to understand and critic e-government interoperability, processes of achieving it and identify loop holes within the processes. The data in turn was used to analyze the possible Kenya e-government interoperability strategy and design the proposed e-government architecture strategy of achieving interoperability, conceptualized in figure 2.6, Figure2.7 and Figure2.8 respectively.

Case analyses

We adopted a qualitative case study and benchmarking as a tool for case analysis whereby, we identified one or more e-government architectures that would support interoperability between the two levels of government; county and national for a devolved government system. The architectures identified were analyzed based on their parameters and loop holes in interoperability in countries where they have been implemented. This formed a basis for source of ideas for improving and developing e-government architecture for Kenya that can fully support interoperability. A view is the representation of a whole architecture/system from the perspective of related set of concerns. So, in order to depict appropriate architectures to improve and benchmark for Kenyan e-government architecture the following views were put into consideration; organization, process, services, technology and infrastructure, data/information, and security and compliance, and most importantly interoperability.

3.3 Processing And Analysis

For the purpose of processing and analysis, a database application was developed based on the e-government architecture developed. The database application put into account

every detail in each and every layer of the proposed architecture parameters shown in Figure2.8. this was essential for alignment of processes with various lines of business.

Depending on the layer of the system, system modelling diagrams were used to critically analyze the database application developed for clarity to meet the set parameters of the e-government architecture at that particular layer.

From Figure2.8, at the information architecture layer a conceptual data model in Figure4.1 was used to establish the overall scope of what is to be included within the model set. It defined master reference data entities that are commonly used by the two levels of government. It described information needs or the type of information that is to be stored in a database.

At the business architecture layer, the business process diagram Figure 4.2, Figure 4.3 use case diagram and Figure 3.2 activity diagrams, were used in process redesign and identify fully the functional requirements of the system.

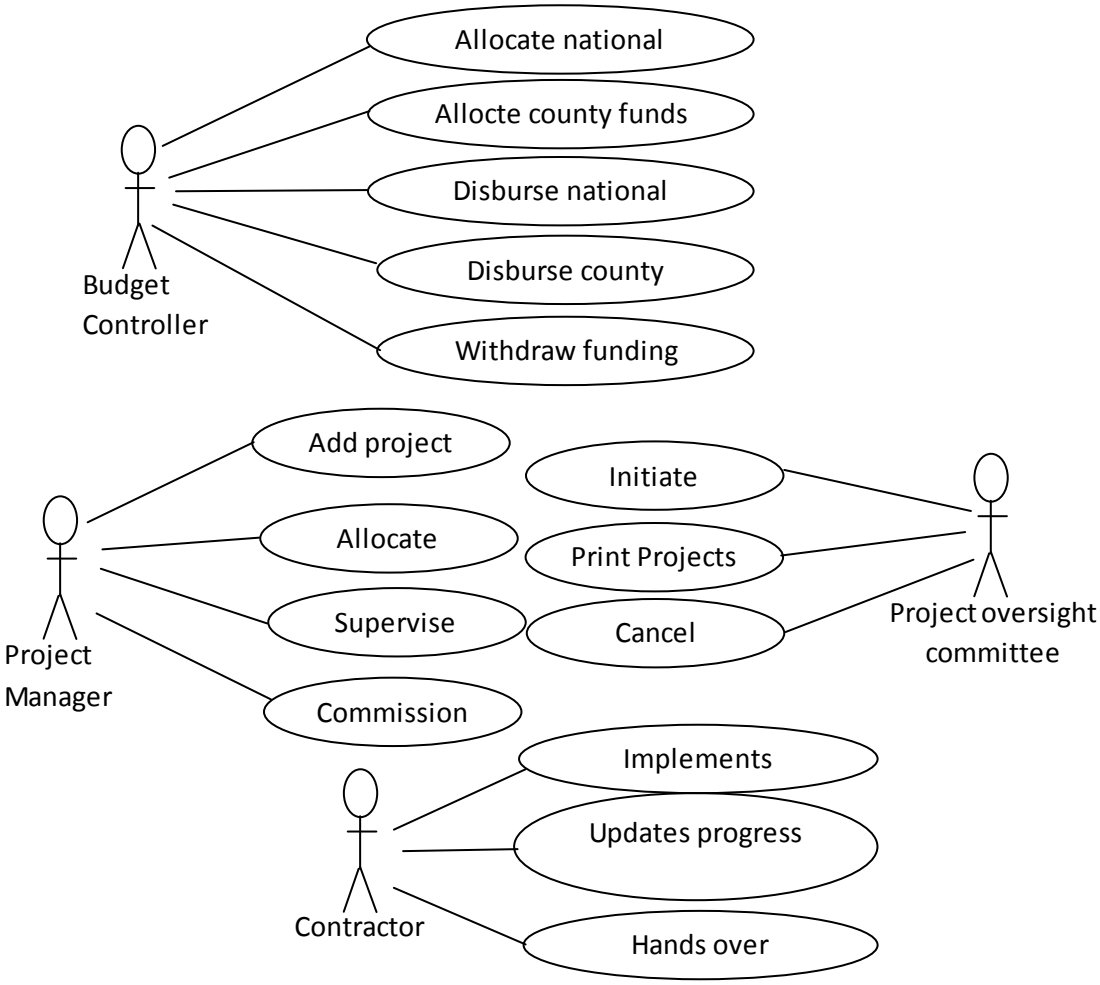

Figure 3.2 Software use Case diagram

3.4 System Validation

The new e-govern project management system was subjected to the prospective government users from both county and national government for testing and validation.

3.4.1 Target population

Target population refers to the total number of interest to the researcher. The system validation, was conducted at Nairobi county as a representation of the forty seven counties and national government and the population was all the system users who are of interest to the system.

Table 3.1 Target population

Category	Target population	Percentage
County Government	10	50
National Government	10	50
Total	20	100

3.4.2 Sample design

A sample is part of the target that is procedurally selected to represent the population. The researcher used purposive or judgmental sampling since this method would be more accurate to select the core systems users for system validation. The table below shows the sampling frame.

Table 3.2 sample size

Category	Population	Sample Size	Percentage
County Government	10	5	50
National Government	10	5	50
Total	20	10	100

3.4.3 Data collection, instruments and procedures

Data was collected using a questionnaire from the 10 prospective system users, comprising 5 from the national government and five from the county government. The system users were subjected to the new e-govern project management system to interact and have system user experience. Each system user filled a validity and user satisfaction questionnaire depending on the user experience with the new system.

The validation and user satisfaction questionnaire comprised a set thirteen questions which were used to test specific system qualities. The first set was labeled information quality and taps the validity of information provided by the system and the relevance of this information to both government needs. The second set; system usefulness is related to the gains in terms of efficiency, effectiveness, transparency and accountability resulting from its usage at county and national level.

The third set is system usage characteristics; specify the ease use of the system to accomplish a certain task. Last but not least is the overall satisfaction; this is the satisfaction of the government on what the system can accomplish once implemented. Five set of questions (items) were used to measure information quality, three in system quality, three for system usage characteristics and two for overall user satisfaction. The items employed a five-point Likert response format with strongly disagree and strongly agree response scale as shown in figure 5.1.

