UNIVERSITY OF NAIROBI

SCHOOL OF COMPUTING AND INFORMATICS

Development of an Inter-Organizational Electronic Information Sharing Framework for Person's Data in Kenya

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Declaration

I, Loyford Murithi Nandi, do hereby declare that this research project is entirely my own work and where there's work or contributions of other individuals, it has dully been acknowledged. To the best of my knowledge, this research work has not been carried out before or previously presented to any other education institution in the world for similar purposes or forum.

Signature…….. Date……

Loyford Murithi Nandi

P56/73909/2012

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I do hereby certify that this project has been presented for examination with my approval as the University of Nairobi Supervisor.

Signature ……. Date ……

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Abstract

Interoperability of person's data in institutions dealing with registrations of persons who are primary stashers of person's data is of paramount importance for Kenya to have an accurate person's data that can be considered as a single source of truth. The purpose of this research project was therefore to interrogate the interoperability and data sharing issues in relation to person's data information with an aim of developing a framework that forms a basis for person's data interoperability improvements. The factors affecting person's data interoperability were categorised into three areas. This included i) technical interoperability which evaluated security, databases and proprietary biometric systems, data heterogeneity and legacy system; ii) Organisational interoperability which considered stakeholder involvement, data ownership, bureaucracy and business process reengineering and lastly; iii) peripheral interoperability that was composed of economic, legal and policy as well as political and donor impacts.

The research was conducted in selected institutions either dealing with person's registration or directly involved in management of processing of persons data. The research targeted officers from Civil Registration Department (CRD), National Registration Bureau, Integrated Population Registration Department and ICT officers across the Ministries.

Results of the survey clearly show the need for person's data interoperability. The results assert the need for ICT use in order to achieve interoperability that would lead to accuracy of person's data in Kenya as well as elimination of duplications in registration process. The results identified the top most key issues that have to be addressed to achieve interoperability in person's data in order of priority as data security, data heterogeneity, elimination of bureaucracy, enabling legislation policy and strategies, data ownership. The results of the survey further identifies data ownership, bureaucracy, and business process reengineering and stakeholder involvement as being closely related in respect to person's data interoperability.

The research proposes a deliberate effort by the government to address person's data interoperability in Kenya during formulation of policies, master plans and strategic documents for the specific person's data interoperability to be achieved.

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Glossary of terms

Abbreviation **Description**

B2B---------- Business to Business

CMMI ----------Capability Maturity Model Integration

CRD----------Civil Registration Department,

DPSM**----------**Directorate of Public Service Management

EC----------European Commission

EDI----------Electronic Data Interchange

EDIFACT----------Electronic Data Interchange for administration, Commerce, and Transport)

e-GIF----------Electronic Governance Interoperability framework

eGIF4M----------E-Government Interoperability Framework for Mozambique

EIMM----------Interoperability Maturity Model

G2G ----------Government to Government

GAO ----------Government Accountability Office's

GHRIS----------Government Human Resource Information System

GIMM---------- ---Government Interoperability Maturity Matrix

ICT ----------–Information Communication and Technology

IDABC---------- Interoperable Delivery of European e-Government Services to public Administrations, Businesses and Citizens.

IEEE---------- Institute of Electrical and Electronics Engineers

IF---------- Interoperability Framework

IPRS----------Integrated Population Registration System

ISSS---------- International Society for the Systems Sciences

ITIM----------IT Investment Management Framework

IT----------Information Technology

LCIM----------Levels of Conceptual Interoperability Model

LISI----------Levels of Information Systems Interoperability

NRB----------National Registration Bureau

NZ----------New Zealand

NZSIT---------- NZ Government Information Technology Security

UNDP----------United Nations Development Programme

URl----------Unified Resource Locator

XML----------Extensible Markup Language

CHAPTER ONE

INTRODUCTION

1.1 Background to the problem

Civil registration is a continuous, permanent, compulsory and universal recording of the occurrence and characteristics of vital events pertaining to the population as provided for through decree or regulation in accordance with the legal requirement of a country. The registration of birth and deaths of persons in Kenya is carried out in accordance with the Births and Deaths Registration Act (Chapter 149). This responsibility is vested under the Civil Registration department in the Ministry of Interior and National Coordination. The Registration of Persons Act (Chapter 107) on the other hand makes provision for the registration of persons and for the issuance of identity cards, and for purposes connected therewith. The Act applies to all persons who are citizens of Kenya and who have attained the age of eighteen years or over or, where no proof of age exists, are of the apparent age of eighteen years or over.

Article 15 of the Universal Declaration of Human Rights (UDHR) accords "[e]veryone the right to a nationality" and that "[n]o one shall be arbitrarily deprived of his nationality nor denied the right to change his nationality". On the other hand, chapter three of the Constitution of Kenya provides for various ways in which one can become a citizen of Kenya. This includes entitlements of citizens (clause 12), retention and acquisition of citizenship (clause 13), citizen ship by birth (chapter 14), and citizenship by registration (chapter 15), dual citizenship (clause 16) and revocation of citizenship (chapter 17).

In addition to the civil registration departments, there are various primary sources of person's data that includes educational institutions, health facilities, and law enforcement agencies among others. The information generated by these organisations is further required and consumed by other organisations for validation/authentication even as they generate their own secondary data. Some of these institutions include both the private and public institutions including employers, tax collectors, banking and health institutions, insurance firms, service providers among others.

Historically, information systems within government Ministries and other institutions have been developed independently to provide specific business solutions. Their design and implementation are often driven by the requirements of narrowly focused functionality independent of existing systems with minimal regard of concurrently developed systems in other government agencies. The Integrated Personnel Registration System (IPRS) is a Vision

2030 flagship project that was initiated in 2005 to provide a solution to the disparate population registration systems that existed in the country. Unfortunately, the expected results have and insignificant impact on the society.

At present, electronic personal information sharing among government departments is minimalist. Where sharing exists, the generation of the data is done in uncoordinated ad hoc manner leading to errors, duplications and inconsistency. This situation has been aggravated by the Government which in itself ought to be a custodian of primary data about persons requesting for the same information it ought to hold from the citizens.

1.2 Problem Statement and Purpose of the Project

The Government is a prime stasher and supplier of data and information related to persons. However, it is a common practice in Kenya for an individual to be requested to produce personal identification documents that have been issued before during an individual's life chain in order to acquire services or worse still additional registration/civil documents. A classical case is where a citizen is required to produce a birth certificate and an ID card as a requirement for acquiring a passport. While this is just one classical case, there are numerous other examples that can be sighted.

The dissimilar and complex nature of various Government agencies involved in stashing and supplying person's data has raised many data sharing and integration issues. Generally, many departments of Government collect personal information of citizen including biometric data through different forms on different occasions according to their needs. Since this is managed and maintained by the individual departments, the information may vary from one department to another. For an instance one department may be capturing name and age while another department is capturing name as first name, last name, surname and age as the date of birth. This therefore means the same citizen information is available within multiple departments and is maintained separately in different format.

This therefore means that in the absence of an elaborate, standardised integrated system of identifying, storing people's data in Kenya, there are seemingly a lot of challenges of inaccuracy, incoherence and duplications of people's data with no single point of truth amongst the institutions. This situation has aggravated insecurity in which the country is not able to identify its own citizens in addition to utmost inefficiencies and bureaucracy that can be eliminated.

The purpose of this research project was therefore to interrogate the interoperability and data sharing issues in relation to person's data information and develop a framework that will form a basis for interoperability improvements.

1.3 Research outcomes and their significance to key audiences

The key audience of this research are public organisations vested with the mandates of registering persons in Kenya as well as executive/ technocrats charged with policy decision on the area of study. The academia interested in future research in interoperability and specifically on the sharing of persons' data would obviously have keen interest on this study.

1.4 Research objectives

The research study sought to carry out a detailed understanding of person's data sharing during an individual's lifecycle in Kenya and develop an interoperability framework to ensure there is a single, trusted reliable source of truth about person's data.

The specific objective of this research project proposal was to:-

i. Assess information generation and sharing amongst key sources of person's data within key public sector entities in Kenya;

ii. Assess identified institutional, technological, policy and legislative preparedness of sharing data and the associated interoperability issues of key person's data;

iii. Propose an interoperability framework of sharing person's data during the citizens' lifecycle in Kenya.

1.5 Research Questions

The research for Inter-Organizational electronic information sharing framework for civil/persons data in Kenya was based on the following research questions.

i. What key issues requires consideration to ensure there is interoperability and sharing of persons data amongst organizations concerned with stashing and supplying persons data?;

ii. Do the existing frameworks sufficiently cover all parameters of evaluating interoperability of person's data? ;

iii. What interoperability parameters/ issues are best suited for consideration for sharing of persons data in the Kenyan situation?

1.6 Justification of Project Proposal

There are hard questions that beg for answers from IT fraternity in terms of the extent to which ICT can solve problems associated with seamless sharing of person's data across organisations. In addition there is a need for evaluating whether technology has no place to play in the problems that are bedevilling Kenyans in terms of assessing person's registration services. The reality of the matter as asserted by the results as is that technology has a direct hand in sorting many business problems like person's data interoperability challenges.

1.7 Assumptions and limitations of the research

i. The data owners are the institutions that generate specific piece of person's data;

ii. The respondents at the headquarters hold the same view with other potential respondents at the county and lower centres;

iii. The chosen model's captures most of relevant person's data interoperability issues;

iv. All targeted respondents have a working e-mail and the details of the sampling frame are error free

1.8 Definitions of important terms

Interoperability - Interoperability is the capability of government organizations to share information and amalgamate information and business processes by means of widespread principles and work practices. Interoperability refers to a possessions of miscellaneous systems and organizations which enables them to work collectively.

Integration - Integration is the forming of a superior unit of government entities, provisional or permanent, for the intention of merging processes along with sharing information. Interoperation in e-government occurs while self-governing or diverse information systems or their components controlled by different jurisdictions, administrations, or exterior associates work collectively in a predefined and established ahead approach.

CHAPTER TWO

LITERATURE REVIEW AND THEORY

2.1 Introduction

Personal information integration is the primary challenge to any Government departments today. As companies adopted new technologies over the years, many new systems acquired at the departments' level did not 'talk' to the other systems already in place. Legacy systems, installed years or decades ago, have typically been heavily customized (often without adequate documentation). The result has been 'silos' of information within the organization. Personal information integration is critical to the centre and state government departments than any other sector due to political pressures; budget cuts and security issues that have brought about much new and difficult challenge (Velamala, Ranga Rao et al 2008).

It is widely known that collection, storage, and management of data about individuals and enterprises in information systems are routine tasks in virtually all public or private organizations. Data about the same individual or business is handled in a number of independent information systems. This data can be shared and cross-referenced, or even merged, as might happen after organizational mergers, for example. More often, the exchange and sharing of data between organizations (within the private and public sector, or crossing this border) is necessary in order to provide seamless, integrated business or governmental services (Benoit Otjacques et al 2007)

Despite these numerous issues regarding privacy, the collection and processing of person-related data in information systems is indispensable for the efficient deployment of these systems and has undisputed benefits independent of the sector in which such systems are used. The identification and sharing of identity-related data in the area of government information systems is driven by (among other things) by the fact that public agencies want to offer seamless, integrated services, following an analogous trend in business, as Lee et al. point out: "e-government initiatives aim at enabling government agencies to more efficiently work together and provide one-stop service to citizens and businesses (Benoit Otjacques et al 2007)

The overwhelming majority of citizens and businesses still have to deal with multiple public organizations. These organizations cannot operate in isolation anymore and need to collaborate with each other. In the digital era, public organizations are changing their strategies and structures and processes to fully benefit from the promises of ICT. Departments and institutions start collaborating and interoperating across organizational boundaries. E-

government was initially driven by adopting e-commerce ideas, but in the last decade, it has emerged as a research area on its own, giving attention to the specific public sector characteristics. Similar to e-commerce, e-government requires multi-agency collaboration and integration of their disparate business processes and information systems. The unique characteristics of e-government, such as accountability, transparency, equal access, sharing of information and collaboration instead of competition, have played a major role and produced a new research direction aimed at meeting the broader expectations of society (Marijn J &, Yannis C et al 2011).

Manual processes of citizen's personal information needs to be reengineered among the government/agencies, in order to leverage maximum benefits. In addition, citizen's personal information captured/stored by various departments/agencies and maintained either centrally or individually, should be made available through multiple channels like common services centers, passport, police and post office on multiple devices like mobile phone, computer, hand held devices and laptops (Velamala Ranga Rao et al 2008).

The open government initiative allows government data, available digitally; to be shared and integrated to produce value added information products and citizen services. This "paperless" government facilitates the transparency of government and fosters collaboration across government agencies and among citizens. Provision of citizen services often requires sharing citizen data among many different collaborating government agencies. Thus, the key point of smart government is that the citizen-related data collected for public services should be efficiently shared among government organizations to create more integrated personalized services that can be delivered to citizens anywhere, anytime to any device, transcending space, time and device differences (John (Jong Uk) Choi et al 2013).

2.2 Persons Registration Process

African Countries should be encouraged to establish expert teams to critically review their national civil registration systems in terms of legal framework, organizational issues, systems design, training needs and quality control issues (Chalapati R et al 2005). Overlapping responsibilities and poor collaborations between sectors concerned with civil registration have been cited as major impediments to system developing in Kenya and Zambia (Kowal, Rao and Mathews 2003)

Vital registration systems operate through a complex network of agencies at different levels in the national administrative structure. These systems comprise two distinct but related

operations: (i) registering vital events and issuing certificates of civil status, and (ii) compiling statistical information from vital records (Chalapati Rao et al 2009)

Generally many departments of Government collect personal information of citizen through different forms (online/offline) or biometric data like thumb/finger impressions or signatures captured through various biometric devices on different occasions according to their needs. Since this is managed and maintained by the individual departments, it may vary from one department to another, for an instance one department is capturing name and age and another department is capturing name as fist name, last name, surname and age as the date of birth. It means same citizen information is available with multiple departments and they are maintaining it separately. Since separate databases are created for the same citizen at different points of time, by the different departments it has now become difficult or challenges to the Government to find out the ways to uniquely identifying a particular citizen by capturing or modifying the citizen information with a single click (Velamala Ranga Rao et al 2008).

