



**MODELLING  
POPULATION REGISTRATION AND  
NATIONAL IDENTIFICATION SYSTEM  
IN  
UGANDA**

**By**

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## **Abstract**

The study examines the current state, access, accuracy and utilisation of population information in Uganda. The problem was that many people are born; they die unaccounted for; enabling the presentation of false demographic estimates and deliberate manipulations and falsification of population statistics in Uganda. The main objective of the study was to develop a model for population registration and national identification System (PRNIS), in which the demographic changes such as birth, marriage, migration, death and some socio-economic characteristics of Ugandan population are continuously recorded. Participants from Uganda Registration Services Bureau (URSB), Population secretariat (PS) and officials from Uganda Bureau of Statistics (UBOS) were interviewed. A qualitative method was adopted, and data collection included content analysis, participant observation, guided interviews and focus group discussions. It was discovered that URBS with assistance United Nations Children's Fund (UNICEF) had introduced Civil Registration and Vital Statistics (CRVS) in some public hospitals. The data gathered from all the sources, provided an insight to pave way for system modelling. The study concluded that creating a model for developing a system for continuous registration of events enables ascertainment of accurate statistics for the population and provides legal proof of identity of citizens and also creates a repository for vital statistics in Uganda. The study recommends that the system should provide a mechanism to manage and coordinate the population information which provides accurate statistics in order to eliminate wrong statistical estimations.

**Statement of Original Authorship**

The work contained in this dissertation has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the dissertation contains no materials previously published or written by another person except where due reference is made.

Signature:

A handwritten signature in black ink, appearing to be 'W. A. W.', written over a faint, illegible printed name.

Date:

December 05, 2014

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**DEDICATION**

To my mother for her devotion,

To my children for their patience,

To my dear wife for her love and support.

**Acronyms**

AG	Administrator General
CID	Criminal Investigation Department
CRVS	Civil Registration and Vital Statistics
CRE	Continuous Registration of Events
EC	Electoral Commission
ER	Entity Relationship
HLR	High Level Requirement
ICT	Information and Communications Technology
IPS	International Passenger Survey
PAC	Public Accounts Commission
PRNIS	Population Registration and National Identification System
PIN	Personal Identification Number
RCDF	Rural Communications Development Fund
LAN	Local Area Network
MCT	Multipurpose Community Tele-centre
NPC	National Population Census
NGO	Non Government Organisation
PS	Population Secretariat
PIN	Personal Identification Number
SQL	Structured Query Language
UA	Universal Access
UBOS	Uganda Bureau of Statistics
UCC	Uganda Communications Commission
URSB	Uganda Registration Service Bureau
UN	United Nations
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund Activities
WHO	World Health Organisation
WAN	Wide Area Network

## Table of Contents

Abstract .....	i
Statement of Original Authorship .....	ii
Acknowledgements .....	iii
DEDICATION .....	iv
Acronyms .....	v
Table of Contents .....	vi
List of figure .....	ix
1.0 Introduction .....	- 1 -
1.1 Background of the problem .....	- 2 -
1.2 Statement of the problem .....	- 4 -
1.3 The Research Questions .....	- 5 -
1.4 The Purpose of the study .....	- 5 -
1.5 The Objective of the study .....	- 6 -
1.5.1 Some specific objectives of the study .....	- 6 -
1.6 Significance of the study .....	- 6 -
1.7 Study Design .....	- 7 -
1.8 Theoretical Framework .....	- 8 -
1.9 Assumption, Limitation and scope .....	- 11 -
<b>CHAPTER TWO</b>	
2.0 Introduction .....	- 13 -
2.1 Population Registration Overview .....	- 13 -
2.2 Population Registration and Identification Cards concept in UK .....	- 14 -
2.3 Population registration in Sweden .....	- 15 -
2.4 Population registration in Jordan .....	- 16 -
2.5 Population Registration in Malaysia .....	- 17 -
2.6 Population Registration in Africa .....	- 18 -
2.7 Population registration in Botswana .....	- 18 -
2.8 Population Registration in Uganda .....	- 20 -
2.9 Summary .....	- 22 -



## CHAPTER THREE

3.0	Introduction .....	- 23 -
3.1	The research strategy .....	- 23 -
3.1.1	A qualitative study .....	- 24 -
3.1.2	A Case Study .....	- 24 -
3.1.3	System model building .....	- 25 -
3.2	Research design .....	- 27 -
3.4	The conceptual framework .....	- 30 -
3.5	Determining accurate statistical data .....	- 33 -
3.5.1	Population measures .....	- 33 -
3.5.2	Natural change measures .....	- 34 -
3.5.3	Migration measures .....	- 34 -
3.5.4	Population characteristics .....	- 36 -
3.6	The selection of the case study .....	- 37 -
3.6.1	Data sources .....	- 37 -
3.6.2	Data collection and analysis .....	- 38 -
3.7	Designing a system model for population registration .....	- 42 -

## CHAPTER FOUR

4.0	Introduction .....	- 47 -
4.1	The system scope .....	- 47 -
4.2	Requirements Engineering.....	- 48 -
4.2.1	Requirements Elicitation .....	- 50 -
4.2.3	Requirement Analysis .....	- 50 -
4.3	System Requirement Specification .....	- 51 -
4.3.1	Functional Requirements .....	- 51 -
4.3.2	Non-functional Requirements .....	- 53 -
4.3.3	Behavioural requirement .....	- 54 -
4.4	System Modelling .....	- 54 -
4.5	PRNIS Modelling Process .....	- 58 -
4.6	Conceptual System modelling .....	- 58 -
4.7	Logical System Modelling .....	- 60 -
4.7.1	Data Modelling .....	- 61 -

4.8	Physical System Modelling .....	- 62 -
CHAPTER FIVE		
5.0	Introduction .....	- 66 -
5.1	The system perspective .....	- 66 -
5.2	The PRNIS Environment .....	- 68 -
5.3	Architectural Design .....	- 69 -
5.4	System Hardware Architecture .....	- 70 -
5.5	System Software Architecture .....	- 72 -
5.5.1	Defining system input requirements .....	- 72 -
5.5.2	Designing On-Screen Forms for Data Input requirements .....	- 73 -
5.5.3	Data Validation Techniques requirements .....	- 73 -
5.5.4	Snapshot of the input .....	- 74 -
5.5.5	Designing the System Processes .....	- 74 -
5.5.6	Designing Data and File Structures .....	- 76 -
5.5.7	Designing the System Outputs .....	- 77 -
CHAPTER SIX		
6.0	Introduction.....	- 80 -
6.1	Sample open-ended interview guide: .....	- 80 -
6.2	Discussing Population Registration .....	- 81 -
6.2.1	Discussing the PRNIS .....	- 82 -
6.2.2	Need for PRNIS in Uganda .....	- 82 -
6.2.4	Legal framework .....	- 85 -
6.2.5	Elements for an identity scheme .....	- 86 -
6.2.6	PRNIS components .....	- 87 -
6.2.9	The PRNIS benefits .....	- 89 -
6.2.10	PRNIS Features.....	- 90 -
6.3	Contribution to the body of knowledge .....	- 91 -
6.4	Future work.....	- 92 -
6.5	Conclusion .....	- 92 -
6.6	Recommendation .....	- 93 -
	Reference .....	- 94 -

## List of Figures

Figure 1: the relationship between concept, data and process in PRNIS .....	- 10 -
Figure 2: population changes cycle .....	- 11 -
Figure 3: Synopsis of the research design .....	- 27 -
Figure 4: The framework for population and migration statistics .....	- 28 -
Figure 5: A framework of population stocks and flows set within a group .....	- 29 -
Figure 6: A conceptual framework for PRNIS in Uganda .....	- 32 -
Figure 7: Framework for internal and external migration statistics .....	- 36 -
Figure 8: A System Context Diagram .....	- 48 -
Figure 9: High level requirement diagram .....	- 49 -
Figure 12: Illustrates PRNIS models development .....	- 58 -
Figure 13: Conceptual model for PRNIS .....	- 59 -
Figure 18: Diagram for the entire System .....	- 70 -
Figure 22: PRNIS Process Flow Model .....	- 75 -

**Approval**

I certify that this dissertation has been examined with my approval as supervisor.

Dr. Ezekiel Uzor Okike .....

Date: .....



## CHAPTER ONE

### **1.0 Introduction**

Population Registration and National Identification System (PRNIS) is an automated national register that contains information of the citizens and non-citizens residing permanently in the territory. Also the system records information about buildings, residences and real estate. Population registration is internationally regarded as a high standard of continuous recording of selected information pertaining to each member of the resident population of a country [1]. The population register is a mechanism for the continuous recording of selected information pertaining to each member of the resident population of a country or area, making it possible to determine up-to-date information about the size and characteristics of the population at selected points in time [1]. Population registers start with a base consisting of an inventory of the inhabitants of an area and their characteristics, such as birth, marital status, death, place of residence, citizenship and demographic changes. These changes may be identified as natality, mortality, territorial movement and social mobility.

A large fraction of this chapter deals with population changes in Uganda over time and statistical presentation. A number of demographic inquiries focused on the analysis of population trends, changes and identification in Uganda, hence gives an overview of the problem and objectives of the study.