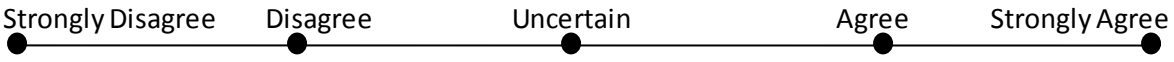

Figure 3.3: Five-point

3.4.5 System Validation Data Analysis procedure

This was a process that started immediately after data collection and ended at the point of interpretation of the processed results. Data collected was tabulated and was used to calculate the degree of user satisfaction of the e-govern project management system using the Cronbach's Alpha formula. The researcher calculated Cronbach's alpha for a set of 13 questions with a Likert scale score between 1 to 5 based on the 10 person sample using the formula, which was applied on Table 5.2 data.

$$Given\ a\ variable\ X_1 \dots\dots\dots\dots\dots X_K \quad and\ X_0 = \sum_j^{\kappa} = 1_k^x\ Cronbach's\ alpha\ is$$

$$\frac{k}{k-1}\left(\frac{\sum_{i\neq j}^{k} cov(x_i, x_j)}{var(x_0)}\right) = \frac{k}{k-1}\left(1 - \frac{\sum_{j=1}^{k} var(x_j)}{var(x_0)}\right)$$

$$where\ k = total\ number\ of\ measured\ values\ x_j = true\ values$$

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

The purpose of the study was to establish the use of e-government architecture as a means of addressing weak interoperability issues in e-government, a case study county and national government of Kenya. E-govern project management database software application was developed to illustrate how interoperability can be achieved based on the developed architecture.

E-government has many autonomous agencies that have various levels of readiness and at different circumstances. Governed by a democratic system and embedded in a certain institutional situation. From this definition we established that the devolved government of Kenya has so many agencies that need to be coordinated and related both in the county and national government to ensure smooth governance. The constitution of Kenya 2010 is the democratic system that governs the devolved government. Different institutions have been set up to ensure efficiency and effectiveness of how the government carries out its duties. This called for e-government implementation with a focus on the public values that is to ensure collaboration and coordination between the county and national government. Also, we developed an architecture that does not limit its ability to respond to changing conditions.

An integrated government focused on development of cohesive services that provide cross-government data integration and seamless transactions. For interoperability to be achieved a process of building organizational infrastructures that enable innovation action was designed and that is the architecture. We discovered that to achieve an interoperable government, integration of government information and processes was essential. Information and the kind of processes that are being carried out by certain

government institution based on the democratic system are very essential in the integration process in order to achieve interoperability. From the literature reviewed showed that many countries have not been able to make a mark as e-government is concern, to shade some light on the same Canada has remained at a virtual standstill since 2005 after offering over 130 most important government services electronically. Also out of 150 Indonesian electronic service deliveries only 6 were good the rest were very poor. The high failure rate was due to reinforcement of existing process rather than adhering to process redesign that can enable development of sectored projects that transforms the way governments carry out their businesses.

The architecture stated clearly how the system should be organized, its components and their relationship. It was used to identify strategic opportunities from various lines of business and business information, software applications and technology investment. To illustrate this element based on the devolved architecture, the information architecture layer is very key in identifying the lines of business, then get to know what kind of processes that are involved and how same information flows within different agencies, once all key information has been identified software can be developed to implement the new line of business identified. This will eliminate the issue of misalignment between business process and IT. Last but not least a technology that can enable and support the implementation must be in place.

The architecture developed improves clarity on application resilience requirements to achieve robust solution designs. The architecture ensures focus on key business functions that span multiple agencies in-order to identify inter-agency synergies and opportunities that promote interoperability. This was achieved by the emphasis of information layer that shows that stable e-governance can be based only on stable elements and that is information.

We discovered that failure to foresee implementation challenges can be costly to the government has can be deduced from the following information; e-government project on smart cards cost 698 million ponds to the British government, national IT Program overran 450% approximately 17 billion, Libra courts management system overran 237% to 341 million ponds as shown in Figure4.1. The sole cause of these overran were development of software specific to processes carried out in specific agency without the need to redesign processes that span multiple agencies. To address this issue the developed architecture explicitly provides away to define and evaluate all the possible processes and redesign mechanism, in the information architecture layer and business architecture layer to thrive in culture of interoperability.

Table 3.3 E-government project overran

E-government project	**Project overran**	**Overran percentage approximately**
E-government project on smart cards	698 million	356%
National IT program	17 billion	450%
Libra Courts management system	341 million	237%

The architecture focused to represent the business objective, producing an added value of delivering a better and more reliable service to county and national government. From Figure2.7 it is quite clear that technology should not be the driver of e-service delivery but rather an enabler of those services. The database application that was developed to illustrate how architecture can be used to thrive in the culture of interoperability was based on Figure 2.8 that shows the overall structure with its functionalities.

4.2 Software Implementation Based On The Architecture

In order to understand how government can achieve interoperability, software was developed which took account details of every layer of the architecture. The software was e-service delivery of how national and count government manages their finances for county and national project implementation.

I. Information Architecture Layer

The data standardization sub-layer is flexible and standard based to enable information sharing and reuse across the government via the standard description and discovery of common data and the promotion of uniform data management practices.

It provided a standard means by which data was described, categorized and shared. This layer enabled government to determine what it wants from the business and develop strategic processes, analysis and prioritization. The processes was organized around outcomes and not tasks, and subsumed information-processing work into the real work that produces the information, while linking parallel activities instead of integrating their results as shown in the figure below.

The criteria used for selecting the processes include;

- Broken process
- Bottleneck and delays
- Cross-functional or cross-organizational units

The perceived improvement opportunities include;