Landsbergen & Wolken, (2001) stated, governmental agencies typically gather, process, and store information regarding those activities in which they are involved while they are not aware of the circumstances in which they can share data and information with other agencies. Moreover, political and economic issues have been identified as two key peripheral critical factors affecting any e-government development project (Heeks, 2006).

Consider, for example a situation where an individual is setting up a new company and needs to provide various documents including criminal record, information about social security debts, etc. Such information is already available in various government departments and should be accessed automatically. This in practice implies business process re-engineering and alignment so that individual government departments share information, avoiding the need for the clients to provide information that is already held by different government departments (Jiri Feuerlicht & David Cunek 2011).

Max Weber's theory of bureaucracy to examine contemporary E-Government related research and literature has two major, prevailing themes. The first theme that emerges is that IT (information technology) is a tool for 'reforming' bureaucracy. The second, somewhat contradictory, theme is that E-government failure may be explained as a consequence of bureaucracy.

Through UNDP's experiences in e-government initiatives, one of the key challenges that have been identified is the existence of a patchwork of ICT solutions in different government offices that are unable to 'talk' or exchange data. In the process of digitization, government processes

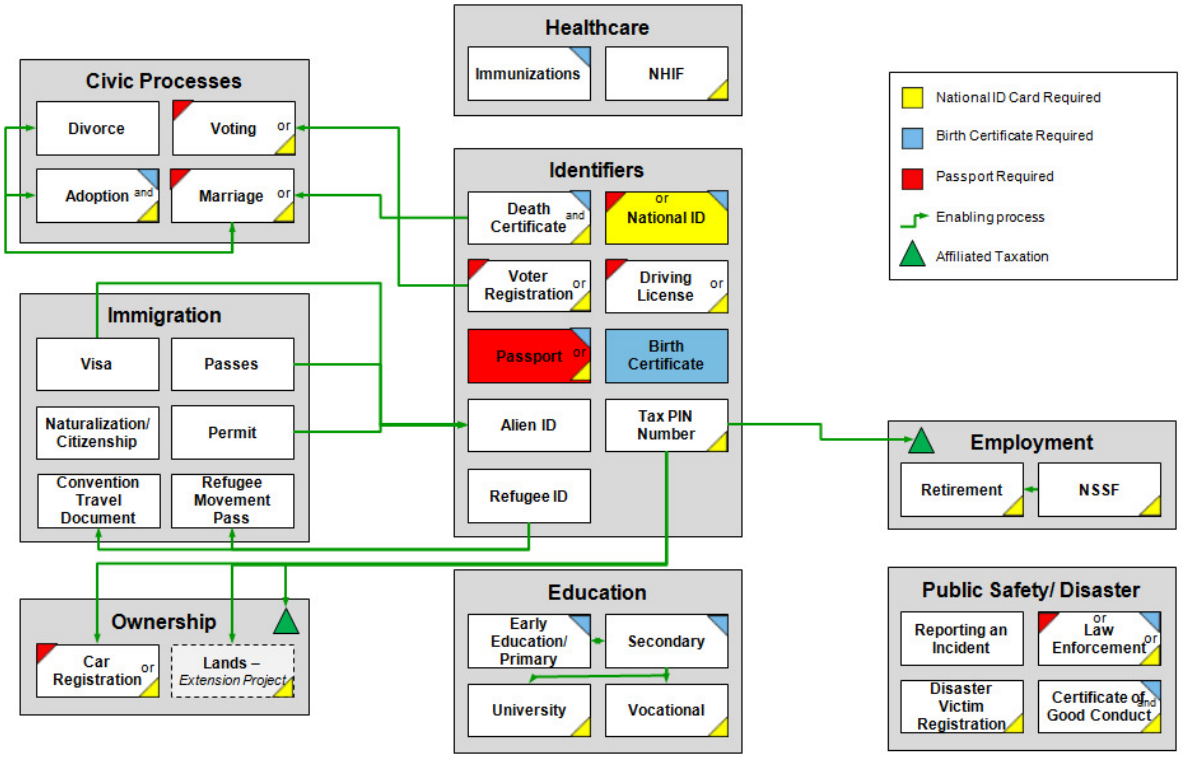
and systems are, in many instances, reinforced rather than transformed. As a result, citizen continues to visit different departments to access public services, even after the introduction of ICTs, as systems are not interconnected (e-Government Interoperability: Overview UNDP 2007)

At present, personal information sharing among government departments and its agencies does not exists and there is an urgent need to not only accelerate information distribution, but also to broaden the scope of organization that can share data. Personal information integration is needed for delivering integrated services (both online and offline), achieving efficiency and effectiveness gains through better use of data, information or technology (especially across Government departments and its agencies); or generally increasing departmental capability or performance. This will help the Government to communicate with each other smoothly (Velamala Ranga Rao et al 2008).

2.3 Civil Registration Process in Kenya

The picture below depicts the registrations system in Kenya as depicted in a study commissioned by Kenya ICT Board to review person's registration systems in Kenya.

Figure 2.1: Person's registration process in Kenya



The study noted that services can utilize an universal ID as a way to limit the need to use or create a different identifier of an individual. Some of the key considerations that the report

highlighted was that changes cannot be implemented quickly and there is a need of setting a strategic, multi-year roadmap for the consolidation, setting guidelines and rules around the data to ensure interoperability and disallowing creation of new identifiers and encourage organizations to reuse existing identifications (e.g., National ID)

2.4 Person's Data Ownership

Data ownership refers to both the possession of and responsibility for information. Ownership implies power as well as control. The control of information includes not just the ability to access, create, modify, package, derive benefit from, sell or remove data, but also the right to assign these access privileges to others (Loshin, 2002). Implicit in having control over access to data is the ability to share data with colleagues that promote advancement in a field of investigation. A notable exception to the unqualified sharing of data would be research involving human subjects. Scofield (1998) suggest replacing the term 'ownership' with 'stewardship', "because it implies a broader responsibility where the user must consider the consequences of making changes over 'his' data".

According to Loshin (2002), data has intrinsic value as well as having added value as a by-product of information processing, "at the core, the degree of ownership (and by corollary, the degree of responsibility) is driven by the value that each interested party derives from the use of that information".

Loshin (2002) alludes to the complexity of ownership issues by identifying the range of possible paradigms used to claim data ownership. These claims are based on the type and degree of contribution involved in the research endeavour as follows a) Creator – The party that creates or generate data; b) Consumer – The party that uses the data owns the data; c) Compiler - This is the entity that selects and compiles information from different information sources; d) Enterprise - All data that enters the enterprise or is created within the enterprise is completely owned by the enterprise; e) Funder - the user that commissions the data creation claims ownership; f) Decoder - In environments where information is "locked" inside particular encoded formats, the party that can unlock the information becomes an owner of that information ;g) Packager - the party that collects information for a particular use and adds value through formatting the information for a particular market or set of consumers; h) Reader as owner - the value of any data that can be read is subsumed by the reader and, therefore, the reader gains value through adding that information to an information repository i) Subject as owner - the subject of the data claims ownership of that data, mostly in reaction to another

party claiming ownership of the same data; j) Purchaser/Licenser as Owner – the individual or organization that buys or licenses data may stake a claim to ownership

The subject of who actually 'owns' the data or, in other words, the term 'data ownership' has attracted the attention of researchers in the past few years (Ali M. Al-Khouri, 2012). Governments and public sector institutions consider data a public utility (WEF, 2012). They tend to label our personal data as 'corporate data' and argue that without data, they cannot function (Holloway, 1988).

Typically, organisations can capture different personal data in a variety of ways (Marc et al., 2010). Each time information is generated, a set of data related to this information is created. This data, when relayed further, should stand up to scrutiny and verification. The contention is that the source that can verify this data and confirm the veracity of the information is the 'True Owner' of the data. It is trivial that the current personal data ecosystem is fragmented and inefficient (WEF, 2012).

On the other hand, personal privacy concerns are inadequately addressed, and current technologies and laws fall short of providing the legal and technical infrastructure needed to support a well-functioning digital infrastructure (ibid.). Instead, they represent a patchwork of solutions for collecting and using personal data in support of different institutional aims, and subject to different jurisdictional rules and regulatory contexts (e.g., personal data systems related to banking have different purposes and applicable laws than those developed for the telecom and healthcare sectors).

It is of importance that governments play a more active regulatory role in modernising their existing policy frameworks to protect personal data from the unlawful processing of any data (Robinson et al., 2009). The government should move away from a regulatory framework that measures the adequacy of data processing by measuring compliance with certain formalities, and towards a framework that instead requires certain fundamental principles to be respected, and that has the ability, legal authority, and conviction to impose harsh sanctions when these principles are violated (ibid.).

2.5 Relationship between interoperability and e-Government

There is unanimous agreement that high quality and comfortable online delivery of governmental services often requires the seamless exchange of data between two or more government agencies. Smooth data exchange, in turn, requires interoperability of the databases and workflows in the agencies involved (Iker Martinez de Soria et al 2009)

A key determinant of success in e-government initiatives is the ability of multiple and often quite diverse government organizations to share and integrate information across both traditional and new organizational boundaries (Caffrey, 1998; Cresswell, et al., 2002; Dawes & Pardo, 2002; Gil-Garcia, Schneider, Pardo, & Cresswell, 2005). E-Government is one of Europe's big challenges, and interoperability is a necessary condition encouraged by the European Commission. Interoperability is believed to ensure effective service to citizens and to perform governmental functions effectively as well as efficiently. (Robert Deller & Veronique Guilloux 2008),

E-Government enterprise integration confronts various challenges that includes: i) strategic barriers (lack of shared goals and governance and overambitious milestones), ii) technological barriers (incompatibility across standards, security models, and legacy systems), iii) policy barriers (privacy and data ownership), and iv) organizational barriers (lack of readiness, absence of e-government champion and stakeholder commitment, and legacy processes; Janssen & Cresswell, 2005b; Lam, 2005a; Wu, 2007). The lack of enterprise-wide interoperability results in ''isolated islands of technology'' (Peristeras & Tarabanis, 2000).

"Interoperability is not simply a technical issue concerned with linking up computer networks. It goes beyond this to include the sharing of information between networks and the reorganisation of administrative processes to support the seamless delivery of e-Government services." (European Commission, 2003). In addition to achieving interoperability through the standards, architectures have a crucial role in ensuring e-government interoperability success (Apitep S. & Choompol B. 2009).

Data heterogeneity in the public sector is a serious problem and remains to be a key issue as different naming conventions are used to represent similar data labels. The e-government effort in many countries has provided a platform for government entities and their business partners to exchange data through Information Communication Technologies (ICT) and standards such as RosettaNet (B2B data exchange standard), EDIFACT (Electronic Data Interchange for administration, Commerce, and Transport), XML (Extensible Markup Language) and EDI (Electronic Data Interchange) (Saravanan Muthaiyah & Larry Kerschberg 2008).

Electronic Government should be considered as an integral system of political objectives, organisational procedures, information content, ICT technologies, operating within Public Administration so as to contribute to fulfilment of its mission. Electronic Government is not a mere technological infrastructure or strategy but rather a new integrated style of Public

Administration organization and operations. Electronic Government addresses all citizens and businesses that Public Administration has a mission to serve, including those handicapped due to physical, social, economic, geographical or cultural factors (Dimitris G, Gregory M & Panagiotis G, 2001)

According to (Z. Al-adawi S. Yousafzai J. Pallister, 2001), many approaches have been established towards founding an e-government stages model. Although the models differ in the numbers and names of stages most of them have similar characteristics for each stage. One of the most used, however, is Gartner Group's 1 model that classified e-government services offered online into four evolutionary phases: (1) publishing (web presence); (2) interacting; (3); transacting and (4) transforming. Transforming is considered to be the long-term goal of almost all government services. In this stage all information systems are integrated and services can be obtained at one virtual centre .There is a growing awareness that the interoperability of national public ICT infrastructures is a precondition for a more service-oriented and competitive public sector. Ever since the adoption of the Interoperability Decision (1720/1999/EC) of the European Parliament and Council in July 1999, the European Commission has focused on the pan-Europe as dimension of e-government and on the interoperability requirements for its implementation.(Giorgos L, Konstantinos M et al 2007)

Interoperability and cooperation can be regarded as enablers of the integration of e-government applications. A prerequisite (or, according to Scholl, the "ultimate goal") for any integrated, collaborating system and organization is the sharing of information or data. Such sharing is only possible when the identification of the entities the data describes is well understood (Benoit O, Patrik H et al).

Recognizing that e-government should be transformative and become more citizen- rather than government focused in delivering public services, investing in the development of an e-government interoperability framework is fundamental. Otherwise, the millions of dollars spent on e-government would rarely lead to good governance and the achievement of the Millennium Development Goals ((e-Government Interoperability: Overview UNDP 2007). For e-Government to be successful it must develop agile, citizen centric, accountable, transparent, effective, and efficient government operations and services (Scholl and Klischewski, 2007). The integration of government information resources and processes, and thus the interoperation of independent information systems, are essential to achieve these goals. Yet, most integration and interoperation efforts face serious challenges and limitations (Petter Gottschalk 2009)

The transaction between citizens and social servants occurs in the front office, while registration and other activities take place in the back office. It is established that back office support is a grim blockage in e-government due to diverse interoperability problems. One basic exploit to develop information sharing is standardization in information systems (M. Headayetullah 2010, Bekkers, V. 2007).

The fulfilment of e-Government visions of such a one stop government service would depend on increased vertical and horizontal integration of government operations and services. High-ranking issues among the defining purposes of e-government are highly agile, citizen-centric, accountable, transparent, effective, and efficient government operations and services (Scholl and Klischewski, 2007). For reaching such goals, the integration of government information resources and processes, and thus the interoperation of independent information systems are essential. Yet, most integration and interoperation efforts meet serious challenges and limitations (Petter Gottschalk, Hans Solli-Sæther, 2008). One of the aims of the e-Government program is to use information and communication technology to provide government services to the citizen in such a way that the citizen access it without being bothered about the structure of the Government. He or she should be able to access the service from a single point of access despite the fact that fulfilment of the service may require inputs from more than one department of the government. Attaining such a state requires interoperability of the government information systems with a strong coordination of all the organisations involved. The fulfilment of the e-Government visions of such as 'One Stop' government service would depend on increased vertical and horizontal integration of Government operations and services.