Statistical method for recording population is not a recent phenomenon. Population census is one of the statistical methods that involve collecting, analysing and interpreting numerical data relating to a certain area of investigation. It helps to draw valid

conclusions in situations of uncertainty and variability. Population registration has been a practice for generations in some countries [2]. Statistical information of national population is fundamental to the country's development, and provides a basis for effective governance and planning for the future [3]. It also serves as a basis for resource distribution such as revenue allocations, allocation of legislative seats and employment. It can be used to determine the location of industries and social amenities like hospitals, schools and police stations.

In the past, population registration in Uganda has been contentious, mostly politicised to achieve political goals by some actors. The political elites have come to realise the degree to which recorded human numbers can be used to determine the proportion of public amenities distributed to their constituencies. This, in turn, would determine their economic and political weight within their constituencies. Some reports suggest deliberate manipulation; falsification of population numbers in some parts and lack of proper identification within the country [4].

### **1.1 Background of the problem**

The Political and economic development in Uganda would have been much better if reliable population data were available. The absence of accurate population data, affects directly the government's inability to ensure balanced political and equal access to important resources and services. To date, Uganda still does not use effective, reliable population registration and identification systems to provide accurate statistics.

However, population changes on a daily basis, by the addition of live births and by the subtraction of deaths and addition or subtraction of migrants. The information about the

numbers of live births and deaths occurrences are crucial for determining the natural increase or decrease in population size and structure. Therefore, Uganda needs to have an accurate statistical knowledge of such population changes, to have an orderly planning for developments. Ministries and corporate organizations make use of these data to assess the progress and consequently locate administrative projects; hence, proper allocation of resources and services.

As a result, registration and identification issues have long been advocated as a means to enhance national security, unmask potential terrorists, and guard against illegal immigration [5]. Population Registration Systems for example, are in use in many countries around the world which include some of European states such as Denmark, Sweden, Finland, Estonia, Lithuania and Latvia as well as Asian countries such as Hong Kong, Malaysia, Singapore and Thailand [6]. Currently, the United States and the United Kingdom have continued to debate the merits of adopting population registration and Identification systems, issues includes the potential and human right abuses [7].

Consequently, a framework for the development of a mandatory population recording and identification helps the country to have proper records of her citizens and migrants as well as enhance national security. This research, therefore, intends to develop a model that integrates population registration and identification systems means of tracking citizens, permanent and temporary residents with an aim of preventing manipulation and falsification of population data, thus providing an accurate statistical data in Uganda [8].



Article 18b of the constitution of Uganda states that: “the state shall register every birth, marriage and death occurring in Uganda” [9]. Population information shall be available for all of those who would wish to access it. Again, the constitution provides for the right of access to such information. Article 41(I) thereof states: “Even a citizen has a right to access information in the possession of the state or any other organs or agency of the state, except where the release of the information likely to prejudice the security or interfere with right to the privacy of any other person” (Uganda 1995a: Article 41(I)) [9].

The modelled system therefore, will be used to develop an information system that may help to eliminate population estimations, recurring problems of electoral fraud and falsification of population data. The system can be helpful in employment-pension contributions, benefits and insurance Law enforcement. Also can be used to conduct the electoral processes, tax and to compute actual national population statistics; instead of relying on censuses which provide estimates.

## **1.2 Statement of the problem**

Despite the fact that there are well established bodies such as Uganda Bureau of Statistics (UBOS) and Population Secretariat (PS) for providing accurate population statistics in Uganda, population statistics is always provided as estimates. Thus promotes deliberate manipulation and falsification of population data. For example, during 2011 elections, some inaccurate data about the voting population were presented by the Electoral Commission [4] [8].

Established bodies responsible for population data in Uganda seem to provide conflicting statistics. Uganda Bureau of Statistics for example, publicized that population estimates

had increased to 32.9 million by mid 2011. Population Secretariat (PS) also reported, that population had grown to 33 million people in 2011. The United Nations Population Fund (UNPFA), also reported that, the population of Uganda stood at 34.5 million in 2011 [4][15]. As basis for developing an automated population registration and vital statistics system which provides accurate statistics there is need for a comprehensive data modelling for the system.

### **1.3 The Research Questions**

The research questions for this study are:

- i. Does the decennial interval system provide accurate population statistical information to and proper identification for citizens and non-citizens?
- ii. Does the Civil Registration and Vital Statistics (CRVS) collect entire data necessary for accurate population statistical information to determine up-to-date information about the size and characteristics of the population at point on time?
- iii. Does permanent and continuous registration of events solve the manipulation and falsification of population data issues?

### **1.4 The Purpose of the study**

The purpose of this study is to create a system model for continuous registration of events in order to improve population statistics presentation also to provide legal proof of identity of citizens, as well as non-citizens and creates a repository for the compilation of vital statistics. This model will help to describe and represents a system which comprises multiple views such as planning, requirement (analysis), design, implementation, deployment, structure, behaviour, input data, and output data views.

## **1.5 The Objective of the study**

The general objective of the study is to create a model for the comprehensive, continuous, permanent, compulsory registration and identification of citizens and non-citizens in the country.

### **1.5.1 Some specific objectives of the study**

The specific objectives for the study are to create a model:

- i. which helps to determine valid and accurate statistical data for the citizens and non-citizens,
- ii. which strengthens and improves the quality of birth and death registration and helps to establish biometric register for identification,

## **1.6 Significance of the study**

Population registration provides on-line registration and documents issuance of services to the citizen and also provides reliable information for the various purposes of government, particularly for;

- i. planning, budgeting and taxation;
- ii. issuing unique personal identification numbers;
- iii. establishing the eligibility of individuals for voting,
- iv. education and health,
- v. military service,
- vi. social insurance and welfare and the pension system;
- vii. policing and judicial references.

Developing a model for mandatory and continuous population registration in Uganda will be highly useful in developing a system which provides accurate statistics of the population and provides legal proof of identity for citizens, as well as non-citizens residing in the country. A population repository is a critical national source for all government planning, development and other activities. Hence proper data modelling for such a system is inevitable. Sectors include:- health, education, labour and employment, urban planning; finance and economic development, industry and trade, social insurance, environment and decision-makers all depend on sound and timely statistics for policy development, and for programme monitoring and evaluation.

The Uganda Bureau of statistics, Electoral Commission, NGOs and International Organisations will also find the system very useful in tracking the origin of individuals and recommendation for travel and employment abroad. The output is also useful to other countries that would like to have similar or related system.

### **1.7 Study Design**

A research design is the framework or a guide used for the planning, implementing and analyzing of a study. It is also a systematic plan of what is to be done, how it will be done and how the study will be conducted. The research approach adopted is qualitative, non-experimental, descriptive and contextual. The study focuses on the design of a model for the pertinent philosophical assumptions which relate to the underlying epistemology that guides the population registration and identification of citizens, residents and non-citizens in a territory [10].

However, qualitative research framework and interpretive methods are considered to be powerful for understanding the subjective experiences at producing an understanding of the context of an information system [11]. The data for this work are gathered from secondary source, interviewing the administrators and observation.

### **1.8 Theoretical Framework**

Malthusian theory [12] states that population growth is limited by unavailability of resources. If that is the case, why the world's population, grows so rapidly especially in regions that have fewest resources, especially in developing countries such as Uganda? His theory was the key figure to analyse the population statistics, but is considered obsolete and is no longer relevant in the contemporary world; it doesn't consider other factors such as technological advancement. Meanwhile, any meaningful interpretation of the causes and effects of population change must extend beyond formal statistical measurement of components for changes and draw on the theoretical framework of several other disciplines [13].

The analysis of causal determinants and consequences of population change forms the subject matter of population theory. In some pre-industrial countries such as Uganda, societies experience high birth rates and high death rates and migration rates [14]. Replacing Malthus' ideas, demographic transition theory defines population growth in three alternating patterns, the continuous registration of addition of births (population increase), addition or subtraction of migrations (increase or decrease of population), and subtraction of deaths (population decrease), plus the exciting population size.

The theory of population size and change is not based on food supply only but also on technological and social development. Therefore, the modern theory should state “*Accurate population size at time t is determined by Continuous Registration of Events*”

(CRE). The scientific quantification:-

$$P_t = B_t \pm EI_t - D_t + T_{t-1}$$

Where

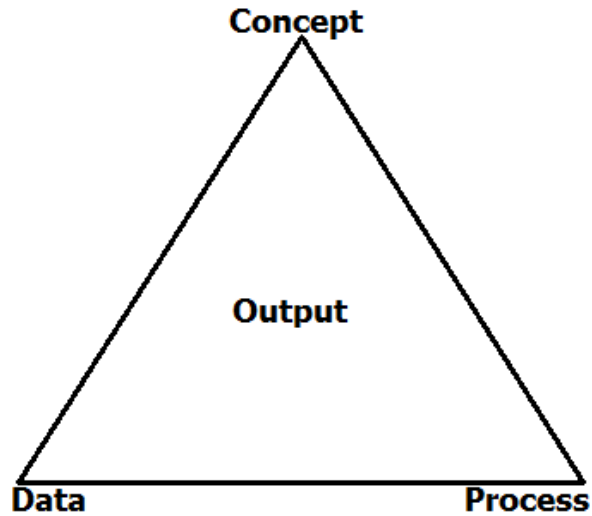
$P_t$	=	Accurate Size of population at time t
$B_t$	=	Additional Births at time t
$EI_t$	=	Addition or Subtraction Migrants at time t
$D_t$	=	Subtract Deaths at time t
$T_{t-1}$	=	Addition of existing Population at time t

Population registration as defined is carried out primarily for monitoring the population changes and repository for proper data sources. The requirement for a framework within population registration is that it covers all vital events occurring in geographic area and all population groups in the national area. Population registration therefore, includes births, deaths, marriages, and migrations.