- Quality
- Time
- Cost

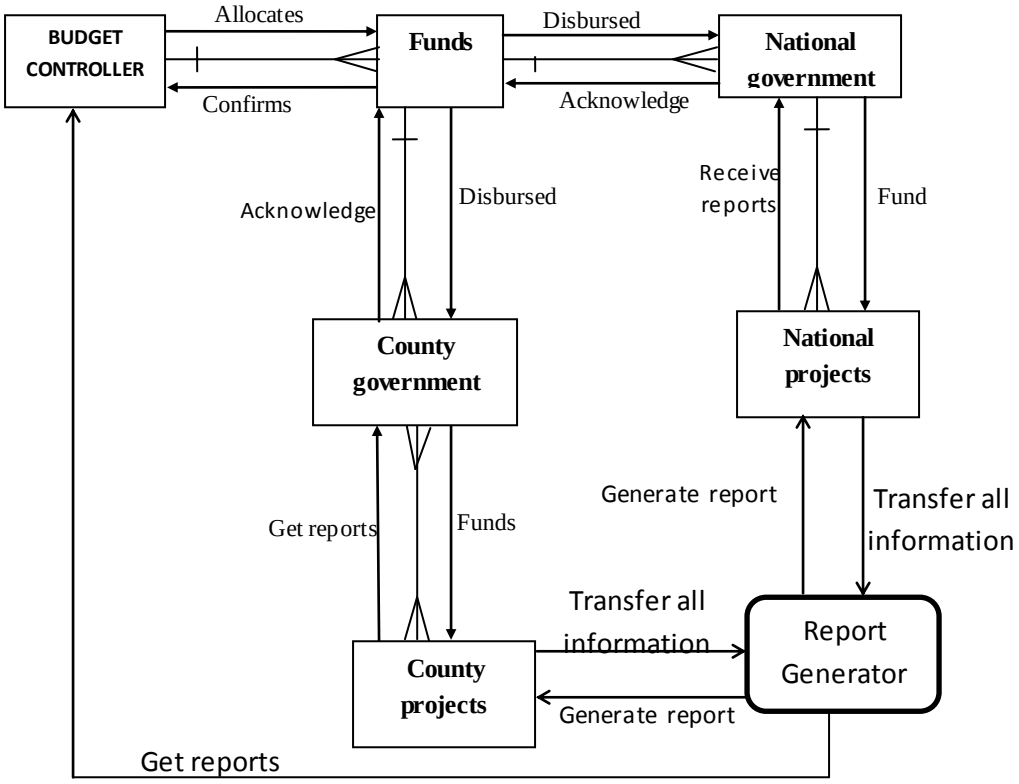

Figure 4.2 Process analysis and prioritization

From figure 4.2, the budget controller implements the percentage of funds that are allocated to national and county governments respectively, for the purpose of executing projects which at the end of the year needs to generate reports how funds were utilized. The national government sponsors projects, of which it requires a report how funds were utilized and the progress/status of the projects. The county government implements projects whose funds need to be accounted, how they were utilized the status and progress of these projects. This will help the budget controller to come up with accurate reports on fund management. Enable county governments to evaluate what kinds of projects have been implemented and open up new opportunities for new projects, aid in the management and utilization of funds. Ensure successful implementation of national and county projects.

Service classification

There are different types of service domains namely e-administration, e-service, and e-democracy. The e-administration domain is aimed at enabling the government function more efficiently and effectively in terms of administration. E-service domain enables government to offer its services online; it makes the government more readily accessible by citizens and other organizations. The e-democracy domain enables the government to carry out national voting when making democratic decisions.

The implemented software enables the county and national government to execute their duties more efficiently and effectively. This is accomplished by both governments accessing information required for decision making easily. From the explanations our service domain is e-administration because it enables the county and national government to carry out their duties more effectively by providing seamless information that promotes coordination and collaboration.

II. Business architecture layer

In the Business architecture layer, the business processes are redesigned according to their business areas and lines of business, all the sub-functions to ensure proper integration and promote interoperability. The developed software identified finance as the business area, it was important to redesign all the processes that pertain to fund allocation to both county and national government. The line of business is how both the national government and county utilize the allocated funds to implement projects at any fiscal year with regard to specific budget. In this layer business process diagram was used to depict the process flow, identify participants involved and message exchange between participants.

The major goal of using business process diagram in this layer is to show how different participants collaborate together to accomplish a business objective. The business process model were used to model the work flow to understand how participants work together and know what functions they need the system to provide in order to function more efficiently and effectively. The figure 4.3 shows workflow of the business processes.

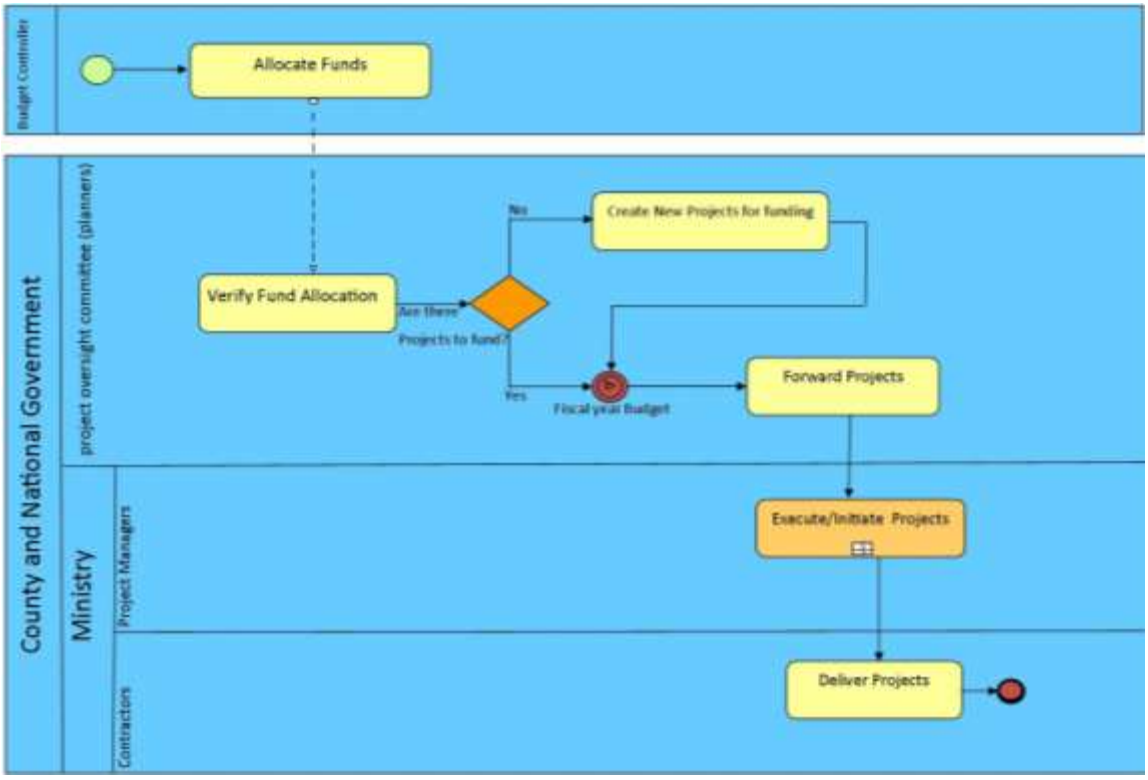

Figure 4.3 Business Process workflow

Additionally use case diagrams were used to specify the context of the system and capture its requirements. This helped to align the narrative with the details of existing process and reveal process alternatives making the business process to be understood well, and also identify system users. This can be depicted from the figure 3.2 in chapter three

The activity diagrams were used to illustrate what happens in a workflow, what activities can be done in parallel, and indicate whether there are alternative paths through the workflow. They were used to visualize the flow of a business use case. The activity states represented performance of a step within the workflow. Completion transition is triggered by completion of the activity that the activity state represents, finally the synchronization bars shows parallel subflows as shown in figure 4.4 below.