A number of academics have clarified that in order to gain the maximum benefits of using ICTs in government processes, organisations within a government must integrate and share their information (Dawes 1996). Siau and Long (2005) also agree that both vertical and horizontal integration of government services are critical. They believe that the success of e-Government to provide integrated and seamless services relies on the cooperation and collaboration among government agencies of different levels, functionalities, and various physical locations. They suggest that information sharing and integration of government databases and separate systems is necessary to improve internal organizational management of government agencies to provide better external public services (Siau & Long, 2005)

2.6 Interoperability Situation in Kenya

The e-Government Strategy in Kenya was formulated in the year 2004. The strategy posits that communication within Government entails Government agencies conducting business electronically among themselves in the electronic management and exchange of Government information through such channels as the internet and intranet. The prerequisites of doing this is addressed through instituting a structure and operational reforms, regulatory and legal framework as well as through development of a government secure and reliable infrastructure. The specific activities to achieve this was targeted as through implementation of integrated and shared databases within the Government, initiating integration of internal government processes and elimination of duplication of efforts and resource wastage by enforcing high levels of sharing information infrastructure.

In terms of the person's data, the strategy endeavoured to implement integrated systems for registration of persons including births and deaths, citizen registration, immigration etc. The operational application that the strategy had towards this endeavour was IPRS. This required integrating all computerization initiatives in the areas of the Department of Civil Registration (CRD), the National Registration Bureau (NRB) and the Immigration Department. Other organisation where systems associated with person's data were to be put in place included the Road Transport, Kenya Revenue Authority, Embassies, Electoral Commission of Kenya (ECK), and Personal Identification Number (PIN) by the Kenya Revenue Authority;

For the Government of Kenya to successfully apply e-government comprehensively, the strategy recognises that ICT standards have to be adopted by all government Ministries and departments. A manual on standards and guidelines was to be developed to ensure minimum standard of quality and the ability to communicate easily among systems set. Data Interoperability was recognised as one of priorities of the Government and this was to address what kind of data must be standardized and ownership of the data in terms of who will have responsibilities in managing it. The standard was also to address data communication considering the coding of data and the standard fields to be used. This was expected to consider levels of sensitivity of the data and what levels can be accessed by the different agencies in the government and/or outside and to which extent.

2.7 . Interoperability and Integration

Interoperability is the capability of government organizations to share information and amalgamate information and business processes by means of widespread principles and work practices (State Services Commission. 2007,). Interoperability refers to possessions of

miscellaneous systems and organizations which enables them to work collectively (M Headayetullah et al 2010, Government CIO 2007).

Integration is the forming of a superior unit of government entities, provisional or permanent, for the intention of merging processes along with sharing information. Interoperation in e-government occurs while self-governing or diverse information systems or their components are controlled by different jurisdictions, administrations, or exterior associates work collectively in a predefined and established ahead approach (NZ e-GIF, 2007).

There has been numerous definition of interoperability put forth by researchers, standard bodies and government over the last so many years. Lack of a uniform definition has forced many countries which have come out with their interoperability framework to define the term in the first place. Ford et al (2007) identified about thirty four distinct definitions of interoperability. Since interoperability is a major deciding factor in modern welfare, most of the definitions are related to armed forces and are mainly concerned about technical interoperability. Another major source of Interoperability definitions is different standard organisations. Some of the most common definitions from different domains are given in the following table

Table 2.1: Various Definitions of Interoperability

Definition	Source	Interoperability Type and Origin
..the ability of two or more systems or elements to exchange information and to use the information that has been exchanged. The capability for units of equipment to work together to do useful functions. The capability, promoted but not guaranteed by joint conformance with a given set of standards, that enables heterogeneous equipment, generally built by various vendors, to work together in a network environment. The ability of two or more systems or components to exchange information in a heterogeneous network and use that information.	IEEE quoted by Morris (Morris, Levine, Meyers, Plakosh & Place, 2004)	Technical, Semantic, Standard
Interoperability: a state which exists between two application entities when, with regard to a specific task, one application entity can accept data from the other and perform that task in an appropriate and satisfactory manner without the need for extra operator intervention.	CEN/ISSS (CEN/ISSS, 2005)	Technical, Data, Semantic, Health

Definition	Source	Interoperability Type and Origin
"to be interoperable, one should actively be engaged in the ongoing process of ensuring that the systems, procedures and culture of an organization are managed in such a way as to maximize opportunities for exchange and re-use of information, whether internally or externally."	Miller, P. (Miller, 2000)	Technical, Organizational, Semantic, Human, Health
"The ability of government organizations to share information and integrate information and businesses by use of common standards."	NZ e-GIF (State Services Commission, 2007),	Technical , Semantic, e-Government
Interoperability is the ability of a system or process to use information and/or functionality of another system or process by adhering to common standards.	European Public Administration network (European Public Administration Network, 2004)	Technical, Business Process, e-government
Interoperability describes the ability to work together to deliver services in a seamless, uniform and efficient manner across multiple organizations and information technology systems.	Australian Government Technical Interoperability Framework (Australian Government Information Management Office, 2005)	Technical Information, Organizational, e-Government
Interoperability means the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge.	IDABC (IDABC, 2004)	Technical, Organizational, Semantic, e-Government

The problem of nomenclature is further complicated by the interchangeable use of the terms Integration, Interoperation and Interoperability. Some researchers and standard organizations attempted to define each term individually. For example Scholl and Klischewski, 2007 has attempted to distinguish them in respect to e-government by providing distinct definition for these three terms:

- **Integration**: E-Government Integration is the forming of a larger unit of government entities, temporary or permanent, for the purpose of merging processes and/or sharing information. E-government integration refers to the mainly non-technical constraints in which technical interoperation occur.

- **Interoperation:** Interoperation in E-Government occurs whenever independent or heterogeneous information systems or their components controlled by different jurisdiction/administrations or by external partners smoothly and effectively work together in a predefined and agreed upon fashion.
- **Interoperability e-Government** interoperability is the technical capability for e-Government interoperation.

According to the authors, interoperability is a higher state of interoperation. Interoperability facilitates working together of computers, operating systems and applications dynamically without any prior communication, whereas interoperation requires statically arranged ("hand-wired") agreement amongst the parties. CEN/ISS defines interoperability as "a state which exists between two application entities when with regard to a specific task, one application entity can accept data from the other and perform that task in an appropriate and satisfactory manner without the need for extra operator intervention". They further defines integration as "combination of diverse application entities into a relationship which functions as a whole".

According to Chen & Vernadat (2003) ability for different system to work together may be characterized at various levels of cooperation. Interoperability has the meaning of co-existence and co-operation while integration relates to the notion of co-ordination and unification. They further define interoperability as capability to communicate with peer systems, while integration is a broader concept embracing communication, co-operation and co-ordination capabilities. Therefore interoperability must be achieved to achieve real integration.

2.8 Interoperability Frameworks

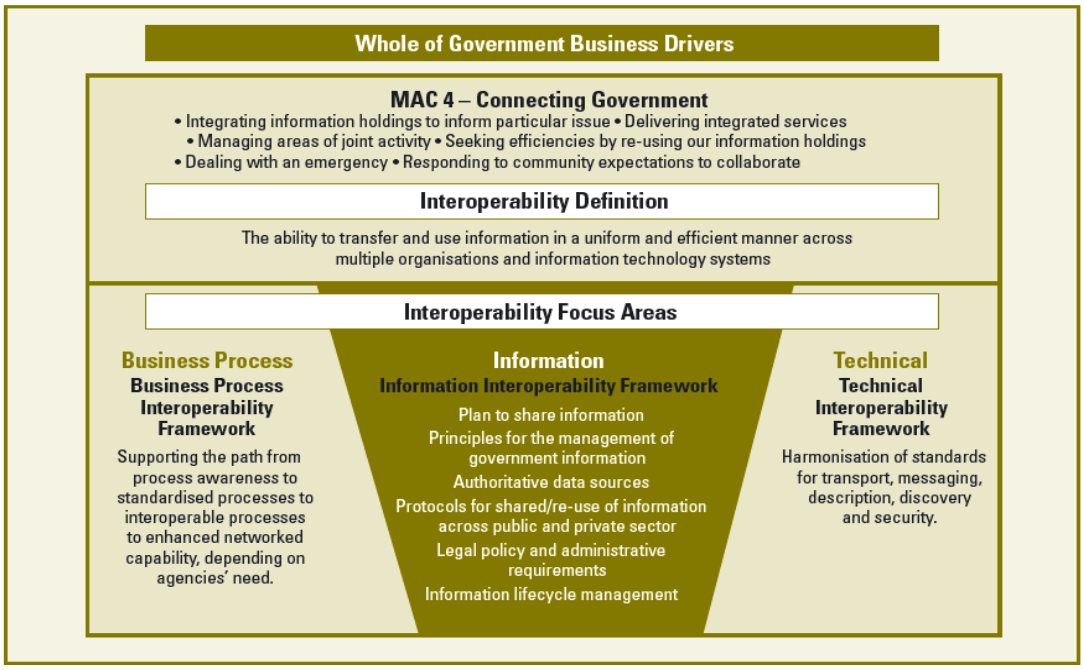
2.8.1 Australian Interoperability Framework

A key theme of Australian Government policy is that agencies should work together to better respond to complex policy challenges and to improve the delivery of services to Australian citizens. Agencies are increasingly required to reach across portfolio boundaries to find collaborative, networked and multi-channel approaches to delivering information and services.

The Framework addresses the information components of the Australian Government Interoperability Framework. The Australian Government Interoperability Framework has three parts, as represented in the diagram below:

- The Information Interoperability Framework comprises information and process elements that convey business meaning;
- The Technical Interoperability Framework which comprises technology standards such as transport protocols, messaging protocols, security standards, process description, languages etc.
- The Business Process Interoperability Framework comprising legal, commercial, business and political concerns.

Figure 2.2: Australian Interoperability Framework



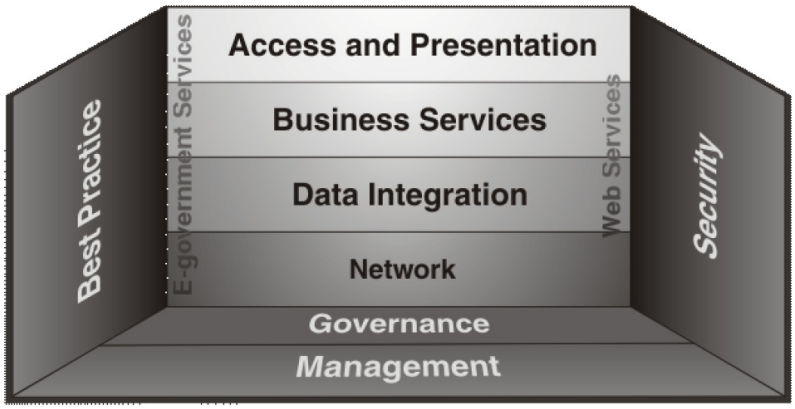
The framework recognises that effective sharing of information is critical to the success of whole-of-government outcomes. The framework further recognizes that information interoperability across government requires a commitment by agencies to the information management principles, a culture of collaboration; and the adoption of agreed standards for managing and sharing information. The enablers of the information interoperability are considered as:- i) forming partnerships that work in a spirit of collaboration; ii) using a 'create once, use many ' approach, with authoritative sources of information; iii) adopting a common business language and standards; iv) establishing appropriate governance arrangements; v) understanding the policy and legal framework governing the exchange of information; and vi) developing and using tools that facilitate the transfer of reliable information across agency boundaries.

2.8.2 NZ e-GIF (State Services Commission 2007)

The benefits of the e-GIF are not specific to the public service or central government. The Cabinet has encouraged adoption by organisations in the wider state sector and local authorities. The e-GIF is also open to use by non-government organizations, the business community, and the public and other jurisdictions.

The model for this version of the e-GIF is illustrated and described below.

Figure 2.3: New Zealand e-GIF Framework



- **Network:** Covers details of data transport, such as network protocols. This is a crucial area for interoperability. Without agreement on networking standards, it is hard or impossible to make systems communicate. The e- GIF uses a subset of the widely proven Internet Protocol suite.
- **Data Integration:** Facilitates interoperable data exchange and processing. Its standards allow data exchange between disparate systems and data analysis on receiving systems.
- **Business Services**: Supports data exchange in particular business applications and information contexts. Some of the standards in this layer are generic, covering multiple business-information contexts. Others work with data integration standards to define the meaning of the data, mapping it to usable business information. For example, an agency will format a stream of name-and-address data in XML (Data Integration) using the business rules of xNAL (Business Services) to create a commonly agreed representation of name-and-address information.
- **Access and Presentation:** Covers how users access and present business systems. Most of the standards in this layer are in the Government web standards and recommendations.