Population registration broadens the uses that can be made of the (PRNIS) in Uganda. For instance, the modelled system provides unique identity of an individual and ensures that each event is recorded once in all linked systems. The issuance of a unique personal identification takes place once at initial registration of an individual or at the birth time [15]. Personal Identification Number (PIN) serves as primary key for identifying each individual for linkage a child to its mother.

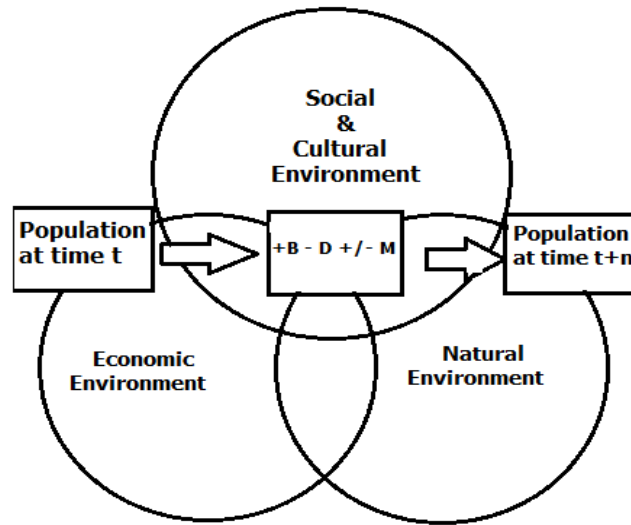
A framework for information systems development specifies the need to first define the dimensions along which the dependent variable may vary. As shown in **Figure 1**, the

correlation between the concepts and the outputs of population statistics in PRNIS is presented. Statistical outputs are often the result of matching available data to a particular concept; the data are processed or combined with other information to fit a particular concept.



**Figure 1: the relationship between concept, data and process in PRNIS**

There is no single source of population information in Uganda that covers a wide variety of needs. Population statistics bring together data from many sources; however, population is both dynamic and heterogeneous. **Figure: 2**, illustrates that population as continuously changes due to three factors; the addition of live births (B), subtraction of deaths (D) and addition or subtraction of migrants (M). These are also influenced by three factors, social and cultural, economic and natural environments in which the population lives [16].



**Figure 2:** population changes cycle

Trusted, independent and robust information about the size, structure and characteristics of a population is seen to be an essential underpinning of a modern society [17] [18]. Such information is essential for improving the well-being, prosperity and legitimacy of a democratic country. As such, it is vital that the data are not only reliable and robust, but the users to understand how the different data are compiled, how they relate to each other and what each variable actually represents. To achieve this, population information needs to be publicly available, transparent and understandable. Creating a PRNIS model is the basis to provide accurate population statistics in Uganda.

### **1.9 Assumption, Limitation and scope**

Administrators at Uganda Registration Services Bureau (URSB) and other selected participants from the Population Secretariat (PS) were contacted to provide the required data; assumptions were that they understand the subject matter for the study.



Nevertheless, if this study does not become politicised, the required information is available at URSB and at the Population Secretariat. The extent of this study has included 15 participants from Uganda Registration Services Bureau (URSB) and Population Secretariat (PS) from central business district.

### **1.10 Summary**

Placing population changes and migration statistics in wider context is useful for understanding the population concepts needed for measuring, data collection, data processing and accurate data presentation. It is also useful to know that inhabitants' and migrants' statistics are key ingredient for understanding society and societal change, hence, are directly linked to the production of population and other vital statistics such as those for marketing, health, elections, social welfare and other services.

## **CHAPTER TWO**

### **Literature Review**

#### **2.0 Introduction**

Population registration is regarded as a systematic procedure of acquiring and recording numbers of a given population. Population registration is not a recent development; however, the earliest record of households register and individuals comes from the second century B.C., in Han Dynasty China and Europe's earliest registers of population date way back to the seventeenth century [20]. The Roman world, registration was used to keep track of all adult males fit for military service [20]. It is now used in connection with national population and housing censuses; other common censuses include agriculture, business, and traffic censuses.

#### **2.1 Population Registration Overview**

It is believed that registration of human began way back in 2 B.C [22]. The Bible says, "Caesar Augustus issued a decree that a population registration was to be taken of the entire Roman world". That was the time when Joseph and Mary returned to Bethlehem for registration and there, Jesus was born. It is established that conducting such registration then was quite common at about the time of Christ, Gospel of Luke 2:1-5 [22]. An ancient Latin inscription, Titulus Venetus indicates that population registration took place regularly in Syria and Judea about 5-6 AD and that this was typical of those held throughout the Roman Empire, from the time of Augustus (23 BC-AD 14) until at least the third century AD [23].

Over the last two centuries, states have gradually begun to register events in life for their citizens, such as, births, deaths, marriages, etc, and also to record their places of residence. The registration of life events is known as civil registration and is mandatory in some European Union Member States [23]. Civil registration is necessary in order to establish each individual's legal identity, also provides the state with valuable statistical information about the make-up of their societies.

## **2.2 Population Registration and Identification Cards concept in the United Kingdom**

The very first census of Great Britain took place in March 1801 and the returns gave a population of 10.9 million people living in 1.8 million houses that was England, Scotland and Wales [24]. The most remembered population registration in Great Britain, was carried in 1931, for England and Wales, unfortunately, during the First World War, all information was lost, and the next census was due to be taken in early 1941, but that never took place due Second World War preparations [24]. There was little accurate population data on which to base vital planning and decision-making. Preparations were made in the shortest time possible to enable a National Register, to rapidly compile data and Identification Cards be issued as the Second World War approached 1939-1940 [24].

The Information gathered for each person was the address, name, sex, date of birth, marital status, occupation and whether member of the armed forces or reserves. The three main objectives for the introduction of the Identification Cards put forward by the government in order to pass the law were [24];

- i. The first was the major dislocation of the population caused by mobilization and mass evacuation and also the wartime need for complete manpower control and planning in order to maximize the efficiency of the war economy;
- ii. The second was the possibility of rationing food distribution during the war and;
- iii. The third and main objective was that the Government needed recent and an accurate statistics about the population.

Therefore, the data in the Population Register are used for performing the tasks assigned to institutions of the state and the local governments as well as physical and legal persons. Legal and physical persons have access to such information in the Population Register only in case of legitimate interests.

### **2.3 Population registration in Sweden**

Population registration is the civil registration of vital events e.g. births, deaths and marriages of the inhabitants of Sweden. The data is kept in the population registry and is administered by the Swedish Tax Agency. The registry spans back several centuries and is thus often used by genealogists [21].

The population registration in Sweden was originally maintained by the Church of Sweden, on the orders of the crown, and it remained the duty of the church until 1991 [21]. The oldest preserved records date from the early 17th century - though rolls of farmsteads, estates and local taxation with the names of peasants and nobles dwelling in the places in question have sometimes survived from the later middle ages on; these do not belong with the later program of population record keeping though, but are land/tax

records. Complete archives are usually found from the mid 18th century onwards, unless records have been lost or destroyed by fire or the like [21].

## **2.4 Population registration in Jordan**

Jordan has a long history of civil registration although a more reliable system only started more recently [25]. In 1930, Ministry of Health was responsible for the registration of births and deaths and the Sharia courts, the churches were responsible for the registration of marriage and divorce and Department of Statistics, according to the law, was responsible for the compilation and dissemination of vital statistics [25].

Until recently Department of Civil Status, took the responsibility of registering all vital events in Jordan. All births occurred in Jordan have to be registered within 30 days or a fine will be imposed. Births to Jordanians abroad should report to the Jordanian embassies or consulates within 90 days. Deaths occurred within the country have to be reported within 7 days and deaths occurred to Jordanians abroad should report to the Jordanian embassies or consulates within 90 days, the law stipulates.

Despite the successes that Jordan has made over the past 70 years, there are still some areas that need improvement. The first issue is the registration coverage and the under-reporting of vital events in the country. It was estimated that 98.8% of the births are registered [25]. The ultimate goal is to register vital events that occurred to Jordanian citizens living in the country and abroad, as well as non-citizen living in the country. Efforts have been made to promote the importance of civil registration and vital statistics,

through improving data dissemination and conducting workshops and seminars, in collaboration with United Nations Population Fund Activities (UNFPA).

## **2.5 Population Registration in Malaysia**

A written law related to the registration of births and deaths was legislated and came into force in 1868 [26]. The registration law enforced in each of the states had similar provisions as it defined the type of events to be registered as they occurred, specified the time allowed for registration, designated the person qualified to give information and to register, outlined the place where registration should be made and provides provisions for penalty [25][26]. Registration function was under State Medical and Healthy department. The state medical and Health officer appointed the state Registrar of births and deaths and subordinate staff in carrying out the function of civil registration. The state registrar was responsible for the overall organization and administration of the registration while the deputy registrars were responsible actual registration process. To ensure an effective registration, it was mandatory for Police and Village Headmen to report every birth or death occurrences within their respective areas to the authorities concerned.