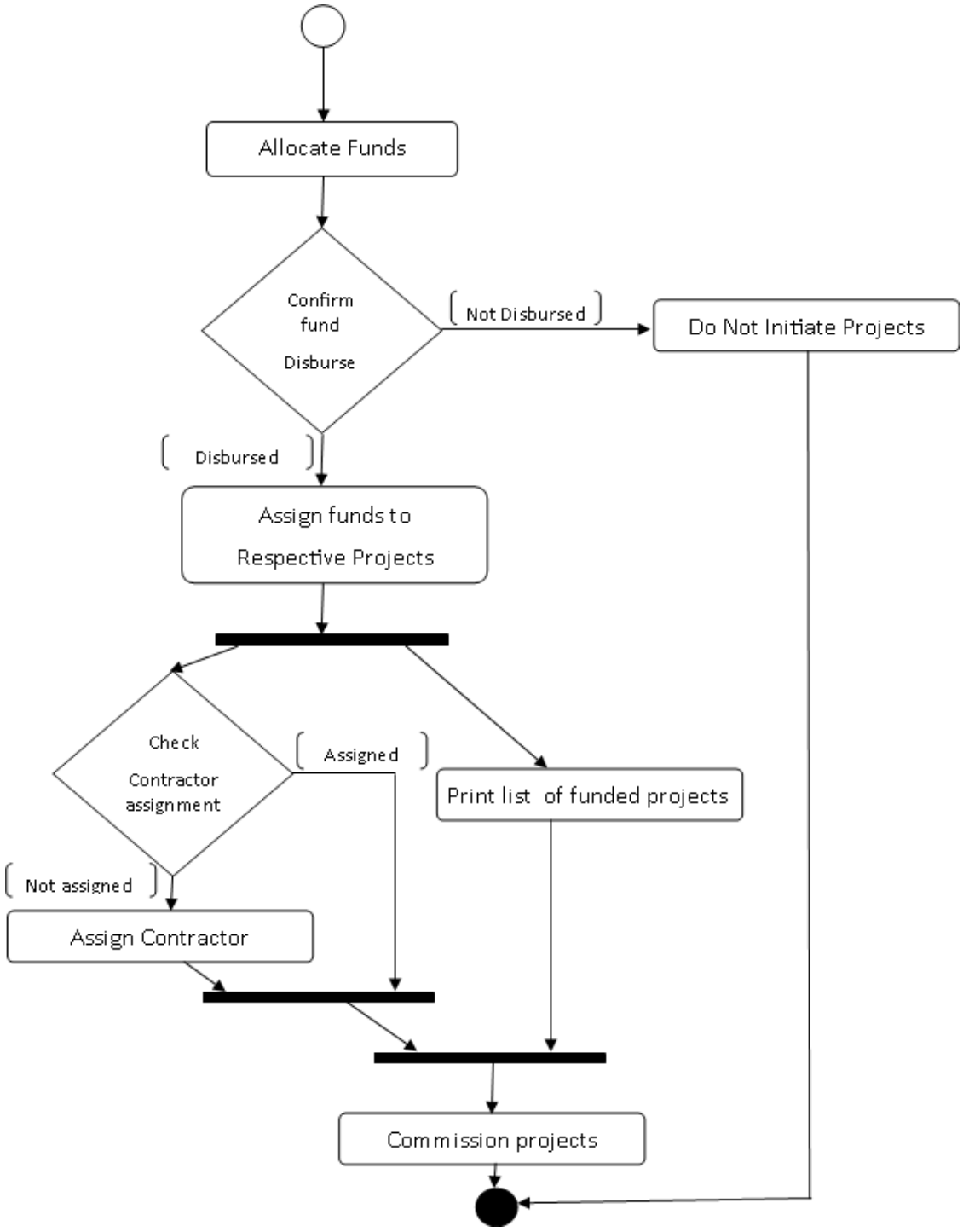

Figure 4.4 software activity diagram

E-government Architecture Layer

The e-government layer is the culmination of the two layers where the derivative of the information and business layer is achieved. The functional software is delivered and can perform the set objectives of any sectored project. The following are screen shots of the developed software.

The authentication screen, like any other systems only authentic users can access the systems

Figure 4.5 login screen snapshot.

Software main interface

Figure 4.6: software's main interface snapshot.

Fund Allocation

Figure 4.7: Fund allocation form snapshot.

Counties

Figure 4.8 county form snapshot

Ministries

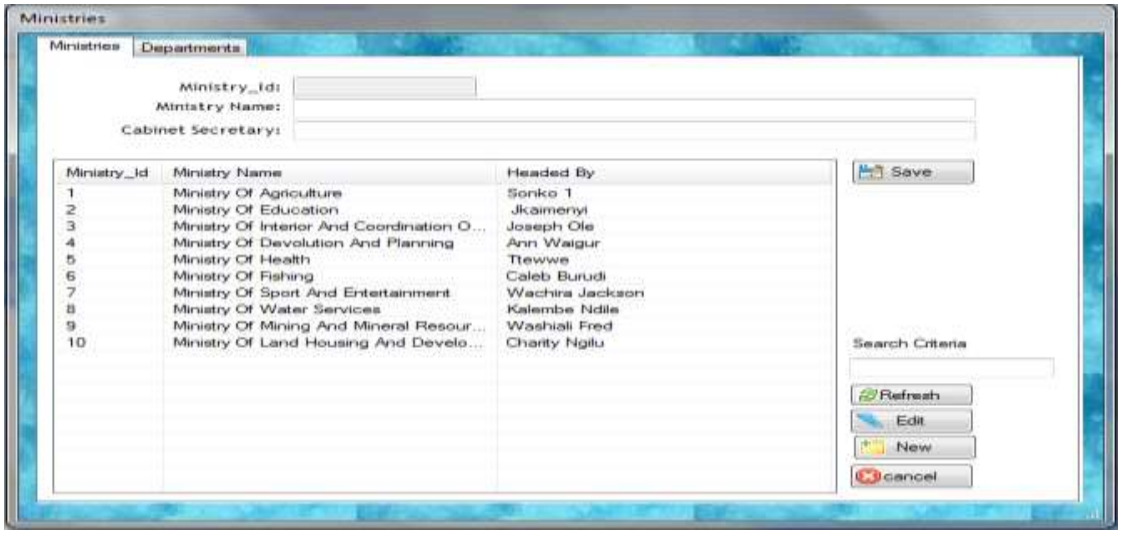

Figure 4.9 Ministry form snapshot

Contractors

Figure 4.10: contractors form snapshot Projects

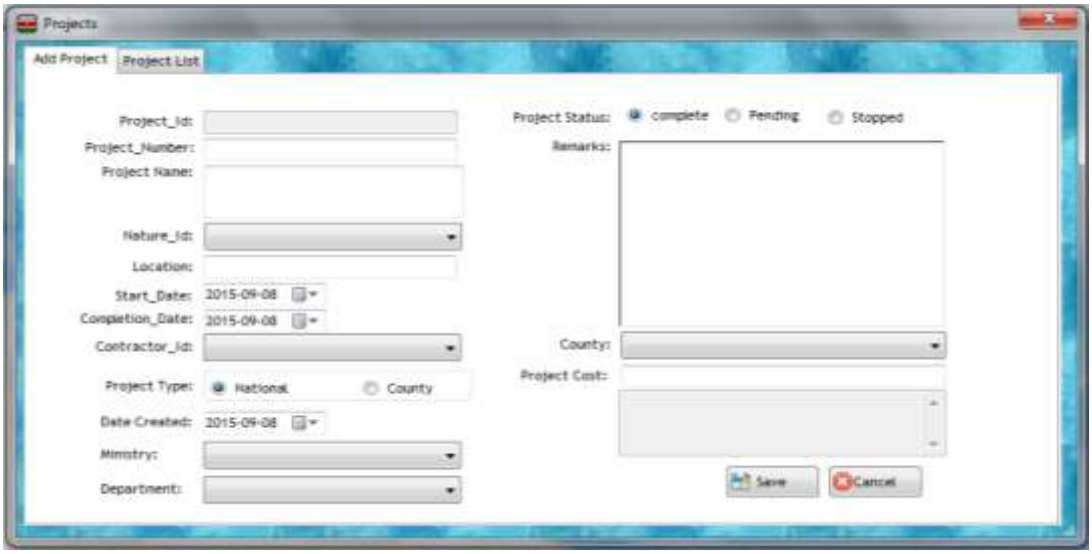

Figure 4.11: projects management form snapshot

The main goal of e-government layer is to achieve a government that;

- does not ask for information it already has
- Is focused on better services towards counties and national governments
- Will not allow its facilities to be misused
- Is well informed
- Is efficiently organized and in control of its internal affairs.