Applying to all of the structural layers are:-

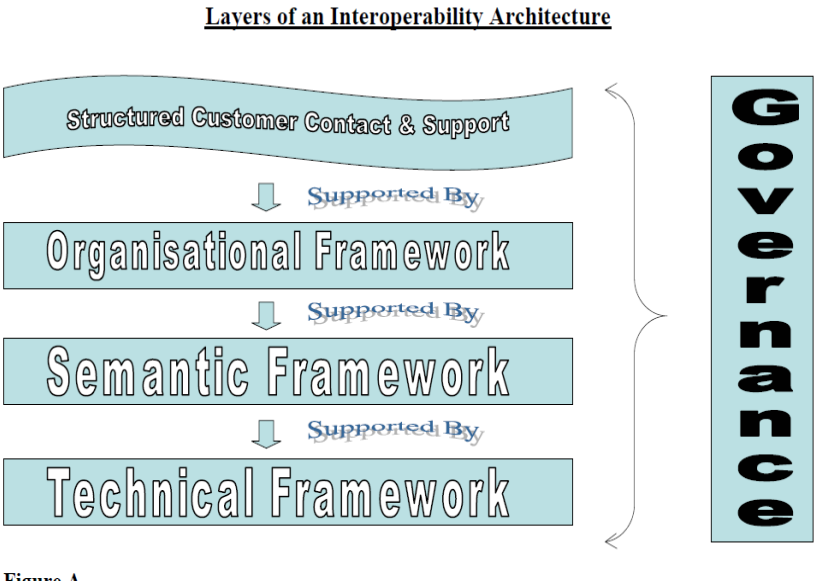
- Security: Crosses all layers, to reflect the fact that security needs to be designed into a system, not added as a layer on top. The e-GIF contains standards at the various levels designed to offer different levels of security as appropriate. It also refers to a series of standards and policy statements which provide advice and direction on the levels required.
- Best Practice: This is a new category to help readers of the e-GIF distinguish published standards from Best Practice, Codes of Practice, and other general or sector-focussed guidance. Published standards alone do not ensure interoperability. They merely offer a common approach to managing and understanding the context of the information exchange.
- E-government Services: These are actual implementations of IT infrastructure, which the ICT Branch of the State Services Commission makes available for public sector agencies to use.
- Web Services: Web Services connect services together. They are an emerging set of standardised applications to connect and integrate web based applications over the Internet. Using Best Practice implementations, agencies can agree a common approach to interoperable service delivery to customers.

Underpinning all these layers are management and governance. Given the need to maintain the e-GIF so that it keeps pace with changing technology, multiple standards may be available for a particular application. Agencies collaborating on interoperability projects may need to either agree on one standard or use mapping technologies to achieve interoperability.

2.8.3 EU (European Public Administration Network 2004)

European Union member states are quite diverse in the way in which their public administrations are organised (using many and varied configurations of central, federal, municipal, regional, district, county, city and town levels of government). This diversity is also reflected in member states structures, laws, procedures and processes. It is against this backdrop of diversity that the e-Government working group of the European Public Administration Network has defined and outlined principles for national interoperability architectures as shown and explained below.

Figure 2.4: European Interoperability framework



a) Structured Customer Contact & Support

This is concerned with the provision of a standardised, consistent and efficient support service that offers the customer multiple channels to choose from, defined points of contact for public service interactions, defence from the complexities of a public administration, and the ability to use self-service and call-centre facilities. To ensure that customers get a consistent experience that is based on very best practices and intensive leveraging of modern technologies, it is suggested that administrations develop one or more customer contact centres as shared services across all agencies at a sectoral, regional and/or public administration level. Such contact centres should have the desired qualities and should facilitate automatic performance measurement. Such an approach could result in significant savings for public administrations and fulfilment agencies through greater use of self-service and the potential for outsourcing non-core activities. In addition, it could allow public administrations to increase their focus on core activities such as strategic policy and planning.

b) Organizational Interoperability

This is concerned with the co-ordination and alignment of business processes and information architectures that span both intra and inter-organisational boundaries. The full business benefits of any interoperability process can only be achieved when all parties to the information

exchange can incorporate and harness the information to suit their own organisational processes, procedures and structures. However as part of this process, a full examination of organisational processes, procedures and structures is required to determine better ways of doing business and to identify and address/remove any possible barriers, including legislative ones, to aggregated services. Co-ordination of business processes across organisational boundaries is essential if a single, aggregated view of a service from the customers' perspective is to be achieved. It is suggested that administrations could develop an exemplar scheme that would define standard approaches to each of the main requirements of any public service and use this exemplar to benchmark all other services; that common functionality could be provided on a shared basis through a broker service to reduce development, deployment and operational costs to the public administration and to each service fulfilment agency.

c) Semantic Interoperability

This is concerned with ensuring that the precise meaning of exchanged information is understandable by any person or application receiving the data. To be of value, interoperability architecture must allow agencies to effectively exchange data, combine it with other information resources, and subsequently process it in a meaningful manner. To achieve this, agreement is required on the context and precise meaning of the exchanged data. It is suggested that administrations develop pan-public service registers/catalogues of standardised business elements that are described and published with a subset of XML. This ensures that each element of data is standardised and registered once only and consequently will endure. Legacy systems need not to be re-engineered as transformations using the registered standards can be developed. These standards can be prescribed to the market when purchasing new technologies or development services, thus ensuring that all future developments and solutions incorporate interoperability standards from the outset.

d) Technical Interoperability

This is concerned with the technicalities of connecting computer systems for the purpose of exchanging information or using functionality. Setting principles, standards and guidelines for a common transfer mechanism, developing standardised metadata (data about data) and using a common language are all required to achieve technical interoperability. To support the interchange of data and use of system functionality in the provision of services, a suggested approach is the development of hub-based standardised XML messaging architectures and XML Web Services. Such architecture has all of the desired qualities that is simple and easy to maintain. Each organisation can connect with a single, standardised interface. Data/information

need to be supplied once and once-only to the hub. That means that special interfaces do not need to be designed, built and maintained but rather accommodates the use of virtual services. This facilitates the use of common or shared services and is infinitely scalable using hierarchical modelling. The core of the architecture is extremely light facilitating maximum flexibility in terms of technology choices for all value-added functions and services located on the periphery of the hub.

e) Governance of Interoperability

This is concerned with the ownership, definition, development, maintenance, monitoring and promotion of standards, protocols, policies and technologies that make up the various elements of an Interoperability Architecture. To ensure that service delivery maintains a pan-public service perspective; that common functionality is developed once and used by all; and that standards are developed, sustained and policed, it is suggested that administrations develop a structured pan-public service governance model. Within this model, "technical" and "semantic" interoperability standards could be the responsibility of a single agency that has the desired qualities and is appropriately underpinned by primary legislation (where required) that defines its establishment, purpose, responsibilities, powers, accountability and redress mechanisms. This agency could also have responsibility for the provision of the common functionality at these layers – although it could outsource the development and operation of them to another competent agency or to the private sector. It is not possible to be prescriptive about the governance of the organisational interoperability layer of the architecture because of the different organisational structures in place across Member States. Therefore, while it is suggested that each administration individually determine which agency is best suited to governing each element in the layer, the Ministry/Agency charged with policy responsibility in that area may be the obvious choice.

2.8.4 E-Government Interoperability Framework for Mozambique

The eGIF4M plan is devised to allow for an incremental introduction, risk minimization, and comprises the following key actions:

a. **Technica**l which includes (i) the implementation of an architectural framework (the eGIF4M service delivery architecture) based on a government service bus, where all the systems shall converge to interoperate, thus reducing the dependencies, the expectations, and the needs of strong coordination with donor funded projects, and (ii) the specification of the standards to be adopted at each level of the architecture, if

applicable, and definition of a life cycle for the standards, to accommodate evolving e-Government projects and innovation in technologies.

b. **Organizational** which is structured in (i) the definition of an interoperability maturity model, which measures the level of compliance and of adoption of eGIF to quantify and make visible the benefits (or disadvantages) of the framework and to setup incentives for the more virtuous projects, and (ii) the setup of an organizational structure and of the decision processes to manage eGIF4M, monitor its execution, and to maintain and enforce it in the longer term.

c. **Systemic support actions,** meant as the set of activities to favour growth of local skills and capabilities, to help create and disseminate a culture of interoperability, to help increase international networking of local companies and universities, and to create a virtuous cycle among public institutions, higher education, and private companies.

2.9 Interoperability Maturity Models

With the aid of an interoperability maturity model, a Government can determine its current interoperability capability and identify its desired interoperability capability and sophistication. By knowing where you are and where you want to be, a strategy can be devised to move towards a desired state of interoperability. A variety of interoperability maturity models have been developed, each adopting a unique vocabulary to express their characterisation of interoperability capability maturity.

The interoperability maturity models below define very similar interoperability maturity levels with the main differences between the models being their focus and the manner in which they rate interoperability (Stefanus V. & Jameson 2012).

The following are the existing maturity models that directly impact on interoperability of person's data and are related to this research.

2.9.1 Levels of Information Systems Interoperability (LISI), Carnegie Mellon 1998

Defines five stages of increasing levels of sophistication regarding information system interaction and the ability of the system to exchange and share information and services such as: (1) Enterprise – Interactive manipulation of shared data and applications, (2) Domain – shared data with separate applications,(3) Functional- minimal common functions, separate data and applications, (4) Connected – electronic connection, separate data & application and (5) Isolated – non connected.

2.9.2 Organisational Interoperability Maturity Model for C2 (Carnegie Mellon, 2010)

The organisational Interoperability Maturity Model for C2 serves to compliment the LISI reference model by extending it into the area of organisational interoperability. The Organisational Interoperability Maturity Model for C2 defines five levels of organisational maturity of which each level is defined by one or more primary enabling attributes. The C2 maturity levels are: (1) Unified- A unified organisation is one in which the organisational goals, value systems, command structure/style, and knowledge bases are shared across the system. (2) Combined-The integrated level of organisational interoperability is one where there are shared value systems and shared goals, a common understanding and a preparedness to interoperate, (3) Collaborative-level is where recognised frameworks are in place to support interoperability and shared goals are recognized and roles and responsibilities are allocated as part of on-going responsibilities however the organisations are still distinct. , (4) Ad-hoc- At this level of interoperability only very limited organisational frameworks are in place which could support ad hoc arrangements. There will be some guidelines to describe how interoperability will occur but essentially the specific arrangements are still unplanned and (5) Independent.- interoperability describes the interaction between independent organisations. These are organisations that would normally work without any interaction other than that provided by personal contact.

2.9.3 Capability Maturity Model Integration (CMMI), Carnegie Mellon

The capability maturity matrix integration (CMMI) was proposed as a process improvement approach that can be used to guide process improvement across entities. CMMI helps to integrate organisational functions, set process improvement goals and priorities, provide guidance, and serve as a reference for appraising processes. CMMI consists of 22 process areas with capability or maturity levels.

2.9.4 Government Interoperability Model Matrix (GIMM), Sarantis, Charalabidis, and Psarras 2008

The Government Interoperability Model Matrix (GIMM) that can be used by organisations to assess their current e-Government Interoperability status in respect to interoperability readiness and performance. The GIMM defines five different sets of organisational interoperability maturity levels, where each level corresponds to a different interoperability level for a set of Interoperability Attributes (IA). The organisational interoperability maturity levels defined in GIMM are closely aligned to the CMMI reference model and to LISI. The GIMM maturity levels are: (1) Independent, (2) Ad-hoc, (3) Collaborative, (4) Integrated and (5) Unified.

2.10 Summary of the Interoperability Models

From a survey done by CS transform, governments are still very far from having a comprehensive set of interoperability products which they can use to drive genuine service transformation. In particular there are three major pitfalls being encountered by governments now seeking to develop and use Ifs. Among these are i) Over-engineering: much of the technical content in many IFs is at a level of detail which, nowadays, is unnecessary. The market has matured significantly in recent years, so the solutions to many of what were previously seen as technical barriers to interoperability are now designed in to a wide choice of competitive, commercial products, ii) Lack of focus on government-wide business transformation and fundamentally the interoperability agenda is still a technically-driven one. The focus on Enterprise Architecture has helped, but the work on this has been very much shaped by the specific needs of the largest government in the world.

The discussed models just like the US Federal Enterprise Architecture (FEA), which many others look to as a model, are very much focused around improving the efficiency of each individual agency and the agencies are required to develop their own EA consistent with the FEA, and much less focused on transforming the relationship of citizens with the government as a whole. In Europe, the debate on expanding interoperability into the organizational and policy layers is right in principle, but in practice is being drowned out by the continued over-emphasis on the technical layer in the EIF. Moreover, the EIF debate is being carried out separately from much of the real progress that some governments are making to address organizational barriers to citizen service transformation. Finally, many governments struggle in moving their IF from being a written document to a delivered reality. Despite the concerns raised above about the limitations of the interoperability agenda, there is no doubt that, it also contains much which is good and useful. Too often though, governments find that a published framework can be difficult to translate into sustained and transformational change in practice.

2.11 Proposed Conceptual Framework

From the above mentioned frameworks, it is evident that the interoperability frameworks are based on technical, semantic, standards, data, organizational, business process, legal/policy interoperability; systems support activities and governance interoperability aspects. All the interoperability frameworks reviewed contained at least two of these aspects.

The context in which interoperability drivers are considered is generally dependent on regions it being applied, the key stakeholder institutions, existing infrastructure and its practicability. As we are particularly concerned with a focussed area of interoperability, it is necessary to consider the aspects of interoperability that affects sharing of person's data across organisations.

According to Gichoya D, (2005) ICT projects success drivers are the factors that encourage or reinforce the successful implementation of ICT projects. Some of these factors are vision and strategy, Government support, external pressure and donor support, rising consumer expectations, technological change, modernization, and globalization. In addition, Gichioya D (2005) defines inhibitors as those factors that do not necessarily prevent the implementation of ICT projects but they do prevent advancement and restrict successful implementation and sustainability. Some of these factors include user needs, technology, coordination, ICT Policy, transfer of ICT idolisers and donor push. Some of the drivers and inhibitors as defined in this literature forms part of the conceptual model as they are closely collated to the implementation of the interoperability framework.

The proposed framework is hinged on the Australian Interoperability framework. For the purpose of simplicity, the term technical interoperability in the proposed framework is retained while business process interoperability is referred to as Organisational Interoperability. In addition, Information Interoperability for the purpose of this framework is referred to as Peripheral interoperability. The terminology, peripheral interoperability, has been coined after assessment of all the factors considered under this interoperability category which are somehow external to the actual drivers of interoperability.

2.11.1 Technical Interoperability

As posited by CS transform, the conceptual framework does not so much dwell on the details of what was previously seen as technical barriers to interoperability since many product are now designed into a wide choice of competitive, commercial products. Scholl (2005) further contends that Interoperability is not merely technical, it has many other dimensions. In fact, the technology side may prove the least difficult to address, while the organizational, legal, political, and social aspects may prove much more of a challenge. The framework looks into issues like security as a very pertinent component of technical interoperability due to the sensitivity of data involved coupled with the many players dealing with people's data. Special focus must be put to measure confidentiality, integrity and availability of the systems and person's data. Confidentiality in particular must be used to ensure there is authorized access to

person's data, while integrity provides protection against data modification, and availability guarantees that the data is available when and where needed in instances where it is shared across organisations. Besides these, system administrator authentication, user access, data storage, and encryption are other aspects that must be addressed to provide a comprehensive solution to network security.