The law on the registration of births and deaths in each state was regional; it was unified into a centralized registration system throughout the Federation when it attained independence in 1957. This was as result of uniform legislation for the compulsory registration of births and deaths including still-births introduced in the Federation when the Births and Deaths Registration Ordinance, 1957 came into force in 1958 [25][26]. Thus, for the first time in the history of the development of civil registration in Malaysia the administrative organization became centralized, national in character and concept as well as the foundation of the present civil registration system. The system of registration

is centralized in the sense that there is a network of registration offices controlled and administered by a central authority of the Federal Government.

## **2.6 Population Registration in Africa**

Generally, many people are born and die without leaving a trace in legal record or official statistics, therefore, rendering them un-seen and un-countable [27]. African Ministers held a conference with a theme “Improving Civil Registration, Institutional and Human Infrastructure” [27]. The purpose was the result of the Africa’s effort to tackle challenges caused by the absence of reliable vital events data such as births, death, marriage etc, which has led to phenomenon known as the “Scandal of Invisibility”.

The training workshop of experts on Civil Registration and Vital Statistics (CRVS) was held in accordance with the declaration made by African ministers responsible for civil registration [28]. The ministerial meeting called upon all African countries to urgently undertake in-depth assessments of their CRVS systems and to develop national CRVS plans as a priority step towards improvement of the systems. The meeting agreed on a common strategy for undertaking the assessments, which included the creation of a regional pool of experts who would support countries in undertaking the assessment and planning processes.

## **2.7 Population registration in Botswana**

The first census in Botswana was conducted in 1904; the population was estimated at 120,776. The 1971 census in Botswana was the first to use de facto enumeration; a method that counts people based on how many people spent census night at a specific

location. According to United Nation estimates, the Botswana population was 2,024,78 in 2011, compared to only 413,000 in 1950 [29]. The “Omang”, literally “Who are you?” refers to the National Identity Card required for adult Botswana citizens to exercise their rights and acquire benefits, was introduced in 1994 for adults attained 21 years. In 1997 the age was revised from 21 years to 18 years and 1999 converted to automatic fingerprint Identity system [30].

Recognizing the importance of having a system through which meaningful population data could be collected at national level and on a continuous basis, in 2003 legislature passed mandating the registration of all births and deaths, as well as having a national registration number (Omang) at the age of 16 years [30]. Birth registrations by the Department of Civil and National Registration have been a success, as a great majority of mothers deliver in health care facilities. Still many births are not registered in rural areas due to lack of facilities in some settlements [30]. With respect to registration of deaths, the uptake has been encouraged by the prevailing situation where insurance companies, burial societies, governmental departments and other relevant bodies insist of seeing an authentic death certificate or letter from local authorities for them to assist in matters involving the estate of the deceased or other related matters.

As it is mandatory for all people over the age of 16 years to show their national registration card where identification is required, be it in government establishments or the private sector, the public response in requesting registration has been phenomenal. But reports from the Department of Civil and National Registration under the Ministry of Labour and Home Affairs suggest that about a quarter of Botswana’s population is made up of non-citizens that have acquired “Omang” cards illegally. This was confirmed by



Minister Edwin Batshu and deputy director of Criminal Investigation Department (CID) Kesetsenao Tsweneitsile [31].

The National Registration Act Cap: 01:02 required that national registration be undertaken for all citizens of Botswana above the age of 16 and a national register be kept. Parliament was informed that as of December 2013, the total number of uncollected Omang cards was 56,679 [32]. It is not clear whether all of the owners are still alive or lost interest in this vital document. To date, the national register stood at 1,502,669, adding that the minister was unable to provide an accurate population numbers because compulsory national registration only commenced in 1988 and was introduced against limited implementation capacity amongst other factors. The Minister said that to this day his ministry continues to discover people who have not registered for national registration [33].

Because they don't have valid Omang cards, many Batswana, particularly those in rural areas, have lost out on benefits accrued from much needed government services [33][34]. However, despite these exceptions, the situation in rural areas suggests that population registration is not up to satisfactory level in terms of coverage, quality of registration and identification in Botswana.

## **2.8 Population Registration in Uganda**

The Ministry of Justice in Uganda, hosts a Bureau of Births and Deaths Registration which is mandated to collect data on vital events, including those related to health at community level [35]. The lack of community involvement and engagement hampers institutionalization of births and death registration at this level. The United Nations

Children's Fund (UNICEF) and Plan International had on a pilot basis conducted vital registration at community levels. Although good lessons were learnt, cost effective replication and scale up were not feasible. Thus there is no systematic system in place to capture births and deaths at community level [35].

Recently, Uganda Registration Services Bureau was established by Chapter 210 Laws of Uganda in 1998. The Bureau was created to take over the functions of the Registrar General's Office under the Ministry of Justice and Constitutional Affairs. The Act came into force on the 16th of August, 2004 and the self-accounting status was granted in July, 2010. Official operations started in 2012, to carry out all registrations required under the relevant laws, maintain registers, data and records on registrations affected by the bureau and to act as a clearing house for information and data on those registrations [35].

According to United Nations, countries need to know how many people are born, die and the causes of their deaths in order to have well-functioning health systems [36]. When deaths go uncounted and the causes of death are not documented, governments cannot design effective public health policies or measure their impact. Population registration is something that all developing countries should have, though most countries are advocating for civil registration, it does not include all the necessary population information. Information on births and deaths by age, sex and cause is the cornerstone of public health planning. WHO, emphasizes that, population registration systems are the most reliable source of statistics on births and deaths, territorial movement and social mobility [37]. Countries that do not have a well-functioning registration system only have approximate ideas of the population numbers, the longevity and the health of their population.

## **2.9 Summary**

Finally, United Nations' reports on improvement of civil registration and vital statistics conclude that good stewardship of a population registration and identification system is a window to e-government [38]. This requires a properly modelled system that entails an information system, which provides accurate statistics that enabling government to provide better services.

Population change is the most difficult component to estimate because of both data and methodological challenges. Despite the systems in developed countries for estimating population change over the last three decades, population data remains a challenge.

## **CHAPTER THREE**

### **Methodology**

#### **3.0 Introduction**

This study conducted exploratory and descriptive research on the creation of a model for the comprehensive, continuous, permanent, compulsory registration and identification of citizens and non-citizens in the country. Specifically the researcher used case study, registration, survey, and statistical representation that had primary goals:-

- i. Create model for population registration and identification,
- ii. Generate accurate statistical data for citizens and non-citizens.

Chapter two highlighted the critical need for standards in population recording and lack of systematic approach, lack of empirical research on how to create such an information system. These two conditions were the primary motivations for the researcher.

To address the objectives of this study, the researcher developed multi-methods research strategy that supported such an approach. This chapter discusses the overall study design and the multiple data collection and analysis activities used to collect data to achieve the objectives of the study. The chapter also highlights methodological issues and limitations encountered by the researcher.

#### **3.1 The research strategy**

Keeping in mind the study goals, the research strategy need to support both the documentation and model development. The strategy also needed to result in system modelling sufficient to achieve the research objectives put forward by the study. Three facets characterize the research strategy, qualitative, case study, system model building.

### **3.1.1 A qualitative study**

According to Weiss and Sirbu, when studying the process by which systems are developed one is struck by the complexity and subtlety of the process [40]. Schmidt and Werle report on the difficulties in conducting research on system development and suggest that the empirical reconstruction system process is confronted with problems of gathering and interpreting data [41].

### **3.1.2 A Case Study**

A case study approach provides a mode of inquiry for an in-depth examination of a phenomenon. Yin [44] characterizes case study research as empirical inquiry that, investigates a contemporary phenomenon within its real life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. He states that the “distinctive need” for case study research “arises out of the desire to understand complex social phenomena” [44]. Given that system development is a complex process comprising activities, entities, processes, and forces and their interrelationships, a case study design was warranted. The case study enables the use of multiple methods for data collection and analysis. The primary sources in this study were primary source materials and documentary evidence, interviews with key participants, and observation of the standards work. Multiple sources of evidence and different data collection techniques are two of several methods that Patton [42] suggests to improve the quality of the data and research findings.

Stake and Yin [43] suggest the importance of setting boundaries of the case, or what is to be considered part of the case. Yin, in one example, suggests that specific time

boundaries need to define the beginning and end of the case [44]. Stake, claims that bounding the case is part of conceptualizing the object of study. The study addressed bounding the case in two ways; temporal and logical. First, the study covered the time period from the initiation of the formal standards. Since a standard effort responds to problems, the study investigated the period prior to understand, describes, and documents the context from which the work emerged. Second, the preliminary conceptual model offers an initial logical bounding of the case.

The model assumed standard development represents an open system, and the boundaries of the various systems or components are not firmly fixed or clear. The assumption is that open systems, by definition, have somewhat permeable boundaries. The preliminary model, however, provided a point of departure for what was investigated in the case study i.e., the environment, the processes, the entities and the stakeholders.

### **3.1.3 System model building**

The third facet of the research strategy was that of system model building. The systems theoretic preliminary conceptual model introduced guided the initial stages of the research by identifying a framework for what was in scope of the case as well as reflecting the researcher's previous experience and knowledge of system development. Reiterating from Chapter 2, a model is an explicit interpretation of one understanding of a situation, or merely of one's ideas about that situation and a description of entities and the relationships between them [45].