In order to achieve all these, the system developed is a distributed system in nature. It need only to be reconfigured so that it can be accessed from a central place without the need to install each and every machine. This is achieved by changing the server by inputting the IP address of the router connecting the server and other nodes, and changing the port to the current port in the .exe file. The figure below highlights how to reconfigure the software to ensure seamless flow of information.

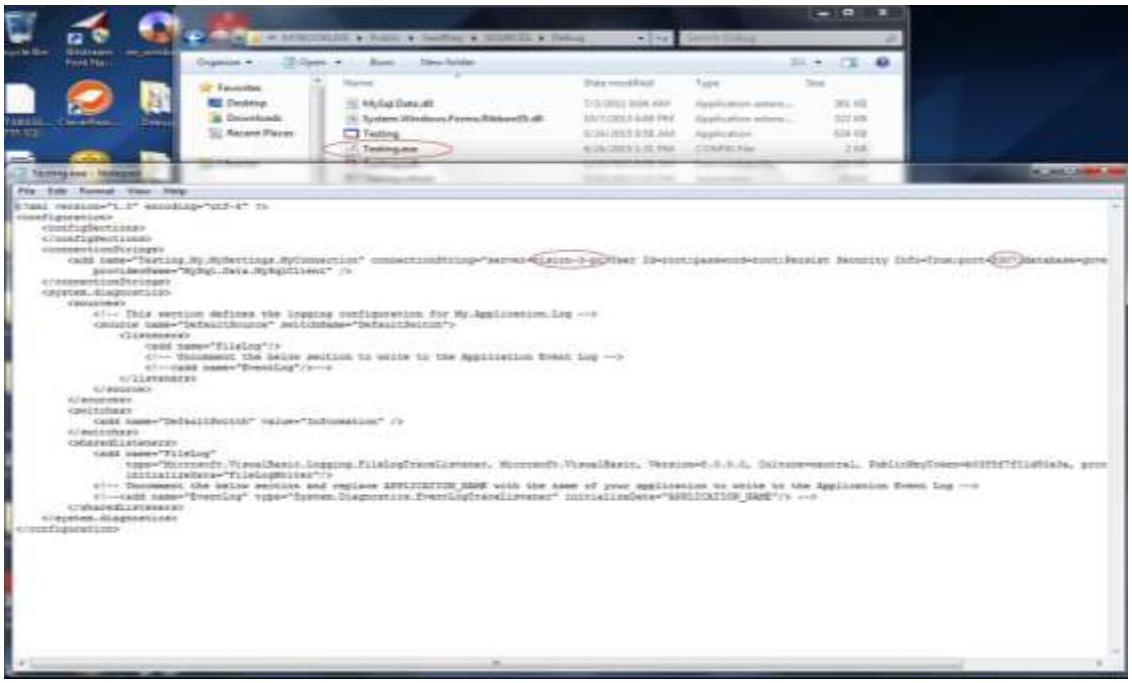

Figure4.12: Software reconfiguration form snapshot.

III. Presentation Architecture Layer

At the presentation layer, we define the mechanism in which our software can be accessed using different hardware components and the specific users of the software. For our case the e-service delivery will be accessed through a pc because the developed software is a desktop application. The major users of the software are; project managers, contractors and budget controller. In order to ensure that each and every user access only required information specific to him or her, the software enable creation of users with specific designation and assign them user rights. Whenever unauthorized user tries to access certain information access is denied.

The following show how to set user rights and authorization

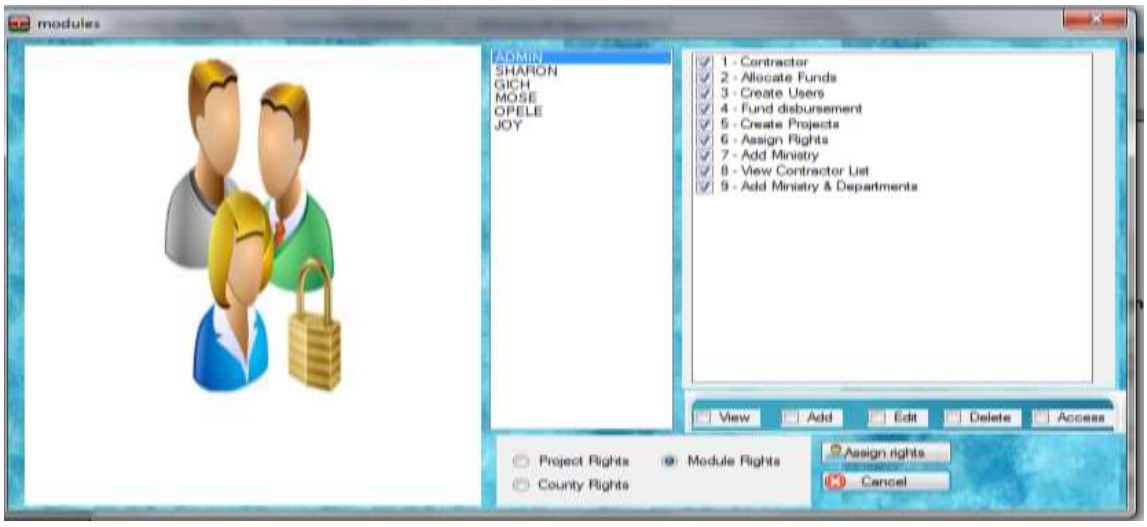

Figure 4.13: User rights assignment form snapshot

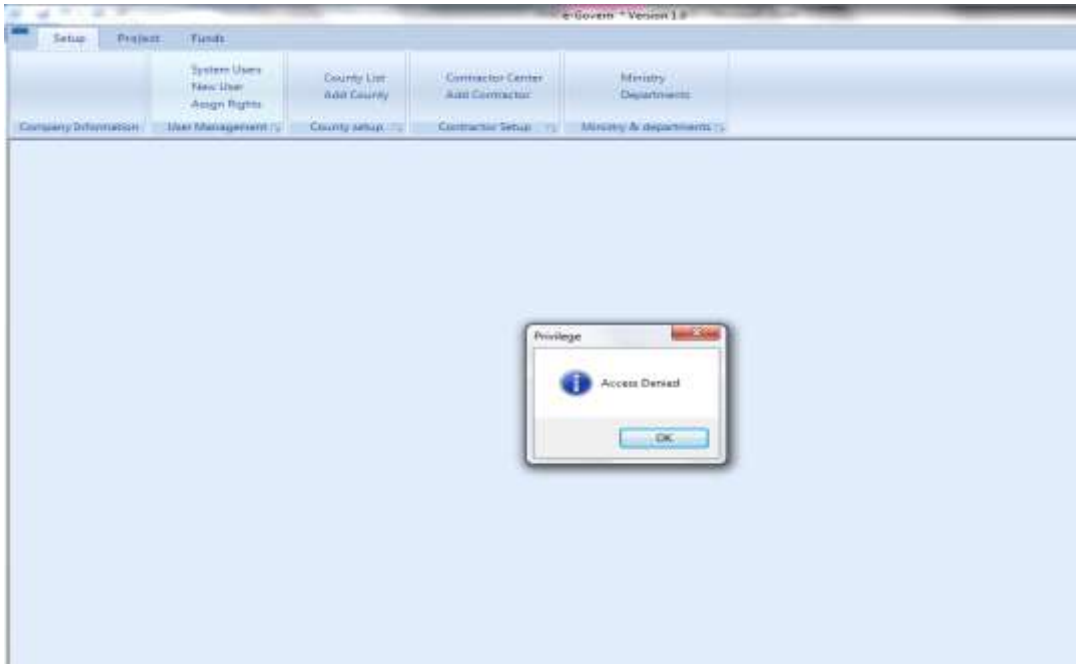

Figure 4.14: Authentication of users snapshot

IV. Technology Architecture Layer

At the technology layer we defined the best technologies that will enable the software work more efficiently and effectively. For the purpose of storing up processed data, database server was required; also internet was very essential to enable access and communication more reliable and available.