To be interoperable, so that person's data can be shared, databases need to be compatible at i) physical level whereby we consider whether it is possible to transfer data values without corruption (e.g. caused by errors or due to differing character sets) (ii) data level whereby the same data is present in both (or can be accepted by the receiving database) and (iii) semantic level where the data actually means the same thing in both databases. The interoperability of the databases and workflows in the agencies involved must be considered for the purpose of addressing any incompatibility that may exist across standards used in some proprietary systems especially the ones used in collection of biometric data, inherit security models in the systems as well as the legacy systems used by some of the institutions.

As per the literacy review, the semantic component was considered critical for ensuring that the precise meaning of exchanged person's information is understandable by any person or application receiving the data. To achieve this, an agreement is required on the context and precise meaning of the exchanged data. This is particularly important due to the various organisations that are concerned with collection and use of person's information that is necessary for harmonisation of data heterogeneity.

Though semantic interoperability components has been considered on its own in the interoperability framework reviewed, this conceptual framework has made considerations to combine it with the technical interoperability in a very generic manner. This is so because the research is based on a much focussed specific area of person's data. Business process re-engineering associated with legacy systems is necessary for this to be achieved. It should however be appreciated that process reengineering is a cross cutting issue both at technical and organisational elements of the conceptual model.

2.11.2 Organisational Interoperability

CS transform identifies the following as the e-GIF good governance dimensions that institutions need to adapt in the implementation of the IFs; i) principle based criteria by publishing a clear set of principles to govern selection of e-Government standards, ii) stakeholder inclusiveness and openness by establishing clear processes by which all stakeholders can see and engage with e-GIF development; iii) process transparency by

publishing a clear audit trail enabling stakeholders to see how the e-GIF evolves over time; iv) take-up and use that involves embedding the e-GIF as an integral part of procurement policy for the public sector and v) lifecycle review through updating e-GIF on a two yearly cycle.

Principle based criteria of publishing a clear set of principles to govern selection of person's data standards as identified by the CS transform stands out as one of the parameters that was considered. This was so in the light of the many player's involved in person's data, stakeholder inclusiveness and openness by establishing clear processes by which all stakeholders can see and engage with e-GIF development thus becoming very pertinent.

Data ownership comprising of definition, development, maintenance, monitoring and promotion of standards, protocols, policies and technologies that make up the various elements of interoperability architecture also becomes very pertinent. This is also closely concerned with accountability, transparency, equal access of sharing of information. It will be appreciated that organizational barriers includes (lack of readiness, absence of e-government champion and stakeholder commitment, and legacy processes. Another important issue for consideration was the impact of bureaucracy in sharing of person's data.

Business process change (BPC) has been defined as a strategy-driven organizational initiative to improve and (re-)design business processes in order to achieve competitive advantage in performance through changes in the relationships among management, information technology, organizational structure, and people. After that, it integrates a strategy-driven change effort and a method of process improvement with Information Technology (IT) introduction. (A. Pateli, S. Philippidou, 2010). Business process re-engineering is required at the individual institutional level for the interoperability of person's data to be achieved. The proposed conceptual model attempts to review BPR preparedness at the institutional level for the purpose of person's data interoperability.

2.11.3 Peripheral Interoperability

From the literacy review, politics has been identified as a key factor affecting the implementation of ICT projects. Gerald Sussman, 1997 in his book communication, technology and politics in the information age contends that technology and politics are conceptually inseparable because the rule under which technological enterprise is undertaken is essentially political in nature. Politics is precisely about what the rules are and who is favoured by them, but most important, it is about who gets to make them. Where there is technology, there is embedded politics. Kenya has general elections after a few years and it is imperative to

measure whether the political scene has had any effects in the IT choices identified including the issues of interference from the political leadership.

From the case presented by eGIF4M and other literature review, it is imperative to consider and evaluate whether donors have any impacts on person's data interoperability. This was done alongside political issues. This will assist in deriving whether donors are genuine and means well for Africa to solve its interoperability challenges. This is exemplified by eGIF4M which does not seem to address critical issues in an IF.

The other issue that has been overemphasised in the literature review and has been considered in this category is provisions of the legal and policy framework for implementation of person's data interoperability.

2.11.4 Summary of the Interoperability issues

The following table outlines the interoperability issues that fall under each category of the conceptual model as outlined above.

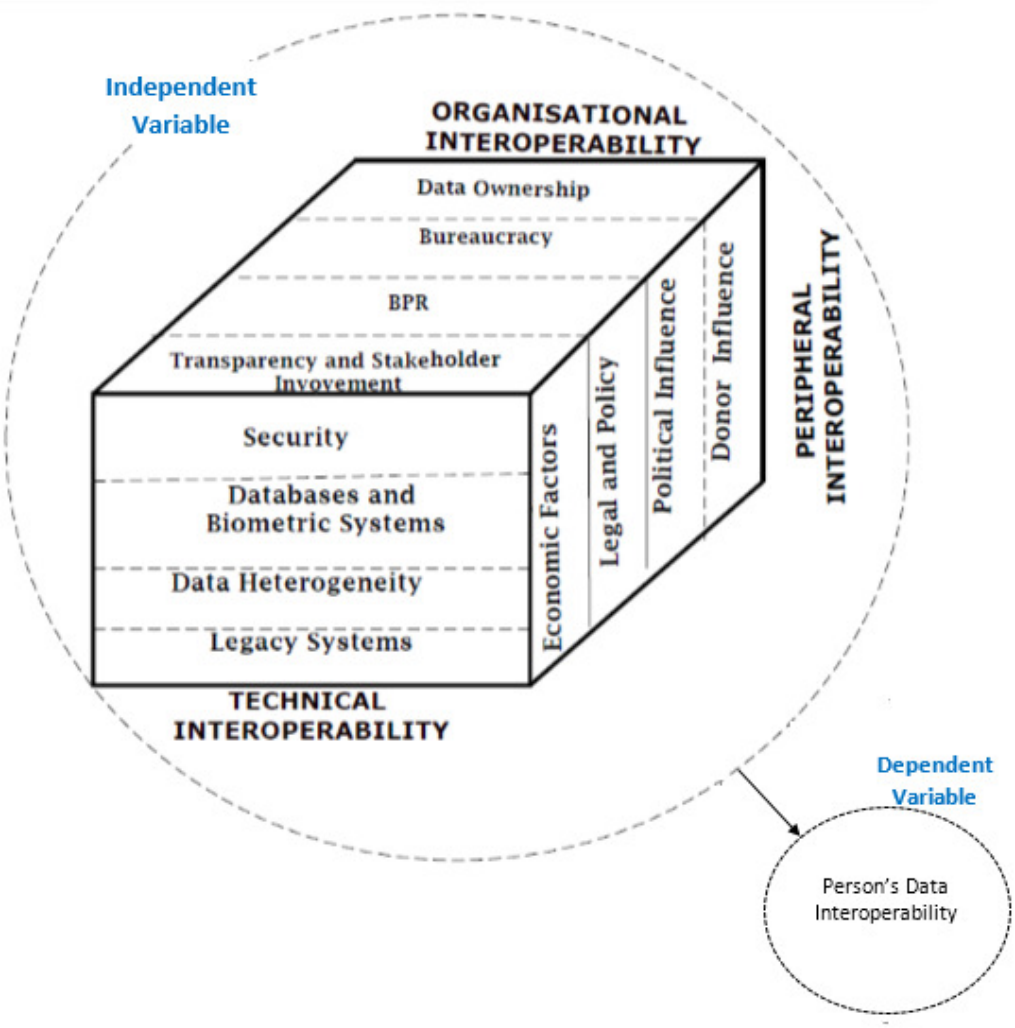
Table 2.2: Conceptual Model Interoperability Issues

Interoperability Categories	Interoperability Measurement Parameter	Interoperability level to be measured
Technical Interoperability	Security	Measure of security impact on interoperability
	Databases and Proprietary Biometric systems	Measure of the impact of databases and proprietary biometric systems
	Data heterogeneity	Measure for the need for same data formats
	Legacy Systems	Measure of impacts of the legacy systems
Organisational Interoperability	Stakeholder involvement	Measure for need of inter-agency collaborations
	Data Ownership	Measure of the data ownership
	Bureaucracy	Measure of effects of bureaucracy to person's data interoperability

Interoperability Categories	Interoperability Measurement Parameter	Interoperability level to be measured
	Business Process Re-engineering	Measure for the need for re-engineering the business processes
Peripheral Interoperability	Economic factors	Economic factors
	Legal and Policy factors	Policy and Legal factors
	Politics	Measure of effects of politics
	Donor funding	Measure of the effects of donors

The following figure is the conceptual Interoperability model upon which this research proposal is based.

Figure 2.5: Proposed Person's data Interoperability Conceptual



CHAPTER THREE

METHODOLOGY

3.1 Research Design and its justification

According to De Vos (1998:123) a research design is a blueprint or a detailed plan of how a research study is conducted. Kothari (1988) says, "Decisions regarding WHAT, WHERE, WHEN, HOW MUCH, by WHAT, means concerning an inquiry or a research study constitute a research design.

This research endeavours to extend the body of knowledge from the previous researches by focussing on specifics of interoperability in respect to person's data. This research was conducted in selected institutions directly dealing with person's registration systems in one aspect or the other. In a descriptive study, the first step is to specify the objectives with sufficient precision to ensure that the data collected are relevant. If this is not done carefully, the study may not provide the desired information, Kothari (2004). In this case, a quantitative, descriptive study was conducted to determine:

i. Key issues that requires consideration to ensure there is interoperability and sharing of persons data amongst organizations concerned with stashing and supplying persons data;

ii. Whether the existing frameworks sufficiently cover all parameters of evaluating interoperability of persons data ;

iii. The interoperability parameters/ issues best suited for consideration for sharing of persons data in the Kenyan situation.

The research design was a non-experimental uni-variate, and descriptive survey design. Couchman & Dawson (1995), Polit & Beck (2004) posits that a survey is used to designate any research activity in which the investigator gathers data from a portion of a population for the purpose of examining the characteristics, opinions or intentions of that population and the objectives of the research. The survey therefore targeted officers from Civil Registration Department (CRD), National Registration Bureau (NRB), Integrated Population Registration Department (IPRS) and ICT officers from across the Ministries.

Kothari C.R (2004:37) defines descriptive research as studies concerning individual, group or situation. Further, he contends that in descriptive research, the researcher must be able to define clearly, what he wants to measure and must find adequate methods for measuring it along with a clear cut definition of 'population' he wants to study. In this study, the researcher obtained and analysed the views of the respondents with regard to the nature of their exposure to person's data, the benefits and views due to their exposure, and the problems that they day to day experience they have gained in the field of person's registration systems. The research was based on several variables that were grouped in categories as discussed in 2.11.3. In addition, there was no manipulation of variables and minimal control of the research setting was exercised due to the nature of respondents targeted in the study. The data collection conditions were however standardized to enhance data quality.

3.2 Research Method

3.2.1 Target Population

Polit and Beck (2004) define a population as the entire aggregation of cases that meet a designated set of criteria. The target population is the aggregate of cases about which the researcher would like to make generalisations (Polit & Beck, 2004). Kothari (2004) posit that in descriptive research, the research design must make enough provision for protection against bias and must maximise reliability with due concern for the economical completion of the research study. The target population in this study was persons that are concerned with registration of person's activities in the respective statutory organisations with an acceptable degree of knowledge in person's data interoperability issues. This was determined by their cadres as captured in the GHRIS database.

The first step in developing any sample design is to clearly define the set of object, technically called the universe to be studied. In infinite universe, the number of items is finite but in case of an infinite universe, we don't have the total number of the items. (Kothari, 2004). Polit and Beck (2004) define eligibility criteria as the criteria that specify the characteristics that people in the population must possess, to be considered for inclusion in a study. The eligibility criteria for inclusion in this study was personnel in the targeted institutions that were either business owners, systems users, administrators or ICT staff primarily concerned with development and support/management of the IT systems at the Ministries having the following attributes:-

i. Person's directly dealing with the registration of person's at the tactical and management level;

ii. An acceptable academic qualification and specifically those having a diploma and upwards;

iii. The ICT staff with acceptable knowledge of the person's registration systems and other related IT systems in the designated institutions;

3.2.2 Sampling frame and Sample Size

The details of the target population were obtained from the Government Human Resource Information Systems (GHRIS) in the Directorate of Public Service Management (DPSM), Ministry of Devolution and Planning. The updated details received included names, job groups, designation, e-mail address and mobile contacts. The targeted officers from this population served as the sampling frame.

When field studies are undertaken in practical life, considerations of time and cost almost invariably lead to selection of respondents. The respondents selected should be as representative of the total population as possible in order to produce a miniature cross-section.(Kothari, 2004). If a population from which a sample is to be drawn does not constitute homogeneous group, stratified sampling technique is generally applied in order to obtain representative sample. Under the stratified sampling, the population is divided into several sub populations that are individually more homogeneous than the total population called strata. (Kothari, 2004)

Due to the homogeneity of the respondents in the target population because of their professions, academic training, orientation and exposure, stratified random sampling was used. Suppose the disjointed groups from the four targeted institutions are N_1, N_2, N_3, and N_4 units respectively. These subgroups, called strata, together compromise the whole population, so that $N_1 + N2 + N_3 + N_4 = N$ as illustrated below form the target stratum. The values of targeted institutions forming the strata in table 3.1 were in this case obtained from the GHRIS database. In order to get the required information with the least sampling error, the following statistical formula was used to determine the sample size

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision (say 95 per cent confidence level (±5% precision).

Table 3.1: Breakdown of Sample Strata Values

Institutions	**Strata size**	**Strata value**
Civil Registration Department	N_1	50
National Registration Bureau	N_2	197
Integrated Population Registration Department;	N_3	9
ICT officers from across the Ministries.	N_4	387
TOTAL		643

For a general survey, the size of the sample should be large, but a small sample is considered appropriate in technical surveys (Kothari, 2004). The sample sizes of the four target groups forming the strata groups are depicted in table 3.2. The sample size was arrived after application of the formula above.