The model provided a sensitizing framework for approaching the topic of system modelling. It did not drive the data collection as in traditional hypothetical deductive research. Instead, the model organized concepts such as inputs, outputs, processes, information feedback, boundaries, and environment that the researcher explored indirectly in data collection. The model oriented the researcher, at least initially, towards inclusion and openness to discovering what data to collect rather than setting out limits and exclusions on what to attend or collect.

Patton points out, however, that the researcher does not enter the field with a completely blank slate and that some way of organizing the complexity of reality is necessary [42]. He suggests that sensitizing concepts serve such a purpose by providing a basic framework highlighting the importance of certain kinds of events, activities, and behaviours [42].

The study was an exercise of developing a descriptive model that would adequately represent system modelling and accommodate the interactions and evolution of the standard. Wilson suggests that a model may be prescriptive or illustrative, but above all, it must be useful [45]. For this study, the revised model presented in Chapter 4 is a conceptual step forward gaining a holistic understanding of system modelling. The model is grounded in the study's data and improves upon the descriptive power the preliminary model. While keeping within a systems theoretic framework, extends the power of a systems perspective by accounting conceptually for the evolutionary mode of PRNIS development.

Throughout this study, the goals of exploration and description took precedence over generalizability, predictability, and model testing. The results of the model building, however, lay the groundwork for subsequent research in system development. The character of PRNIS development discussed in Chapters 4 and 5 highlights the unpredictable and chance occurrences that impacted its development. While accommodated in the model, the conceptual insights related to such aspects of system development need further exploration.

### 3.2 Research design

The research strategy provides a framework for conducting a systematic study that would address its goals and objectives. **Figure 4**, summarizes the overall study design, activities and the extent of data resulting from this approach. The summary reflects the logical flow from preliminary activities that initiated the study and the development of preliminary conceptual model through the data collection, the refinement of the conceptual model and the articulation of the set of working objectives.

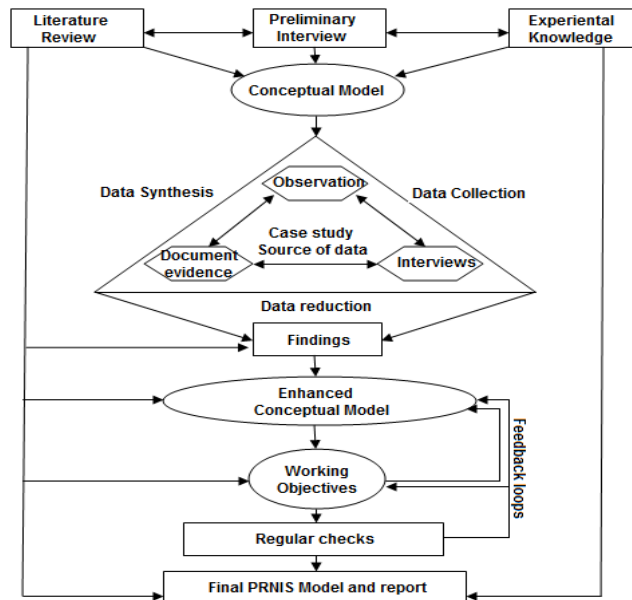
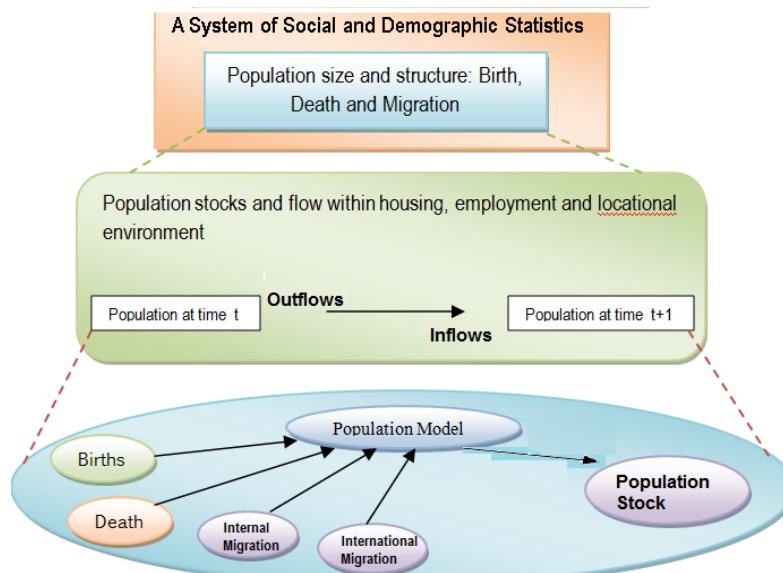


Figure 3: Synopsis of the research design



### 3.3 The modelling phase

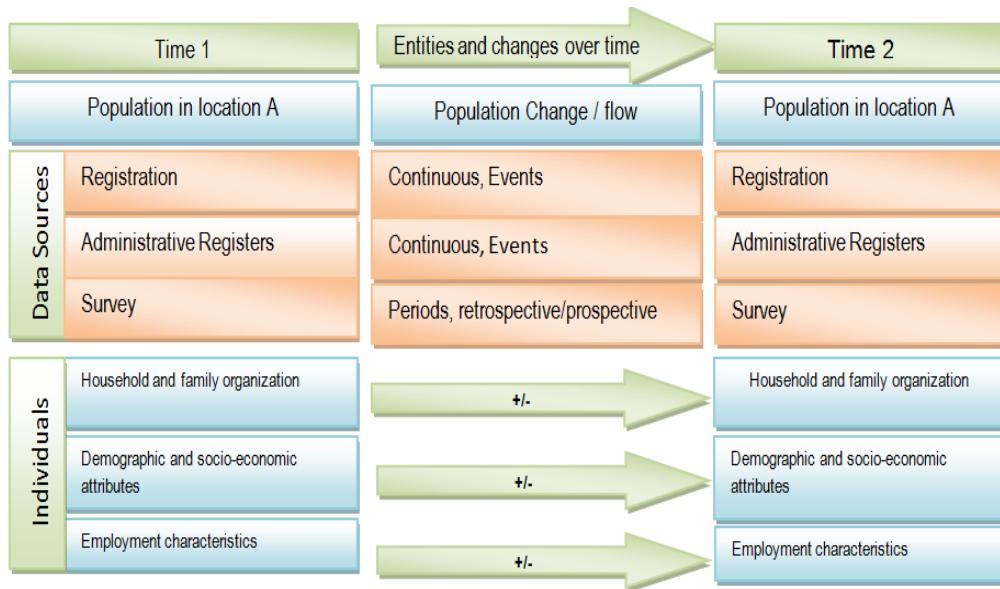
The conceptual modelling phase within a methodology for systems development is used to present a preferred approach to an idea or thought aimed at providing a classic diagram that can be used as basis for the modelling of the classes of several application domains. The main elements of the conceptual framework for a population registration and national identification system can be characterized formally, (with some overlaps, in terms of content, procedures, responsibilities and the rights of data subjects) and has the following building block in **Figure 4**.



**Figure 4:** The framework for population and migration statistics

The framework has three layers; the top layer is the comprehensive framework that identifies one component, the size and structure of the population, birth, death and migration, and then expands this form to the second layer, which shows the two population stocks, inflows and outflows with relationship at each time point. The population part of this middle layer is then expanded in the bottom layer which provides

details of the flows into current Uganda population model that generates successive population stock accuracy.



**Figure 5:** A framework of population stocks and flows set within a group and infrastructure

**Figure 5** shows a graphical representation of the context in which population changes. Left hand side of the diagram shows the set of population stock in a particular location with a variety of entities at a time point 1. These stocks then pass through change boxes and experience gains or losses that transform them into the corresponding stocks at time point 2. The gains are represented by plus signs while losses are presented by minus signs. Changes can occur both within locations and between locations. The gains to the population stock occur through new births and new migrations during the time interval. Losses to the population occur through deaths and migrations during the time interval. However, these gains and losses in real-time are organized into population accounts and their associated theoretical equation “ $P_t = B_t \pm EI_t - D_t + T_{t-1}$ ” It is often useful for planning and policy making to disaggregate the stocks and flows by attributes. There are three dimensions of population attributes which are of general interest:

- i. Demographic (sex, age, date of birth, marital status, living arrangement)

- ii. Social (education attainment, occupation, social class, religion, ethnicity)
- iii. Economic (activity class, employment/unemployment, income, wealth)

Once we disaggregate the population into classes using an attribute variable eg (DoB, Sex, Religion or Income) then the flows become multidimensional; people can move between classes over time interval. In some cases this movement is strictly controlled; we move from younger age to an older age over a time interval. In other cases, such as marital status the move depends on the way categories are defined.

Individuals as single entities live in small groups called households which share living space and living arrangements. A small portion of the population lives in communal establishment in which they may either have their rooms but food is provided centrally e.g. boarding schools, military bases, prisons, long stay in hospitals, students halls of residence and refugee camps,. Another group entity is the family, which consists of individuals who are related by marriage, partnership and through generations (children, parents, grandchildren). Some households contain individuals who are not related at all, such as those live in a lodging house or share a housing unit while studying. Changes in the nature of households over time, such as the rise in the number of lone person households, have impacts on housing requirements and this forms part of the context for population change of a territory.