Discussion

Weak interoperability between the national and county government can be successfully addressed by use of e-government architecture. From the technology architecture layer, well and able technology should be used as an enabler of interoperability by integrating distributed institutions and ease access of systems but not a means of addressing weak interoperability as shown in Figure2.7. Sophisticated technology in place is a trigger of innovation and process redesign on how the two levels of government work more efficiently and effectively through easy access of quality information for decision making in time.

Organizational interoperability between the two levels of government can be achieved by in-depth understanding of the kind of information needed for consultation and cooperation at any given time to execute a common objective. The information architecture layer of the proposed e-government architecture enable identification of common data that span multiple agencies but necessary for seamless flow of information need for decision making. All the common information to accomplish any process between county and national government is captured together with all the agencies that produce the information and the ones that require the information.

After common data has been identified, the Business architecture layer of the proposed e-government architecture, enable business redesign of all the identified processes. The as-is and to-be best practices are identified and implemented to enable interoperability.

Once all the processes have been redesigned, an application is developed to implement the to-be processes that lead to the achievement of an integrated interoperable system under the e-government architecture layer.

Best mechanism to access the application should be put into place and system users identified to prevent unauthorized user access and authentication.

CHAPTER FIVE

NEW E-GOVERN PROJECT MANAGEMENT SYSTEM VALIDATION

5.1 Introduction

The purpose of this research was to address weak interoperability between the county and national government, by developing an e-government architecture that would ensure smooth deployment of interoperable systems. Once the architecture and the new e-govern project management systems were in place that fulfilled objective three, shown in figure 4.5 to figure 4.14. This chapter validates the system to determine whether it is interoperable and if both governments can access necessary data seamlessly for decision making. Interoperability was achieved by measuring user satisfaction of system users from county and national government by analyzing the data collected and interpreting it as follows.

5.2 Presentation Of Findings

The Likert scale responses were tabulated as shown in table 5.1.

Table 5.1: Likert scale response table

	Information Quality					**System usefulness**			**System usage characteristics**			**Overall satisfaction**	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
0	4	5	3	3	4	2	3	3	3	2	3	4	3
1	5	3	4	5	4	4	4	4	4	4	5	5	4
2	4	4	4	4	5	5	5	5	5	4	4	5	5
3	5	2	2	2	3	4	4	4	4	5	4	4	4
4	4	3	4	4	4	5	2	4	4	3	2	3	3
5	4	4	2	4	4	4	5	5	4	4	5	4	4
6	3	3	4	5	5	3	5	5	5	2	4	5	5
7	4	5	5	4	5	4	4	4	4	3	5	5	4
8	5	4	4	3	4	5	4	4	4	4	4	4	5
9	4	5	5	4	5	4	5	4	5	4	4	5	5

The tabulated data from table 5.1 was used to calculate the degree of user satisfaction of the e-govern project management system using the Cronbach's Alpha formula as sighted in the methodology. The commonly accepted rule of thumb is that an alpha of 0.7 or 0.6 indicates user satisfaction or system reliability, very high degree like 0.95 indicates redundancy.

Table 5.2 Cronbach's alpha for user satisfaction.

Cronbach's Alpha														
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	**Total**
0	4	5	3	3	4	2	3	3	3	2	3	4	3	42
1	5	3	4	5	4	4	4	4	4	4	5	5	4	55
2	4	4	4	4	5	5	5	5	5	4	4	5	5	59
3	5	2	2	2	3	4	4	4	4	5	4	4	4	47
4	4	3	4	4	4	5	2	4	4	3	2	3	3	45
5	4	4	2	4	4	4	5	5	4	4	5	4	4	53
6	3	3	4	5	5	3	5	5	5	2	4	5	5	54
7	4	5	5	4	5	4	4	4	4	3	5	5	4	56
8	5	4	4	3	4	5	4	4	4	4	4	4	5	54
9	4	5	5	4	5	4	5	4	5	4	4	5	5	59
Total	42	38	37	38	43	40	41	42	42	35	40	44	42	524
Var	0.36	0.96	1.01	0.76	0.41	0.8	0.89	0.36	0.36	0.85	0.8	0.44	0.56	8.56
k	13													
Σvar	8.56													
var	30.44													
α	0.77869													

From table 5.2: after calculating Cronbach's Alpha to test system user satisfaction. The coefficient is α=0.77869 which falls under the acceptable and good system reliability when rounded off to 0.8.This shows that the system users were satisfied with the system and it can be applied between county and national government in order to achieve interoperability since both government needs were met and each government can access important data seamlessly for decision making.

The information in table 5.1 was used to summarize user response as shown in table 5.3

Table 5.3: The Extent to which the system conferred to the set analysis Items

Item Analysis	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree	Total
Information Quality	0	4	8	24	14	50
System usefulness	0	2	3	15	10	30
System usage satisfaction	0	3	4	16	7	30
Overall satisfaction	0	0	3	8	9	20

Figure 5.1, shows that higher percent of respondents were satisfied that the new e-govern project management system produced quality information by 48% agreeing and 28% strongly agreeing.

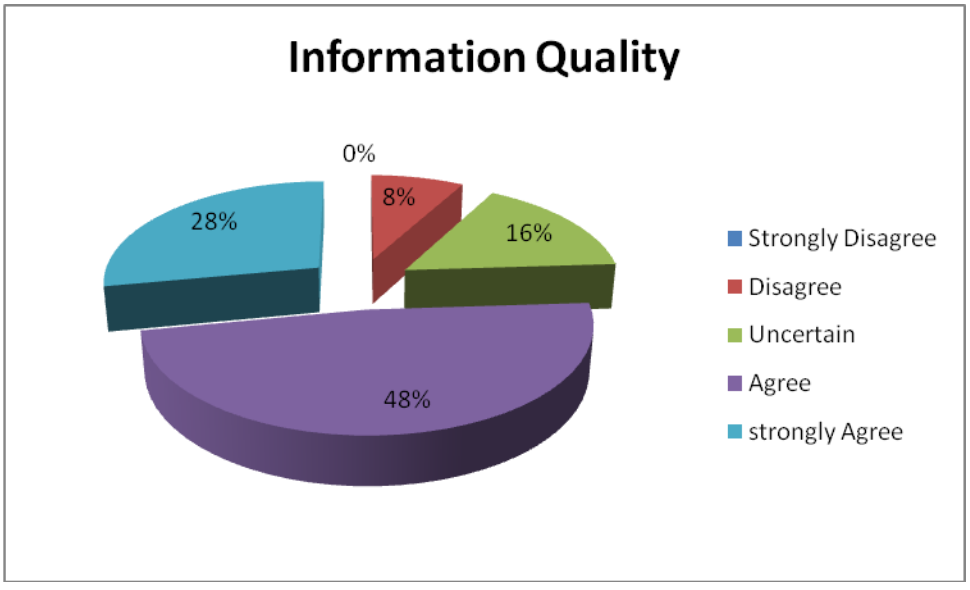

Figure 5.1: the Extent to which the system produced quality information

Figure 5.2 below shows the extent to which repodents felt that the system was useful for both levels of government that is the county and national government.