Table 3.2: Sample size of the Stratas

Institutions	**Strata size**	**Strata value N_i**	**Sample** $n = \frac{N}{1 + N(e)^2}$
Civil Registration Department	N_1	50	22
National Registration Bureau	N_2	197	33
Integrated Population Registration Department;	N_3	9	7
ICT officers from across the Ministries.	N_4	387	36
TOTAL		643	98

The Mann-Whitney U-test was performed to determine whether there are any existing differences between the responses from various strata.

3.2.3 Data Collection Methods

A self-administered questionnaire was developed using online survey tools and the url of the site generated. This choice was necessary because it was possible to reach as many of the targeted respondents as possible regardless of their geographical locations. This ensured achievement of the economic viability of the study in terms of financial and time constraints of distributing the questionnaires. The url of the site was circulated to the targeted respondents through their email addresses that had been acquired from the GHRIS database. This was followed by telephone calls to as many respondents as possible to increase the response rate.

The respondents filled the questionnaires and the responses from the url were collated into the web server database.

According to Kothari (2004), while designing data collection procedure, adequate safeguards against bias and uncertainty must be ensured. Whichever method is selected, questions must be well examined and made unambiguous. Pre-testing of an instrument is done to determine its feasibility and validity (Brink & Wood 1998:259). Validity refers to the degree to which an instrument measures what it is supposed to be measuring (Polit & Beck 2004: 422). The researcher pre- tested the questionnaire prior to data collection to enhance its validity and eliminate any ambiguity. This was achieved by subjecting the questionnaire to five experts in the area of person's data interoperability in which all their inputs were considered in the development of the questionnaire.

To the extent possible, the processing and analysis procedure will be planned in detail before the actual data collection is undertaken (Kothari 2004). The questionnaires language was kept as simple and non-technical as possible for the benefits of the non-technical respondents. The research ensured that the flow of the questions was in a manner not likely to intimidate the respondents especially the non-technical staff.

3.3 Validation and Reliability of the results

To test the validity of the resulting interpretive understanding, the researcher refers back to the subjective understanding, accomplishing this by for example discussing the conceptual models with other participants to verify the sensibility of "apparent absurdities" (Lee 1991, p. 352). Misunderstandings or misinterpretations of the subjective understanding can be more easily recognized by jointly discussing the conceptual models. By so doing, conceptual models serve as an instrument for the researcher to engage into a dialogue with practitioners (Mårtensson & Lee 2004). In order to ensure that the research is reliable, Cronbach's alpha statistical test was carried out to measure the reliability of the questionnaire.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

In this research, the structured questionnaire (Appendix I) was developed and the url link was sent to the targeted respondents who included ICT officers in the Ministries, business technical arm and administrators from National Registration Bureau, Civil Registration department and Integrated Population Registration Systems department via an email.

After the participants had filled the questionnaires, the responses were imported from the online survey server to an excel work sheet. What followed data cleaning of the responses to ascertain their correctness and completeness. The total number of completed questionnaires that had been filled was 217. A random sample was drawn from the filled questionnaire to meet sample targets of the four strata's considered as explained in table 4.61.

The main purpose of the questionnaire was to answer the research objectives. The questionnaire captured all metrics that were used to evaluate the proposed person's data interoperability framework.

4.2 Data Processing and analysis

SPSS statistical software's (version 17) was used to perform statistical test and analysis. The findings, analysis and interpretations from the data that was collected from the targeted population are presented in this chapter.

4.3 Coding of the Data

The data collected and captured in the Microsoft excel worksheet was first of all imported to SPSS package. The data from the online server was not coded at this stage. Each question was assigned a number that made a distinction of which section of the questionnaire it came from. The questionnaire in this case had different sections covering different aspects that were being investigated in relation to the research objectives. There were two main types of questions that were used for the survey. There was a set of Likert-type questions that were assigned numbers 1 to 5 as below and were considered as ordinal data.

Table 4.1: Likert type questions codes

Response	Code
Strongly agree	1
Agree	2
Neither Agree nor Disagree	3
Disagree	4
Strongly Disagree	5

The questions on respondents profile were coded as nominal data. The section that was measuring the levels of priorities and challenges in respect to the parameters under research were considered as nominal data. These types of questions were coded. Instead, the strings were converted into integers for quantitative analysis. The data that was randomly sampled from the four strata's was eventually combined into one file. Once this has been done, the data was eventually coded awaiting analysis.

4.4 Reliability and Validity of the collected data

In many surveys, it is important to ensure that data collected with the survey instruments is reliable and valid. Cronbach's alpha test was used to measure how closely related a set of items are as a group. Two sets of items were measured. The first was the Likert-type of questions in the respective sections. The following table shows the results of this measure.

Table 4.2: Cronbach's alpha statistics results on relaibility and validity of the data

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Existence of interoperability	19.9020	24.810	.171	.714
Improvement of verification	19.9608	23.198	.620	.674
Use of ICT in improving Interoperability	20.0392	24.358	.471	.690
Improvement of person's data accuracy	19.7451	22.874	.556	.674
Duplication of person's data generation	19.9216	25.194	.131	.718
Need for a common identifier	20.0980	25.770	.217	.709
Stakeholder Involvement	19.6078	22.563	.412	.684
Data Ownership	19.8039	23.521	.324	.696
Bureaucracy	19.6275	22.478	.475	.677
Business Process Reengineering	19.7451	23.034	.498	.678
Enabling legislation policy and Strategies	19.4902	22.135	.313	.702
Lack of budget	18.4510	22.293	.242	.719
Political and donor factors	18.6667	20.787	.366	.696
Cronbach test = 0.712				

The following was the Cronbach's alpha test for the questions testing validity and reliability of the priority type of questionnaires for each aspect of interoperability that was being investigated.

Table 4.3: Cronbach's test results on Priority questions

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Business Process Reengineering	41.94	62.358	.502	.789
Data Ownership	41.79	62.424	.586	.783
Stakeholder Involvement	41.75	60.574	.619	.778
Bureaucracy	42.02	59.425	.670	.773
Enabling Legislation, policy and Strategies	41.73	63.563	.482	.791
Lack of Budget	42.67	70.823	.139	.819
Political Interference	42.31	64.858	.397	.799
Donor factors	43.27	70.585	.100	.828
Data Security	41.40	64.840	.505	.790
Data Heterogeneity	41.85	62.723	.524	.788
Databases and Biometric Systems	41.63	63.644	.499	.790
Legacy Systems	42.04	62.551	.494	.790
Cronbach's Alpha = 0.808				

George and Mallery (2003) provided the following rules of thumb for the Cronbach's alpha reliability test: Greater or equal to 0.9 is excellent, equal to 0.8 is good, equal to 0 .7 is acceptable, equal to 0.6 is questionable, equal to 0.5 is poor, and less than 0.5 is unacceptable. The two sets of questions had Cronbach's alpha value of 0.712 and 0.808 respectively. This means that the two set of questions had all met the threshold of reliability.

4.5 Choice of the Sampling Method

Mann Whitney U test was carried out to test any existing differences between the responses from the business owners who are non-technical in the area of speciality in question and ICT officers. The intrinsic role played at the ministries was treated as the dependent variable while the parameters sought for were treated as the independent variables. In Man Whitney U test, the existing difference is determined by the value of asymptotic significance (2 tailed). The existing differences decreases as this value increases. Therefore, any measure whose value is zero is said to have a huge difference whereas any value that is nearing 1 is said to have zero difference. Values that are more than 0.5 are said to have an acceptable difference. Save from

few of the parameters, it can be observed that the perspective of the issues under investigation by the two groups is different and hence the justification of the stratified random sampling as our sample design. Table 4.4 below shows the results for all the variables denoted as v5…..v33 that were tested during the study.

Table 4.4: Man Whittney U test results

	v5	v6	v7	v8	v9	v10		
Mann-Whitney U	28.500	18.000	22.000	31.000	39.000	31.500		
Wilcoxon W	73.500	63.000	67.000	76.000	84.000	76.500		
Z	-1.347	-2.525	-1.975	-.935	-.160	-1.458		
Asymp. Sig. (2-tailed)	.178	.012	.048	.350	.873	.145		
Exact Sig. [2*(1-tailed Sig.)]	.297a	.050a	.113a	.436a	.931a	.436a		
	v11	v12	v13	v14	v15	v16	v17	v18
Mann-Whitney U	33.000	28.500	23.500	22.500	38.500	18.000	23.000	36.000
Wilcoxon W	78.000	73.500	68.500	67.500	83.500	63.000	68.000	81.000
Z	-.728	-1.214	-1.607	-1.735	-.211	-2.149	-1.665	-.430
Asymp. Sig. (2-tailed)	.466	.225	.108	.083	.833	.032	.096	.667
Exact Sig. [2*(1-tailed Sig.)]	.546a	.297a	.136a	.113a	.863a	.050a	.136a	.730a
	v19	v20	v21	v22	v23	v24	v25	
Mann-Whitney U	21.500	40.500	24.500	25.000	28.000	22.500	18.500	
Wilcoxon W	66.500	85.500	69.500	70.000	73.000	67.500	63.500	
Z	-1.778	.000	-1.454	-1.483	-1.145	-1.660	-1.999	
Asymp. Sig. (2-tailed)	.075	1.000	.146	.138	.252	.097	.046	
Exact Sig. [2*(1-tailed Sig.)]	.094a	1.000a	.161a	.190a	.297a	.113a	.050a	
	v26	v27	v28	v29	v30	v31	v32	v33
Mann-Whitney U	34.000	40.000	23.500	18.500	33.000	25.000	36.000	27.000
Wilcoxon W	79.000	85.000	68.500	63.500	78.000	70.000	81.000	72.000
Z	-.685	-.047	-1.795	-2.029	-.910	-1.459	-.505	-1.245
Asymp. Sig. (2-tailed)	.494	.963	.073	.042	.363	.145	.614	.213
Exact Sig. [2*(1-tailed Sig.)]	.605a	1.000a	.136a	.050a	.546a	.190a	.730a	.258a

4.6 Respondents of the Survey

This section details the results of the responses received from the survey.

4.6.1 Respondents by Strata's

The following table shows the percentage response from the four strata's considered.

Table 4.5: Breakdown of the respondents by departments

Department	Sample Values	No of Responses	Percentage Turn-around
Civil Registration Department	22	22	100%
National Registration Bureau	33	35	106%
IPRS	7	6	86%
ICT Officers	36	154	428%
TOTAL	**98**	**217**	**221%**

The high percentage response from CRD, NRB and IPRS who are the technical arms in the person's registrations systems was made possible by persistent follow up calls to ensure that the number satisfies the sample targets. However, it was not possible to acquire the targeted sample target for IPRS due to time limits and unavailability some target population. For the purpose of this survey, this compensated by swapping one of the extra responses from National Registration Bureau.

4.6.2 Respondents by Gender

From table 4.5, 63% of the respondents were male while 37% were female. Given that the ratio of female employees is still low as compared with male in the targeted institutions; this is a clear indication that the survey was gender representative.

Table 4.6: Respondents by Gender

Gender	Frequency	Percent	Cumulative Percent
Male	62	63.0	63.0
Female	36	37.0	100.0
Total	98	100.0	

4.6.3 Respondents by Age

Table 4.6 below shows the respondents by age. The selection of the ages was purely random. The results showed that 9.2% were within 20-29 age blanket, 59.2% were within 30-39 age blanket, 27.5% were within 40-49 age blanket and 4.1% were within 50-59 age blanket. From these results it is indicative that the majority (59.2%) of the respondents were between 30-39 years of age. This is an age that is responsive to changing dynamics in the IT field hence reinforcing the validity of the survey results.

Table 4.7: Respondents by Age

Age blanket	Frequency	Percent	Cumulative Percent
20-29	9	9.2	9.2
30-39	58	59.2	68.4
40-49	27	27.5	95.9
50-59	4	4.1	100.0
Total	98	100.0	

4.6.4 Respondents by levels of education

Table 4.7 shows four levels of education that were used to measure the knowledge levels of the respondents regarding interoperability of person's data. The levels included O-level, college, graduate and post- graduate levels. There was no one with only an O-level qualification. 7.1% of the respondents had college education qualification while the rest were all graduates and post graduates both standing at 43.9% and 49.0% respectively. It should be noted that the survey attracted a huge percentage of graduate and post graduate qualifications at 92.6%. This is obviously a very knowledgeable portion of the society that undoubtedly reinforces the validity, precision and reliability of the survey results.

Table 4.8: Respondents by level of education

Level of Education	Frequency	Percent	Cumulative Percent
O-Level	0	0	0
College	7	7.1	7.1
Graduate	43	43.9	51.0
Post-Graduate	48	49.0	100.0
Total	98	100.0	

4.7 Detailed Survey Results after analysis

4.7.1 General questions – Justification for Person's data Interoperability

The questions in this section were used to assess information generation and sharing amongst key sources of person's data within key stakeholder public sector entities in Kenya. The first four questions sought to access sharing of person's data in Kenya and the results of the survey are discussed hereunder. 94.4% of all the respondents strongly agree and agree that there ought to be interoperability of person's data. Similarly, a total of 96.3%, of all the respondents strongly agree/agree that interoperability between person's data registration systems will improve verification of person's data amongst the key stakeholder organisations. 98.2% composed of 81.5%, 16.7% strongly agree and agree respectively that ICT has a crucial role to play in improving interoperability in person's data. Again, over 90.2 % were of the opinion that the overall accuracy of person's information will be improved once interoperability is implemented across systems dealing with person's data.

The next questions in this section sought to access person's data generation as discussed below. 90.2% of the respondents agree that there was duplication in generation of person's data during a citizen's lifecycle. A significant 98.2% of the respondents agree that there is a need for adapting a common person's identifier in the course of a citizen's life cycle.

From the above statistics, it is imperative to note that there is clearly a need for person's data interoperability. The results epitomises the need for ICT use in order to achieve interoperability that will lead to accuracy of person's data in Kenya as well as in elimination of duplications in registration process.