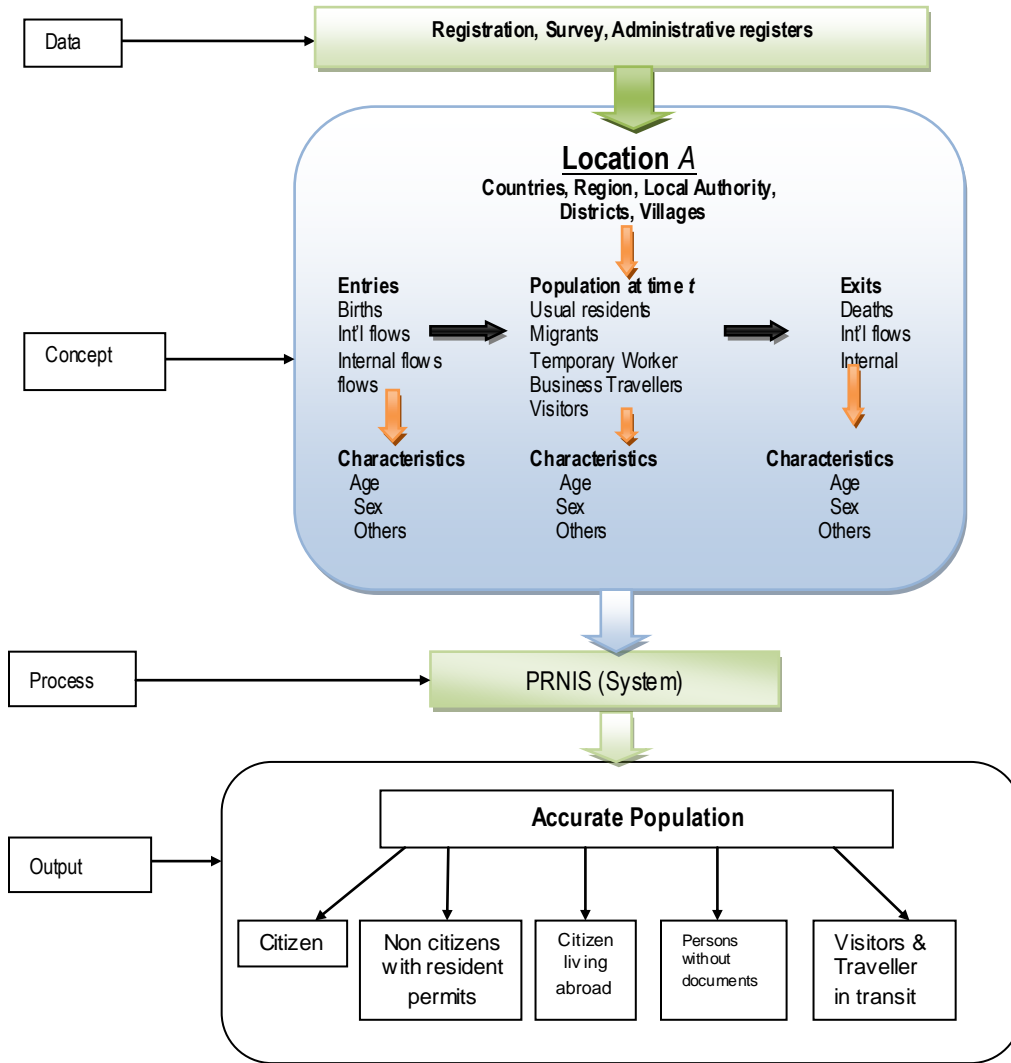
### **3.4 The conceptual frame work**

The conceptual framework for population statistics in **Figure 6** includes the main ingredients of data, concept, processing and accurate outputs. Data are any information

gathered about the population of interest and its movements, usually obtained from continuous registration, administrative registers or surveys.

Concepts refer to particular types of population or migration statistics, such as usual residents, employees, students in higher institutions, persons present in Uganda without citizenship. Processing refers to data cleaning, imputation, combining two or more information sources through matching or proportioning and statistical modelling. Outputs are the accurate published statistics at time  $t$ .

The concepts of population and migration vary depending on the need of the user eg by age, sex, returnees, visitors or ethnicity. However, all types of population can be related to the accurate population at time  $t$  in location  $A$ . Likewise, concepts of migration can be related to the movement of all people in and out of location  $A$  between two time points. To quantify accurate populations, therefore, one must consider the types of entries and exits between time point  $t-n$  and  $t$ , where  $n$  refers to the width of the time intervals e.g. hours, days or months. There are various data sources that can be relied on to capture populations present in location  $A$  at time  $t$  in statistical form, the main attributes are age and sex. However, to understand changes in populations across space, it is useful to also have more information such as place of birth, education qualification, employment status, occupational group and marital status.



**Figure 6:** A conceptual framework for PRNIS in Uganda

Due to time and data constraints, the outputs rarely consider all the different types of population present in location A and at time t. More often, they include just one type population of particular need, such as the populations that are considered to be usual residents. As an illustration of how the conceptual framework would be applied, consider the concept of all migrants arriving in Uganda for at least a year, residing in local authorities and assume that there are only two sources of information available; migrants captured at the international entry points and at administrative registrations. Because of the relatively small sample size (from those two sources), the information is only reliable

at the national level. The information is collected at the time of registration with reliable address information but no information on length of stay.

The main advantage of the PRNIS is that it measures those residing in local authorities. To combine these two sources together and the concept above, the system would have the accurate number of visitors and migrant switchers i.e. those changing their intentions and be able to determine the lag between arrival and registration and duration of stay. Furthermore, one would like to separate the non-Ugandans aged 18+ years from the rest of immigrants. The resulting output would be non-Ugandan aged 18+ years arriving in the country for at least a year residing in local authorities. This illustration shows how a framework is needed to match the available data to a concept and the obstacles and limitations that often occur with such a process.

### **3.5 Determining accurate statistical data for the citizens and non-citizens**

#### **3.5.1 Population measures**

When constructing a time series of populations, it is important to be clear about the criteria for inclusion or exclusion of individuals. PRNIS has the concept of usual residence that defines the population accuracy on 30 June / 1 July to start with. The population accuracy begins with compulsory population registration or count and then rolls forward day by day, adding and subtracting relevant vital events and migration flows that change the population statistics.

### **3.5.2 Natural change measures**

Perhaps the most accurate information is on the number of live births and death for locations in Uganda over time. This is because all births and death have to be registered by law. Births are published according to the birthdates, sex, birthplace and residential location of the mother, whereas deaths are recorded for all persons by ID no, age, sex and residential location.

### **3.5.3 Migration measures**

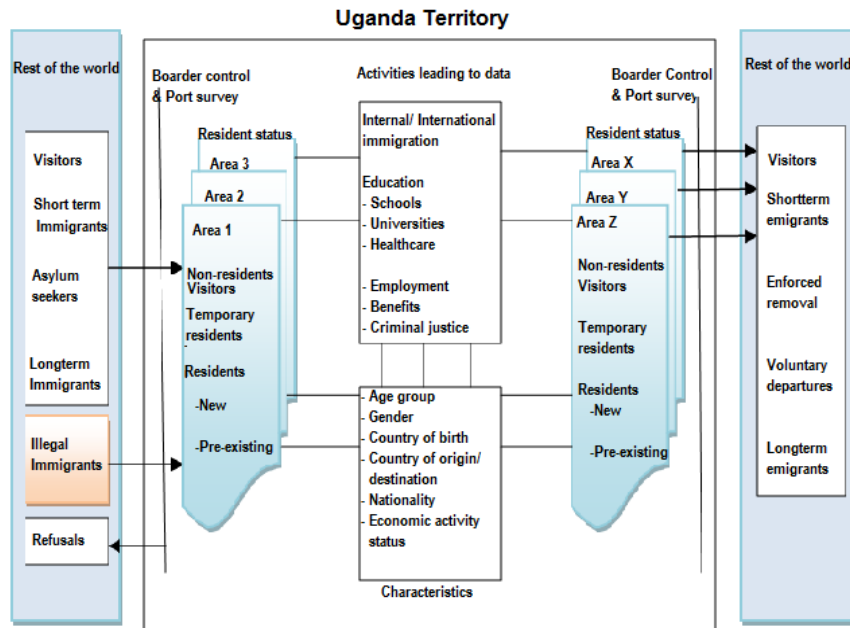
Migration is a loosely defined process that represents the relocation of people during a period of time that causes them to relinquish the ties with their previous locality [46]. Migration involves people moving within a country, as well as across international borders. The factors that separate migration from other forms of mobility eg daily commuting, weekly commuting, holiday visit or seasonal moves are generally distance travelled and length of time spent in the destination or away from the origin.

Migration data are obtained from general purpose registration or administrative registers. The practical measure of migration data obtained from these sources often does not coincide with theoretical or contextual definition of migration [47]. The reason for this is that, unlike births and deaths, there are no legal frameworks for measuring migration. In practical terms, migration can be defined as relocations between administrative areas and mobility as relocations within areas. Therefore, a residential movement within the same suburb is refer to as migration which may have relevance for the estimation of the population change of very small areas, such as output areas.

In recent decades in Uganda for example, migration has gained importance in driving both sub-national and national population change. Internal migration is driven by people seeking employment, or a better physical or social environment to live, depending on what stage in the life course the migrant is at. The drivers of international migration, however, differ by direction. Immigration is often motivated by the demand for low-skilled, low-wage labour, the need to fill specific labour gaps, education, people seeking to reconnect their families, national returning home after spending a period of time working abroad and people seeking asylum. Emigration is driven by high skilled nationals seeking better employment opportunities abroad and non-citizens returning home.