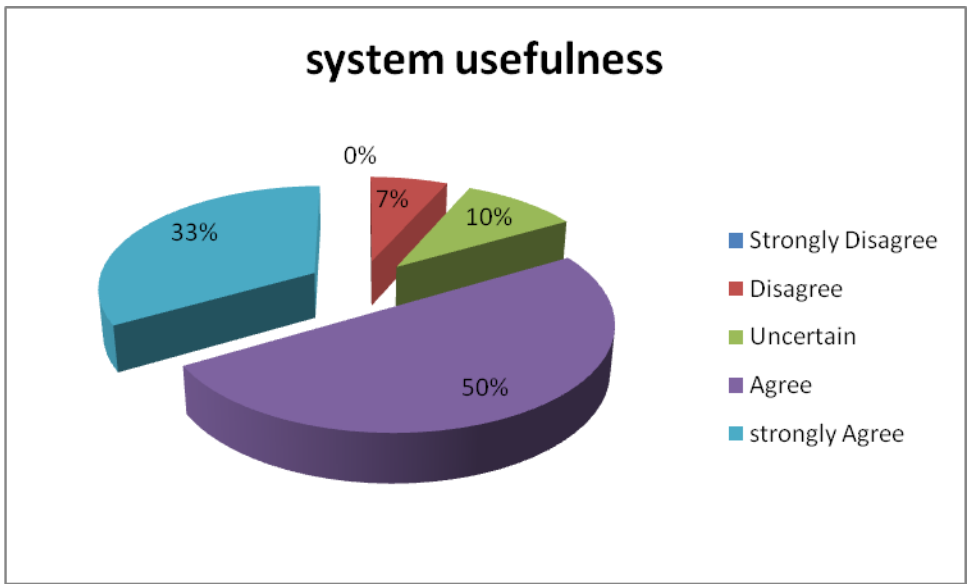

Figure 5.2: the extent of system usefulness to the two levels of government.

Figure 5.3 shows how the respondents evaluated the system for its usage characteristics

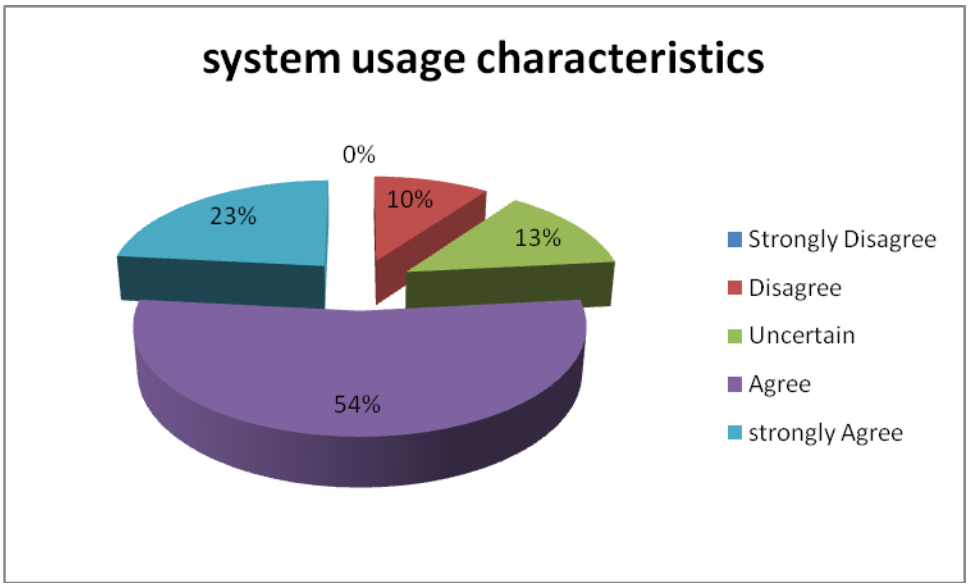

Figure 5.3: the extent of system usage characteristics were exhibited by the system

Figure 5.4 shows the overall evaluational experience with the new project management system.

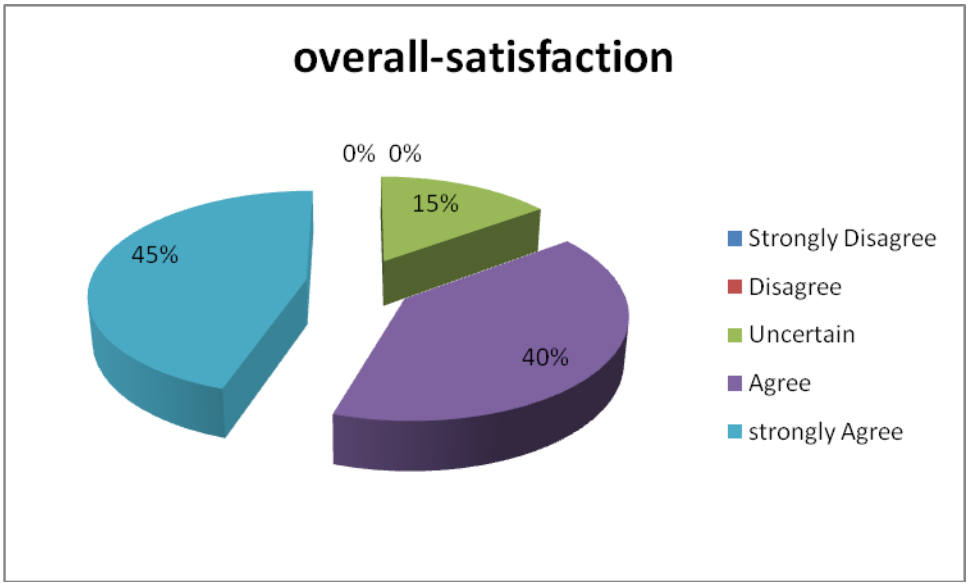

Figure 5.4: the extent of overall satisfaction with the new system

Figure5.8 shows the degree of importance of each Item exhibited from the new project management system.

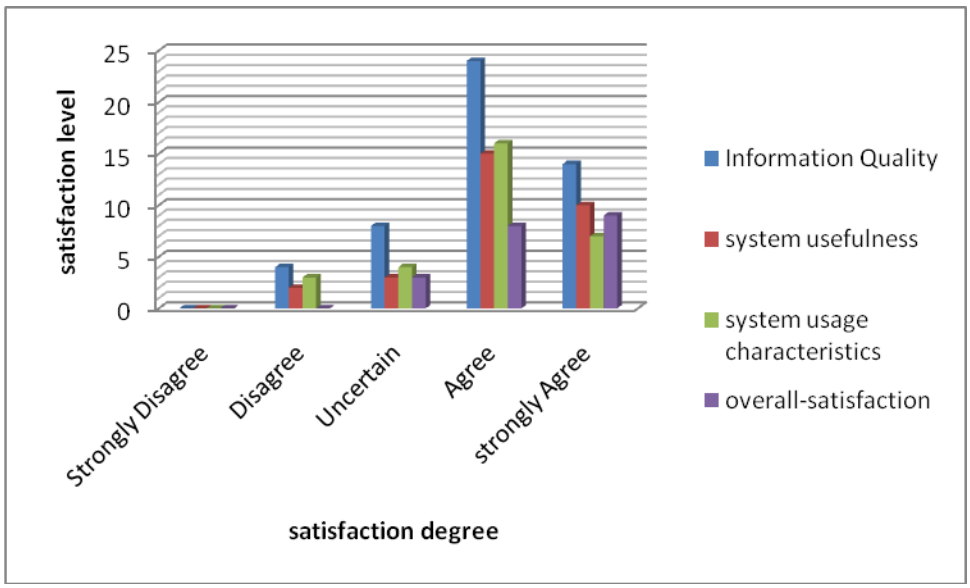

Figure 5.5: Degree of importance.