Table 4.9: Responses on sharing and generation of person's data

		Strongly Agree	Agree	Neither Agree/ Disagree	Disagree	Strongly Disagree	Total
Existence of interoperability	Count	71	22		5		98
	%	72.2%	22.2%	0.0%	5.6%	0.0%	100%
Improvement of verification	Count	74	20	4			98
	%	75.9%	20.4%	3.7%	0.0%	0.0%	100%
Use of ICT in improving Interoperability	Count	80	16	2			98
	%	81.5%	16.7%	1.9%	0.0%	0.0%	100%
Improvement of person's data accuracy	Count	54	34	7	2		98
	%	55.6%	35.2%	7.4%	1.9%	0.0%	100%
Duplication of person's data generation	Count	73	20	4		2	98
	%	74.1%	20.4%	3.7%	0.0%	1.9%	100%
Need for a common identifier	Count	82	15		2		98
	%	83.3%	14.8%	0.0%	1.9%	0.0%	100%

4.7.2 Organisational Person's data Interoperability issues

This section was used to collect data on what was considered from the literature review as very pertinent organisational issues affecting person's data interoperability. The issues that were considered under organisational interoperability includes stakeholder involvement, identification of a clear data owner, bureaucracy in the public institutions dealing with person's data and the need for business process reengineering in our persons registrations systems processes. Over 87.7% of the respondents were in agreement that individualism and lack of stakeholder involvement was a challenge to person's data interoperability. A partly small percentage of around 4% were of the different opinion whereas 8.2% didn't have an opinion on the issue. A significant percentage of over 87.3% believed that there was need for a single agency being in charge of ownership of the person's data that can be populated by other organisations. There was 8.2% that neither agreed nor disagreed with this assertion with only 4.1% of the respondents disagreeing. 55.1% and 29.6% bringing a total of 84.7% strongly agreed and agreed respectively that bureaucracy is a challenge affecting interoperability of person's data in Kenya. We however had over 13.3% who had no opinion on the issue with 2% disagreeing on the issue.

57.1% of the respondents strongly agreed that business process reengineering was necessary for interoperability of person' data while there was a 36.7% that agree that BPR is necessary. Only a small fraction of 4.1% of the responds neither agree nor disagree with the necessity for BPR for ease in implementation of person's data while 2.0% were in disagreement.

Table 4.10: Responses of Organisational Interoperability issues

		Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	Total
Stakeholder Involvement	Count	51	35	8	2	2	98
	%	52.0%	35.7%	8.2%	2.0%	2.0%	100%
Data Ownership	Count	69	17	8	4		98
	%	70.4%	17.3%	8.2%	4.1%	0.0%	100%
Bureaucracy	Count	54	29	13	2		98
	%	55.1%	29.6%	13.3%	2.0%	0.0%	100%
BPR	Count	56	36	4	2		98
	%	57.1%	36.7%	4.1%	2.0%	0.0%	100%

The responses received in these questions cemented the need for business process reengineering in our registration systems, stake holder involvement in the process as well as clear identification of the data owner. There were also a huge percentage of the respondents that felt that bureaucracy was a key impediment to person's data interoperability as is illustrated in the results above.

In every area of interoperability surveyed, there were subsequent questions that measured the priority rankings that the respondent would accord each aspect required for interoperability of person's data. Since these are ordinal type of questions, there has been a scholarly argument that calculating means of ordinal data is not a very accurate measure of the ranking of the various aspects considered. In order to overcome the bias of means of ordinal data, Friedman test was considered as the most appropriate test that would provide mean rankings of factors considered in each area of interoperability considered.

Table 4.10 shows the Friedman's rank means for the four issues considered in the order of priority in the organisational interoperability. Surprisingly, the respondents felt that bureaucracy was the top most hindrance to persons data interoperability followed by data ownership, lack of stakeholder involvement and finally the need for the business process reengineering each with a mean rank of 2.69, 2.61, 2.38 and 2.32 respectively.

Table 4.11: Level of Priorities for Organisational issues

	Parameter (Issues)	Mean Rank
1	Bureaucracy	2.69
2	Data Ownership	2.61
3	Stakeholder Involvement	2.38
4	BPR	2.32

By further analysis of Friedman test with a confidence interval of 0.05, and the null hypothesis Ho: there is no difference between the four conditions and the alternate hypothesis H1: there is difference between the four conditions results in the test statistics being 4.914 (3, n=98), $p>0.5$ hence the conclusion that there is no difference among the four groups.

Further analysis to determine the valuables that have no significant differences by application of Wilcoxon sum test as shown in the results of table 4.11 below indicate that bureaucracy and business process reengineering are more or less the same. This also applies to data ownership

and business process reengineering. Both of the combinations have exhibited a very low value of Z indicating that they could be having an insignificant difference.

Table 4.12: Friedman test of various combinations of factors

Factors Combination	**Z**	**Asymp. Sig. (2-tailed)**
Stakeholder Involvement, Data Ownership	-.974[a]	.330
Bureaucracy, Stakeholder Involvement	-1.140[a]	.254
BPR, Stakeholder Involvement	-.337[b]	.736
Bureaucracy, Data Ownership	-.241[a]	.810
BPR, Data Ownership	-1.180[b]	.238
BPR, Bureaucracy	-1.707[b]	.088

a. Based on negative ranks.

b. Based on positive ranks.

c. Wilcoxon Signed Ranks Test

4.7.3 Peripheral Person's data Interoperability issues

In regard to peripheral factors affecting person's data interoperability, lack of enabling legislation policy and strategies, lack of budgets and political and donor interference were considered. Table 4.12 shows the outcome of the survey.

Table 4.13: Responses on the Peripheral Person's data interoperability issues

	Strongly Agree	**Agree**	**Neither Agree nor Disagree**	**Disagree**	**Strongly Disagree**	**Total**
Enabling legislation policy and Strategies	56	25	6	8	4	98
	56.9%	25.5%	5.9%	7.8%	3.9%	100%
Lack of budget	19	19	31	19	10	98
	19.6%	19.6%	31.4%	19.6%	9.8%	100%
Political and donor Factors	21	35	15	17	10	98
	21.6%	35.3%	15.7%	17.6%	9.8%	100%

A significant percentage of 72.4% of the respondents, strongly agree and agree that lack of enabling legislation, policy and strategies is a hindrance to achieving sharing of person's data in Kenya while 11.7% were in divergent opinion with inconsequential percentage of 5.9% having no opinion on the issue. 11.7% were in disagreement that the enabling legislation,

policy and strategies does not affect interoperability. 39.2% of were in agreement that lack of budget has hindered implementation of inter-operability of person's data. A significant percentage of 31.4% did not have an opinion on the issue while 29.4% disagreed that budget provision was not a hindrance to implementation of interoperability. In regard to political and donor interference, 56.9% agree that it is a factor that can affect the said interoperability, 15.7% were of no opinion while the rest of 27.4% were of contrary opinion which is a significant percentage.

The survey findings points to a conclusion that lack of budget cannot indeed be considered as a major factor affecting person's data interoperability followed by political or donor impacts. The findings further show that lack of enabling legislation, policy and strategies is a key component to consider for person's data interoperability.

The respondents were further asked to give the level of challenge posed to interoperability of person's data by lack of enabling legislation, lack budget as well as political and donor factors which were subjected to Friedman tests. Lack of enabling legislation came out as the top most issue that poses serious challenge with a mean rank of 3.19 followed by political interference at mean rank of 2.65 while lack of budget and donor factors had a mean of 2.35 and 1.81 respectively.

Table 4.14: Friedman Test Ranking of the Peripheral issues

	Factors (Issues)	Mean Rank
1	Enabling Legislation, policy and Strategies	3.19
2	Political Interference	2.65
3	Lack of Budget	2.35
4	Donor factors	1.81

Further Friedman test analysis with a confidence interval of 0.05, null hypothesis Ho: there is no difference between the four conditions, alternate hypothesis H1: there is difference between the four conditions results in test statistics value 47.927 which is greater than the Chi-square value of 7.815 (3, n=98), $p>0.5$. The conclusion of the Friedman test is there is a difference among the four groups.

4.7.4 Technical Person's data Interoperability issues

This section was geared towards measuring the technical issues that may impact on interoperability of person's data. The technical issues considered in this area included security, database and biometric systems, data heterogeneity and legacy systems. More than 58.4% of the respondents as in table below were in disagreement that sharing of persons data would compromise security while 27.1% were in agreement that sharing of person's data would not compromise its security. The rest of 14.6% were neither in agreement no disagreement on the issue. Half of the respondents (50.0%) were in agreement that vendor specific biometric and databases are a challenge to implementation of interoperability. 22.9% of the respondents had no clear cut opinion while the rest (27.1%) were of contrary opinion that database and biometric systems were not a challenge to interoperability. A huge percentage of the respondents composed of 85.4% were in agreement that there is need of consistency and agreement on the format of capturing person's data amongst the key stakeholders. Only 4.2% of the respondents were of the contrary opinion and the 10.4% were neither in agreement nor in disagreement. 70.9% of the respondents were in agreement that legacy systems or outdated technology has a negative impact on implementation of interoperability while 16.7% were of contrary opinion. 22.9% of the respondents neither agreed nor disagreed on the issue.

Table 4.15: Responses on Technical Interoperability issues

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Agree	Total
Security	12	14	14	43	14	98
	12.5%	14.6%	14.6%	43.8%	14.6%	100%
Databases and Biometric Systems	14	35	22	18	8	98
	14.6%	35.4%	22.9%	18.8%	8.3%	100%
Data Heterogeneity	61	22	10	2	2	98
	62.5%	22.9%	10.4%	2.1%	2.1%	100%
Legacy Systems	39	31	12	14	2	98
	39.6%	31.3%	12.5%	14.6%	2.1%	100%

Security of data has become a key concern to experts, institutions and citizens in general. It is no wonder that it is one of the fundamental issues that the respondents felt had a huge ramification on development of interoperability in person's data. Opinion was divided on databases and biometric as well as legacy systems being a hindrance. This is so as posited by CS transform in the literature review that today there exists technologies that can overcome

limitations of particular technologies. Data heterogeneity was considered important for person's data interoperability. This position is cemented by the need for a single data owner as well as person's identifier.

Table 4.15 shows the technical issues considered by the respondents in increasing order of rank means. The respondents considered data security as top most consideration for interoperability, followed by databases and biometric systems, data heterogeneity and legacy systems in that order each with a mean of 2.90, 2.64, 2.34 and 2.13 respectively.

Table 4.16: Friedman test ranking of technical interoperability issues

	Issue	Mean Rank
1	Data Security	2.90
2	Databases and Biometric Systems	2.64
3	Data Heterogeneity	2.34
4	Legacy Systems	2.13

Further Friedman test analysis with a confidence interval of 0.05, null hypothesis Ho: there is no difference between the four conditions, alternate hypothesis H1: there is difference between the four conditions results in test statistics value 20.709 which is greater than the Chi-square value of 7.815 (3, n=98), p>0.5. The conclusion of the Friedman test is that there is a difference among the four groups.

4.7.5 Combined Interoperability issues

Considering all the factors under peripheral, organisational and technical interoperability, table 4.16 shows all the mean ranks for issues considered for person's interoperability framework in order of priority as per the responses.

Table 4.17: Overall ranking of all interoperability issues

Rank	**Factor (Issue)**	**Mean Rank**	**Interoperability Area**
1	Data Security	8.50	Technical
2	Data Heterogeneity	7.78	Technical
3	Elimination of Bureaucracy	7.50	Organizational
4	Enabling legislation policy and Strategies	7.42	Peripheral
5	Data Ownership	7.19	Organizational
6	Databases and Biometric Systems	7.00	Technical
7	Stakeholder Involvement	6.65	Organizational
8	Business Process Reengineering	6.48	Organizational

Rank	Factor (Issue)	Mean Rank	Interoperability Area
9	Legacy Systems	6.40	Technical
10	Political Factors	5.42	Peripheral
11	Lack of budget	4.42	Peripheral
12	Donor Factors	3.26	Peripheral

From the above table, the topmost issues ranked as necessary for person's data interoperability were data security, data heterogeneity, bureaucracy, enabling legislation and data ownership in that order. On the other hand donor factor, lack of budget, political factors and legacy system are ranked lowest in terms of priority.

A Friedman test analysis with a confidence interval of 0.05, null hypothesis Ho: there is no difference between the twelve conditions, alternate hypothesis H1: there is difference between the twelve conditions results in test statistics value 114.718 which is greater than the Chi-square value of 21.026 (12, n=98), $p>0.5$. The conclusion of the Friedman test is that there is huge difference among the twelve groups.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

There has been minimal electronic sharing of person's data by the public institutions that are the prime stashers of person's data in Kenya. Whereas the persons data from different institutions is basically about the same citizenry, this desperate situation of collecting persons data is uncoordinated leading to duplication of effort in addition to inaccuracy in person's data and errors. The current situation calls for interoperability of systems dealing with person's data. With interoperability of person's data, there are definite chances of leaping from very efficient, cost effective person's data systems with a data that can be considered as a single source of truth of person's data.

In this study, we sought to study the factors that are necessary for interoperability of person's data. Evidence from the literature review shows that interoperability studies are very general and are not as focussed as in this study. As indicated in Chapter three above and premised on the literature review, the Australian Interoperability Framework was considered as the most relevant to the specific area of person's data interoperability in Kenya. The areas of interoperability that were considered included organisational, technical and peripheral interoperability.

The study as shown in chapter four shows the need for interoperability amongst person's data systems. Generally, over 90% of the respondents were in agreement that i) there ought to be interoperability of person's data; ii) interoperability between person's data registration systems will improve verification of person's data amongst the key stakeholder organisations; iii) ICT has a crucial role to play in improving interoperability in person's data and iv) the overall accuracy of person's information will be improved once interoperability is implemented across systems dealing with person's data. In regard to person's data generation, again over 90% of the respondents agree that there is duplication in generation of person's data during a citizen's lifecycle and there is a need for adapting a common person's identifier in the course of a citizen's life cycle.