A framework for demonstrating the influence of internal and external migration statistics on population is presented in **Figure 7**. Both types of movement are linked to residence status. It also includes the distinctions between immigrations and asylum seekers and between emigrants and enforced removals / voluntary departures, demonstrating the importance of understanding migrant's characteristics and motives. Data are obtained through the activities the migrants carry out, such as enrolling for education, seeking healthcare or social benefits. Thus, migration is measured differently depending on the source. Administrative registers usually capture data suggesting events, such as initial registration or registration with local doctors or health clinics. Surveys, on the other hand usually capture transitions such as place of current residence by place of residence one year ago.





**Figure 7:** Frame work for internal and external migration statistics

### 3.5.4 Population characteristics

Age, sex and geographical location are considered as the baseline characteristics required for population statistics. For understanding change or differences between population groups, it is often useful to have more detailed attribute information, depending on the need or user. For those interested in migration integration, information on the non-citizen population, their level of education and their occupations are useful. For setting up migration policy, understanding the reasons or drivers for migration is important. The service provision, information on population health, number of children and economic activities are required. The key population and migration attributes needed for understanding society and source of data.

### **3.6 The selection of the case study**

As stated, the purpose of this research is to create a model for the Population Registration and Nation Identification System in Uganda. This entails a detailed study of a wider and local context factors influencing population statistics and the processes of demographic change. The research has established connections between socio-economic and socio-demographic variables, values, as well as relationship between value and behaviour. The findings served as a premise for this study in which relationship between social environment value and political participation were singled out as factors influencing population statistics.

Such a focus led to the adoption of an interpretive stance, which seeks to uncover truth by understanding regularities, the phenomena in the real-time context [48]. A case study approach was therefore, used to describe the collection and implementation of population statistics in three responsible organisations. For three years beginning with 2012, conflicting population estimates have been published by reputable organisations. (Reference is made to problem statement above). The Uganda's population has been estimated to 37.5 million by the year 2013.

The selection of these case studies was based on the issue that the two organisations (UBOS and PS) are under Government of Uganda, to provide information concerning population change in the country. They are assigned duties of monitoring population change and advise the government on how to provide services to the population. However, the government cannot plan for the citizens if it has not had census over 13 years. The Decennial census should have taken place in 2012, but it has been repeatedly postponed due to lack of funds [49].

#### **3.6.1 Data sources**

Data collection for this research was done through both secondary and primary sources. Primary data sources included respondents from each case study and the secondary data sources mainly covered population statistical estimates, were reports of the UBOS and

Population Secretariat. Valuable insight was also gained from the analysis of research studies conducted by the UNFPA, UNICEF on CRVS in Uganda.

The secondary data covered different sources and provided an essential preparation for the interviews. Secondary data helped to cross-check official information, learn about major vital events, historical decisions and main government players and roles. They also supported the exploring of particular responses during interviews [50][51]. Case studies and benefit of examining written secondary sources as research material, provides a multitude of interpretations [52]. For this study it was possible to conduct the data collection and analysis in an iterative manner.

### **3.6.2 Data collection and analysis**

The main data techniques used in this research study were semi-structured interviews, investigator's observation and secondary source analysis. Personal interviews constituted one of the most important valuable sources of information.

The social nature of information systems leads many Information System researchers to adopt research approaches that focus primarily on human interpretations and meaning [48]. Interpretive studies advocate a relativistic understanding of the phenomena being studied [37]. Interpretive researchers see the pursuit of meaning and understanding as subjective and knowledge as a social construction [42]. They examine the social reality and subjective meanings held by people by eliciting and observing what is significant and important to them.

There is no rigid separation between data collection and analysis and the process is an iterative cycle of data collection and analysis, with the intention that the results of analysis which helps guide the subsequent collection of data. The cycle is repeated and theory is elaborated and checked as the process continues. When conducting interpretive research, it is generally accepted that researchers should interact directly and intensively with the subjects of their research over a period of time. The interviewees were chosen for their relevance to the conceptual questions rather than their representativeness.

The total number of respondent interviewed was reached heuristically, i.e. the decision to stop adding respondents was taken when nothing new was being learnt from the interviews and a state of theoretical saturation was achieved. The interviewees were selected on the basis of their closeness to the topics of the study project and their levels of experience in management and organisational issues. The information gathered from these interviews was subjective, although an attempt was made to present an account from various perspectives and levels within the organisations.

Interview transcripts and written notes were analysed systematically through iterative and repeated re-reading of them. This made it possible to gain an increasingly detailed understanding of each interviewee's view point and perspective, of links and contradictions within and across interviews, of complex contextual factors emerging from the aforesaid interviews and of the many relationships between the relevant concepts.

In the case studies, a total of 30 were expected, but only 15 interviews were conducted with senior managers and selected administrators plus observations by the investigator. The interview response rate was 100% of which 50% were valid responses and 50% were regrets due to sensitivity of the population data. The data about population estimates were gathered from reports, books and web sites. Document analysis was used in the fieldwork conducted for this study, together with interviews, and participation observation, which provided face-to-face contact with the social actors in order to explore and probe responses.

There is a multitude of data collection techniques and these vary according to the extent of interaction between the investigator and the phenomena under scrutiny. Until quite recently, much of the reported interpretive information system research only involved relatively distant data collection methods such as analysis of published data, textual analysis or surveys [53].

The case study method necessitates the collection of a large amount of rich, qualitative information from a number of sources in order to address the complexity of the process and the context studied. The analysis of the data was done by following the trends in the patterns that emerged in the course of the research that explain past data. One fundamental theory of the sociology of technology is that there is no one inevitable way of developing technological artefacts. Therefore, when interviewing respondents, one is listening for narratives about why things happened in the way they did or not, in the case of adoption. Hence one is collecting multiple interpretations with all their contradictions rather than finding the correct interpretation.

First of all, analysis of data dealt with the description of each case study based on the collected data via the different instruments. It was investigator's contention that the descriptions of the case studies allow one to gain insights into the specific context. Finally, considering that this research study is composed of three case sites, it was necessary to search for patterns in all the cases. This enabled the researcher to develop a strong body of evidence from the cases.

The methods employed are primarily interpersonal, in-depth consultations and focus groups. Thus the nature of this type of research is explorative and open-ended. Small counts of people were questioned in-depth, and a comparatively small number of focus groups are conducted. Participants are called for to reply to general questions; however, this study focused on the current situation and suggests improvements necessary to create a model for developing a PRNIS for the Republic Uganda, along with recommendations for its implementation. The study elaborates, in particular:

- i. objectives and principles that need to be taken into account for the creation of a functioning computerized PRNIS;
- ii. the National Registration System (NRS) setup, legal framework, information management and operations; and
- iii. Implementation requirements for the functioning of a computerized PRNIS.

The conceptual framework contains the factors, variables and presumed relationships amongst them [54]. In the interpretive tradition, there are no correct or incorrect theories [55]. Instead, they should be judged according to how interesting they are. The result is not the creation of a new theory, but the generation of an inter-subjective one, that is, a

theory built on by people working in the field. There are three different uses of theory in interpretive case studies: i) theory guiding the design and collection of data; ii) theory as an iterative process of data collection and analysis; and iii) theory as an outcome of a case study [56].

The use of theory as an iterative process between data collection and analysis has been applied in this study. The emphasis is that the theoretical propositions before the case study should be formulated very carefully because they contribute to the design of the model [57]. The formulation of the theoretical propositions will also, according to Yin [63], indicate what analytical generalizations are expected as an outcome of the case study.

### **3.7 Designing a system model for population registration**

The PRNIS model intended to develop a decentralized system, aimed at providing an on-line registration and documents issuance services to the citizens, resident and migrants in the country. The offices are connected via telecommunication network to the central computer centre, in which powerful servers/Database and back-up features ensure 24-hour system uptime. The heart of the Population Registration and Identification System is the centralised database, which serves as the source for all population registry systems. Other government application systems are connected to the central population database, providing it with data and retrieving information from the central database for queries and management reports.

The birth registration for example, is the most important source for creating and maintaining a comprehensive population initial registration. The system includes facilities for registration, issuing of certificates, handling of Birth and Death registers and generating management statistical reports. The Birth and Death data can be accessed and used by government ministries and departments for management purposes.

i. The Birth Registration module performs five (5) main tasks:

- a. Registration of birth data for a newly born
- b. Generation of an ID number when registering a newborn
- c. Registration of family relationships
- d. Printing of birth certificates
- e. Providing statistical information

ii. The Death Registration module performs three (3) main tasks:

- a. Registration of death data for a deceased person
- b. Printing of death certificates
- c. Changing the activity status on personal records to “Deceased”

The third task of the Death Registration affects other related systems

- d. Deletion of the deceased person’s name from voters roll
- e. Prevention of issuing passports or ID card
- f. Enabling reliable demographic statistics
- g. Supplying information about the deceased to other government offices

iii. The Marriage and Divorce Registration is vital for maintaining the Family Relations

Registry. The Marriage/Divorce Registration System handles the following:

- a. Marriage/Divorce registration
- b. Displaying of relationships



- c. Registration of religious organizations
  - d. Printing relevant marriage/divorce documentation.
- iv. The Identity Card System is an on-line decentralized system, covering the entire process from handling the application form and data capturing up to the issuance of the ID card to the citizen. Data is captured online at registration/mobile offices throughout the country, by officers who have been trained. The offices are equipped with digitized equipment, such as PCs, digital cameras, fingerprint scanners and printers. At the end of the process an ID card is issued and delivered on the spot to the citizen.