Summary

Most respodents felt that the new project management system was up to standard based on the analysis items and could be of great importance to the two levels of government; county and national government

5.3 E-Gorven Project Management System Security

With regard to system security; system users and other stakeholders want to be assured that they will keep working even in the face of disasters, accidents or deliberate attempts to interfere with or prevent their function. The three areas of information security the system as taken into account include; confidentiality where information should be available only to those who rightfully have access to it. Integrity where

information is modified only by those who are authorized to do so and availability where information is accessible to those who need it when they need it(Lampson et al, 2010).

Security Measures

E-Govern project management system as applied the following security measures;

Authentication; Authentication provides away of identifying a user, typically by having the user enter a valid username and a valid password before access is granted. The process of authentication is based on each user having a unique set of cretria for gaining access.

Authorization; following authentication, a user must gain authorization for doing certain tasks. The authorization process determines whether the user has authority to carry out certain operations. It determines what types or qualities of activities or service a user is permitted. Authorization occers within the context of authentication, once you have authenticated a user, they may be authorized for different types of access that is county, projects or system modules.

Use of Passwords; use of strong passwords is one of the secure ways of creating passwords that are both hard for others to hack and easy to remember. System recommends passwords that have a combination of numbers, uppercase letters, lowercase and if possible other chacters.

Network security

Since the system required network to fully function it was important to consider network security issues. Encryption was a key element. It involves the process of transforming data so that it is unreadable by anyone who does not have a decryption key. By encrypting the data exchanged between the client computer and server, information can be sent over the internet with less risk of being intercepted during transit.

Secure connection between clients and the server using the secure socket layer protocol. The secure socket layer protocol uses encryption algorithm to ensure that data received over public network can be trusted. It has mechanisms to detect any data change, loss or replay. It also incorporates algorithms that provide identity verification using the X509 standard. X509 makes it possible to identify someone on the internet (Sandhu & Jajodia, 2012).

The public IP address should only be visible to a computer on the internet and private IP address only be visible to computers on the LAN, be they wired or wireless. The use of a firewall in the router, which denies unsolicited incoming traffic. Finally disabling remote adminstration

CHAPTER SIX

SUMMARY, CONCLUSIONS & RECOMMENDATIONS

6.1 Chapter Brief

This chapter contains a summary of the findings obtained from the research, conclusions and recommendations on the topic of study. The researcher evaluates the findings and makes recommendations deemed necessary. The researcher attempts to answer the research questions based on the finding of the study. In conclusion, the study contains the findings, recommendations and suggestions on how e-government architecture can be used as a means of addressing weak interoperability in government, a case of county and national government.

6.2 Summary

E-government has many autonomous agencies that have various levels of readiness and at different circumstances, governed by a democratic system and embedded in a certain institutional situation. Different institutions are set up to ensure efficiency and effectiveness of how the government carries out its duties. This called for e-government implementation with a focus on the public values that is to ensure collaboration and coordination between the county and national government. Government agencies deploying new ICT systems with specifications and solutions relevant to particular requirements without the need to connect exchange and re-use data within systems leads to weak interoperability in government.

For interoperability to be achieved a process of building organizational infrastructures that enable innovation action was designed and that is the architecture. E-government architecture acts as an information management and planning tool to enable government optimize their ICT assets by rigorously analyzing and identifying strategic opportunities

from its various lines of business and business information. This enables the development of appropriate software applications in-line with technology investments. The architecture developed improves clarity on application resilience requirements to achieve robust solution designs. The architecture ensures focus on key business functions that span multiple agencies in-order to identify inter-agency synergies and opportunities that promote interoperability. This was achieved by the emphasis of information layer that shows that stable e-governance can be based only on stable elements and that is information.

To address this issue the developed architecture explicitly provides away to define and evaluate all the possible processes and redesign mechanism, in the information architecture layer and business architecture layer to thrive in culture of interoperability. The Cronbach's Alpha that was used to measure user satisfaction for the new e-govern project management system is α=0.77869 which falls under the acceptable and good system reliability when rounded off to 0.8. This shows that the system was interoperable and could be deployed successfully to execute duties between the two levels of government since it lies between the commonly accepted rule of thumb that is an alpha of 0.7 or 0.6 indicates user satisfaction or system reliability while very high degree like 0.95 indicates redundancy.

System security was a key factor to consider and ensure that the e-govern project management system was secure. The security measures that were put to consideration include use of passwords, authentication, authorization, encryption and use of secure socket layer.

6.3 Conclusion

E-government architecture can be successfully used as a means of addressing weak interoperability in government more especially between the county and national government. Parameters for each and every architecture layer should be well stated and

followed to the latter when deploying interoperable systems based on the architecture. Information architecture layer is key in identifying information that span multiple agencies but very essential in accomplishing a process. This will ensure successful business redesign in the business architecture layer and development of interoperable systems. System validation is very essential to ensure systems accomplish specific task of systems users intended for. Last but not least security mechanisms should be in place for any system developed more especially those to be accessed via a network.

6.4 Recommendations

For governments to deploy fully interoperable systems, Governments should embrace use of e-government architecture as a means of addressing weak interoperability in government. For successful deployment of interoperable systems details and parameters of each and every layer of the architecture should be taken into account. Developed systems must be validated to ensure user satisfaction. Security must be factored during system development and deployment. Technology should not be used as a means of e-governance but rather than an enabler of e-governance. Information that spans multiple agencies is very essential to successful process redesign in government for interoperable system development.

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APPENDICES

Appendix I: Validity and user satisfaction questionnaire

Information Quality	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. Information I get from the system is clear	☐1	☐2	☐3	☐4	☐5
2. The system is accurate	☐1	☐2	☐3	☐4	☐5
3. The system provides me with efficient information	☐1	☐2	☐3	☐4	☐5
4. The system provides me with up-to-date information	☐1	☐2	☐3	☐4	☐5
5. The system provides reports that seem to be just about exactly what I need					

System usefulness	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. Using the system increases productivity	☐1	☐2	☐3	☐4	☐5
2. Using the system saves time	☐1	☐2	☐3	☐4	☐5
3. Using the system improves performance, promotes transparency and accountability	☐1	☐2	☐3	☐4	☐5

System usage characteristics	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. The system is easy to use	☐1	☐2	☐3	☐4	☐5
2. The system is easy to learn	☐1	☐2	☐3	☐4	☐5
3. It is easy to get the system to do what I want it to do	☐1	☐2	☐3	☐4	☐5

Overall satisfaction	Never	Rarely	Sometimes	Very often	Always
1. Do you feel the system meets the information processing need of both governments?	☐1	☐2	☐3	☐4	☐5
2. Overall, how often are you satisfied with the system?	☐1	☐2	☐3	☐4	☐5