In terms of rankings, data security comes as the top most issue that needs to be addressed for implementation of person's data interoperability. It is followed by data heterogeneity, elimination of bureaucracy, enabling legislation policy and strategies and need for a specific organization to own persons data in that order. The last ranked factors that the respondents felt

had minimal effects in the implementation of person's data interoperability were influence by donors, absence of a budget provision, political interference and elimination of legacy system.

The results indicate that there are factors in person's data interoperability that have no significant differences and are somehow interrelated and due consideration is necessary while addressing person's data interoperability. An example of these factors could be bureaucracy versus business process reengineering as well as data ownership versus business process reengineering. As seen in the results, stakeholder involvement and data ownership are directly linked to business process reengineering. According to Hammer and Champy (1993) the definition of BPR is fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, and service and speed. The close relation of BPR with the other two factors may be so because there can be no BPR without stakeholder involvement. Again in terms of data ownership, a well thought out process of person's data interoperability ought to identify a definite owner of the person's data.

5.2 Limitations of the Study

One of the limitations of this research could arise from the specific sample that was chosen in which the results were generalized for the entire populace. Most importantly with respect to this research, readers need to remember that only clearly determined population and sample from the main stream civil service was used, reference to other settings like the general public may have produced different results.

This study was conducted through a questionnaire that was administered through the web. There might have been surmountable improvements to this study if it was conducted by interviewing the participants. Personal interviews normally elicit greater information regarding participant's knowledge and attitudes. This method could have added important qualitative data and greater insights into the participant's thoughts and opinions. The choice of the data collection methodology was informed by time constraints.

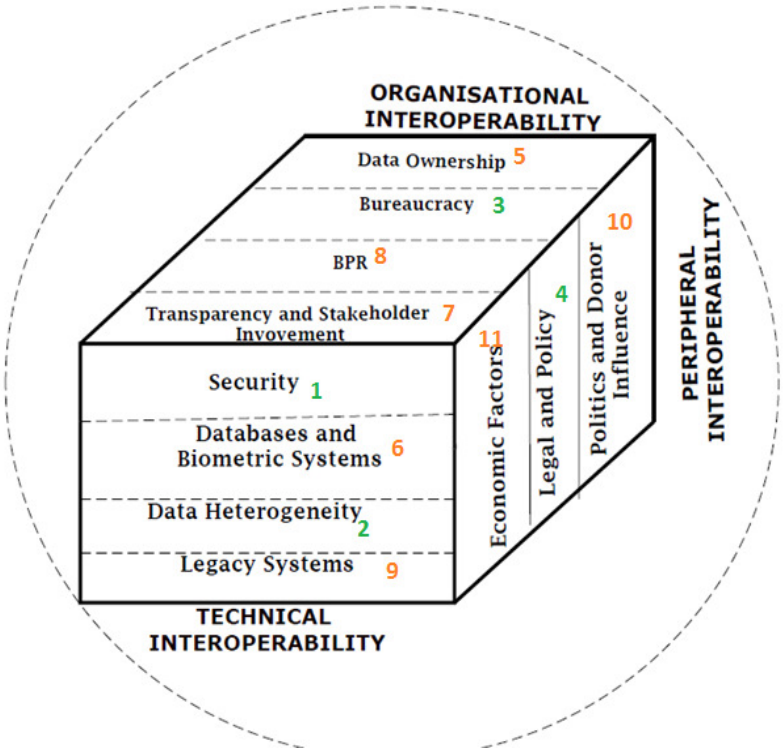
The variables under this study were expressly informed by the literature review. After an extensive literature review, there are indications that little (if any) research has been done specifically for a focused area like person's data interoperability. The parameters under investigation were entirely informed by the literature review. This therefore means that the variables necessary for interoperability of person's data that might not have been exhaustive.

5.3 Conclusions

There has been no person's data interoperability framework in Kenya over the years which has resulted in challenges of managing person's data. One of main objective of the study was to propose an interoperability framework for sharing person's data during the citizens' lifecycle in Kenya. This is in addition to carrying a review of the factors that are critical/essential for implementing person's data interoperability in Kenya. Critical analyses of person's data interoperability indicate that there are various factors that are necessary for the implementation of person's data in Kenya.

The study indicates that there is clearly a need for implementing person's data interoperability in Kenya. The results of this survey can indeed serve as a basis of developing master plans and policy guidelines geared towards implementing person's data interoperability in Kenya. The following figure shows the rankings of some of key factors considered in person's data interoperability framework. These factors require prioritization while formulating a person's data interoperability strategy.

Figure 5.1: Rankings of various factors



In order to implement person's data interoperability, there is a need for addressing all data security related matters. This comes at a crucial time where identity theft is major cyber security threat. Similarly, any flaws that involve person's data insecurity is likely to elucidate a lot of emotions and uneasiness and therefore an area that requires to be addressed adequately. Another key factor that requires to be addressed in this area is data heterogeneity. Concerned organisations need to define an agreed format in which person's data is captured by individual organisations for smooth implementation of person's data interoperability.

The survey further indicates that there is a sufficient budget provision to operationalize person's data interoperability. This so because the silo systems handling person's data receive funding every financial year which when combined in interoperable environment would have a huge impact.

On other hand, it came out from the survey that politics and donor influence have very minimal bearing on the interoperability of person's data. This is so due to the fact that most of person's data registration processes in Kenya are funded from the exchequer. On the other hand these systems are mostly designed by the executive and direct politics would ordinarily have very minimal effects on them.

There exists factors in person's data interoperability that have no significant differences and are somehow interrelated and due consideration is necessary while addressing person's data interoperability. An example of these factors is bureaucracy, business process reengineering data ownership and stakeholder involvement.

5.4 Recommendations

Based on the findings of this study, the Government stand to improve services by implementing person's data interoperability. The specific issues that needs to be addressed in this process includes but not limited to:-

i. The need for inculcating or addressing person's data interoperability in national ICT master plans and in policy directives is of paramount importance in order for the Government to offer services more efficiently.

ii. Appointment of champions/ leaders with a right mind-set of what needs to be done in respective departments and who share the same vision of person's data interoperability is important.

iii. The need for addressing bureaucracy in Government due to its significance before person's data interoperability is realized.

iv. Assessment and establishment of IT maturity levels within respective individual stakeholder government institution is important to inform on the person's data interoperability strategy.

v. Special focus of government processes rather than individual institutions is important as we develop both the legislation and policies for person's data interoperability.

vi. Security is a very critical ingredient of person's data interoperability. Proper change management and awareness creation is important for the whole exercise to succeed.

vii. Need for addressing person's data heterogeneity is important in order to achieve the specific interoperability

viii. There is a an apparent need for addressing stakeholder involvement, bureaucracy , data ownership and business process reengineering in a coherent manner while addressing person's data interoperability. Further research is necessary to investigate how the three are inter-related.

ix. Person's data interoperability cuts across many Government institutions, this therefore calls for top most political support to succeed in addressing most of the aspects of interoperability including elimination of bureaucracy, putting in place appropriate legislative and policy aspects and appropriate business processing policies,

5.5 Further Research

Person's data interoperability is very crucial for the Government to integrate person's data registration process. Whereas integration is about how the data is shared amongst the institutions, one area that could require further research is the process of data generation and sharing itself. This would be by investigating who should be the source of data, where and how the data generated at one step can be re-used by another institution without having many institutions recreating the same type of data hence eradicating duplications.

The results of this study have indeed shown that bureaucracy is a key hindrance to person's data interoperability. Further research would specifically investigate bureaucracy as one of the hindrance to person's data interoperability and how its elimination could lead to improvement

of interoperability. Departing from the specifics, a review on the effects of bureaucracy on technology forms a very interesting area for further research.

Whereas in the actual fact the respondents of this survey were drawn from the mainstream civil service, it would be interesting to find out whether the same results would be got if the survey is done in a different setting like in inclusion of the general public in a similar survey. Similarly there is a need for investigating the relationship between stakeholder involvement, data ownership, bureaucracy and business process reengineering in respect to person's data interoperability

From the results, it comes out that donors and politics have minimal influence on the person's data interoperability. This is contrary to the impression elucidated by the literature review. It would be necessary to carry out research particularly on whether donors have genuine concerns for person's data interoperability and general IT projects.

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APPENDIX I: Survey Questionnaire

University of Nairobi

School of Informatics and Computing

Persons Data Sharing Evaluation Questionnaire

My name is Loyford Murithi Nandi, a student at the University Of Nairobi School of Computing and Informatics, undertaking a research project titled: Inter-Organizational Electronic Information Sharing Framework for Persons Data in Kenya

The focus of my research is to test the validity of a framework construct. This research is purely academic, confidential and will be solely used for that purpose. Your details or data collected or provided will not be passed to any third party without your prior permission.

I humbly request that you take a moment of your time to answer the questions below as posted in the url link below.

Please feel free to contact me for any clarifications.

Loyford.murithi@gmail.com, loyford.murithi@kenya.go.ke **or +254-720278110**

Section A	**Personal Information**	
1	**Gender** 1. Male ☐ 2. Female ☐	
2	**Age Bracket** 1. 20-29 ☐ 2. 30-39 ☐ 3. 40-49 ☐ 4. 50-59 ☐	
3	**Level of Education**	
	1. O-level ☐ 2. College ☐ 3. Graduate ☐ 4. Post- Graduate ☐	
4	**Your Ministry/Department**	
	1. National Registration Bureau ☐	

	2. Civil Registration Department ☐ **3.** Integrated Persons Registration System Department ☐ **4.** Other Ministries ☐ Specify…….						
Section B	**GENERAL**						
	To what extent do you agree or disagree with the following statements about Interoperability (Inter communication and Inter-exchange) of person's data	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	
5	There should be **inter-communication and inter-exchange** (**interoperability**) across all systems to share details of person's data amongst stakeholder institutions.	☐	☐	☐	☐	☐	
6	Interoperability between person's data registration systems will improve verification of person's data amongst organisations dealing with the data.	☐	☐	☐	☐	☐	
7	Use of ICT technologies can play a vital role in obtaining inter-operability between systems that share person's data.	☐	☐	☐	☐	☐	
8	Overall accuracy of person's information will be improved once intercommunication is implemented across systems dealing with persons data?	☐	☐	☐	☐	☐	
9	There is duplication of generation of person's data during a citizen's lifecycle.	☐	☐	☐	☐	☐	
10	There is a need of adapting a common person's identifier in the course of a citizen's lifecycle	☐	☐	☐	☐	☐	
Section C	**ORGANISATIONAL INTEROPERABILITY**						
i)	**To what extent do you agree or disagree with the following statements about Interoperability (Inter communication) of person's data**	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	
11	Individualism and lack of consultations amongst organisations dealing with a person's data is a challenge to interoperability of person's data in Kenya.	☐	☐	☐	☐	☐	
12	For interoperability of person's data, there is need for a single agency being in charge of ownership of the person's data that can be populated by other organisations.	☐	☐	☐	☐	☐	
13	Bureaucracy is a challenge affecting interoperability of person's data in Kenya.	☐	☐	☐	☐	☐	

14	For interoperability of our person's registration systems to happen, many of our person's registration process needs to be re-engineered.	☐	☐	☐	☐	☐	
ii)	**In a scale of 1 to 5 of priority which Organisational issues at the Ministry needs to be addressed for interoperability of person's data to be implemented (1- Low Priority 5 – High Priority)**	1	2	3	4	5	
15	Forming partnerships that work in a spirit of collaboration	☐	☐	☐	☐	☐	
16	Clearly defining who the person's data owners are	☐	☐	☐	☐	☐	
17	Carrying out business process reengineering in our registration processes	☐	☐	☐	☐	☐	
18	Elimination of bureaucracy of delivering services related to person's registration processes.	☐	☐	☐	☐	☐	
Section D	**PERIPHERAL INTEROPERABILITY**						
i)	**To what extent do you agree or disagree with the following statements about Interoperability (Inter communication) of person's data**	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	
19	Lack of an enabling legislation, policy and strategies on interoperability is a challenge impeding sharing of person's data among systems in Kenya?	☐	☐	☐	☐	☐	
20	Lack of budget provision has hindered implementation of inter-operability of person's data in the organisations concerned.	☐	☐	☐	☐	☐	
21	Political and donor factors have played a key role in the determination of ICT projects and therefore affected the interoperability of person's data	☐	☐	☐	☐	☐	
ii)	**In a scale of 1 to 5, what do you think is the level of challenge posed to interoperability of persons by the following? 1-Low Challenge 5-High Challenge**	1	2	3	4	5	
22	Lack of an enabling legislation, policy and strategies	☐	☐	☐	☐	☐	
23	Lack of budget provision	☐	☐	☐	☐	☐	
24	Political factor	☐	☐	☐	☐	☐	
25	Donor factors	☐	☐	☐	☐	☐	
SECTION E	**TECHNICAL INTEROPERABILITY**						

i)	**To what extent do you agree or disagree with the following technical related issues affecting interoperability of person's data.**	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree	
26	Once the systems dealing with persons data are shared security of data would be compromised	☐	☐	☐	☐	☐	
27	Vendor specific biometric systems and databases are a challenge to implementation of interoperability of person's data.	☐	☐	☐	☐	☐	
28	In order to have accurate person's information, there is a need of consistency and agreement on the format of capturing the data amongst key stakeholders.	☐	☐	☐	☐	☐	
29	The use of outdated technology in person's registration systems has a negative impact on implementation of interoperability.	☐	☐	☐	☐	☐	
ii)	**In a scale of 1 to 5 of priority, which technical issues do you think require priority to be addressed for interoperability of person's data to be implemented (1- Low Priority 5 – High Priority)**	**1**	**2**	**3**	**4**	**5**	
30	Data Security	☐	☐	☐	☐	☐	
31	Compatibility of biometric systems and databases	☐	☐	☐	☐	☐	
32	Using a *'create once, use many '* approach for authoritative sources of person's data information;	☐	☐	☐	☐	☐	
33	Eliminations or upgrade of outdated technology	☐	☐	☐	☐	☐	
Section F	**OTHERS**						
34	Name other majors issues that you feel have impact in implementation of interoperability of person's data.						