To facilitate registration of individuals in rural and remote areas, mobile stations for ID registration can be implemented. PRNIS provides services of ID requirements analysis, including final design of the ID card and its security features.

- v. The Immigration, residence and Citizenship Registration System handles the following:
- a. Management of immigration, residence and citizenship application process.
  - b. Issuance of various certificates, visas, permits and other official documents
  - c. Renunciation of national citizenship process, which affects the issuing of ID card, passports and inclusion in the voters roll
  - d. Interface with external authorities, such as – police, Interpol, Border Control, passport systems, civil registration, national ID and others.

- vi. Election, PRNIS System is designed to Assure One Citizen - One Vote. This system handles and manages voter's registration. PRNIS can extract and provide data to create a reliable and accurate voters registration database.

The Election System includes the following modules:

- a. Voter Registration
- b. Provinces and Ward demarcation
- c. Creation and printing of voters roll by polling stations
- d. Generation of supplementary voters roll after update of inspection data
- e. Issuance of Voters' Cards

According to the Election System design, registration to one of the election types will lead to an automatic registration to all other election types. The advanced Election System designed and implemented by PRNIS assures the principles of democracy, namely "One Man, One Vote", as shown in the previous page.

### 3.8 Summary

In this chapter the theoretical and philosophical assumptions underlying the research methodology in the Information System field were reviewed. In addition, a discussion of the research design for this study was made. A summary of this chapter is presented in Table below through highlighting the major decisions made in order to conduct this research work.

<b>Level of decision</b>	<b>Choice</b>
Epistemological and ontological assumptions	Interpretive
Research strategy	Case studies
Research Techniques	Participant observation, Interview guide, Group discussion and document analysis.
Subject	Modelling Population Registration and National Identification System (PRNIS).
Theoretical Framework	Use of theories, and Design strategy for Integrated PRNIS

**Table 1:** Summary of the research design

## CHAPTER FOUR

### System Requirement Engineering and Modelling

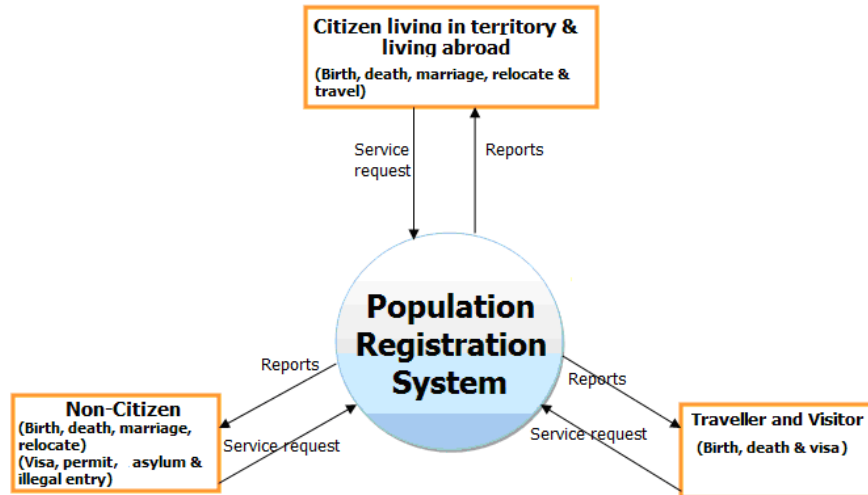
#### 4.0 Introduction

System modelling is a generic discipline to handle objects existing or to be created system, in a way that supports reasoning about the structural properties of these objects. Therefore, it is a response to the conceptual and practical difficulties of the description and the design of complex systems. Depending on the context, systems modelling can refer to a model that describes/analyzes a system or a method of building a system. As a discipline, system modelling has its own practical rules and heuristics, as much as powerful best practices from various fields.

The model for Population Registration and National Identification System (PRNIS) therefore, is the conceptual model that defines the structure, behaviour, and views of a population statistical system. The model description however, is the formal description and representation of PRNIS, organized in the way that supports analysis of the structures and behaviours of the system. This chapter therefore, sets the convention rules and standards employed in PRNIS technical framework, plus requirements and specifications that are necessary for modelling various components.

#### 4.1 The system scope

The conceptual or scoping model defines the boundaries of the system. The system size is a measure of the magnitude of all components that are within the system scope, the scope clarifies the system boundaries so that it is clearly understood before the system size is estimated. Hence the boundaries identify where the system to be sized starts and ends.



**Figure 8:** A System Context Diagram

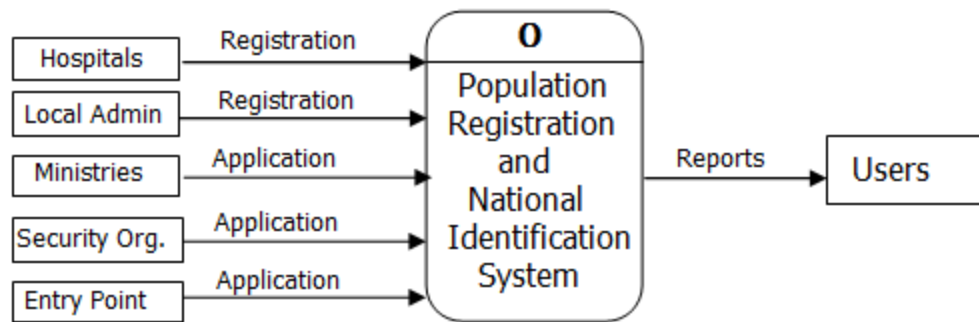
A System Context Diagram in **Figure 8:** presents a high-level view of the overall system boundary of interest and defines the PRNIS domain that is being modelled. Within the domain, the diagram depicts the top process together with its major incoming and outgoing data flows linked to participating external entities. Therefore, it is a diagrammatic tool for process modelling and scoping systems which will be used for modeling PRNIS for registration of citizens within the country and living abroad, non-citizen with documents, person without documents, visitors and travelers.

## 4.2 Requirements Engineering

Stakeholders were interviewed about the current system that is being used in data collection over demographic events. Data gathered from various stakeholders, plus open ended interviews with no pre-defined agenda, defined the requirement for the system. In arriving at the necessary requirements, some pertinent questions including the following:-

- What are current process problems?
- How will the proposed system help?
- What will be the integration?
- What facilities must be supported by the proposed system?

The requirements however, identify High Level Requirements (HLRs) associated with each type of requirement within the system. This is the most generalized breakdown of requirements for the system level that corresponds to major system functions. This begins the top-down identification of the system requirements; **Figure 9:** illustrates a system which includes High Level Requirements (HLR) for interface, and reporting of Population and National Identification System in Uganda.



**Figure 9:** High level requirement diagram

### **4.2.1 Requirements Elicitation**

In reality requirements elicitation is a multifaceted and iterative activity that relies heavily on the communication skills of researcher and the commitment and cooperation of the system stakeholders. One of the main problems facing system development project teams is communication barriers and agreement about the requirements. The main point is that concepts that are clearly defined to one community of participants can be entirely opaque to members of another. The fact that this situation exists often goes unnoticed in the course of elicitation unless specific attention is paid to the problem.

### **4.2.3 Requirement Analysis**

Requirements analysis involves frequent communication with system users to determine specific feature expectations, resolution of conflict or ambiguity in requirements as demanded by the various users or groups of users, avoidance of feature creep and documentation of all aspects of the project development process from start to finish. The effort should be directed towards ensuring that the final system or product conforms to client needs rather than attempting to mould user expectations to fit the requirements [68]. The System Requirement Specifications form parts of the documentation for the system and some desired features of the system include:

- i. The ability to input data/out information on-line
- ii. The ability to search/view information on-line
- iii. Provide reports and certificates on-line
- iv. Provide ability to resolve and registration conflict(s)
- v. Allow citizen to fill out applications for ID, Passport online.

The system will primarily concern itself with the registration process. At its core, users fill out or answer a web based form that will be processed in near real time system. In addition, the system will provide feedback regarding current registration. The system will be secured with a User ID and password/PIN.

### **4.3 System Requirement Specification**

Population Registration and Identification System will be a Web-based, allowing accessibility to users with authentication. It takes the advantages of the Internet to radically improve the registration process and it is a structured collection of architecture that embodies the requirements of a system.

#### **4.3.1 Functional Requirements**

Functional requirement defines a function of a system and its components as set of inputs, the behaviour, and outputs. Functional requirements may be technical details, data manipulation and processing and other specific functionality that define what a system is supposed to accomplish. In other words, these are the main things that the user expects from the system in this case, population registration system should be able to register new births, update the events, delete a record, etc. Functional requirements explain what the system does by identifying the necessary task, action or activity that must be accomplished. The requirements analysis is used identify the top level functionality and specifies the behaviour or function of the system and includes:-

- i. The system policies
- ii. Transaction corrections, adjustments and cancellations
- iii. Administrative functions



- iv. Authentication
- v. Authorization levels
- vi. Audit Tracking
- vii. External Interfaces
- viii. Certification Requirements
- ix. Reporting Requirements
- x. Historical Data
- xi. Legal or Regulatory Requirements

**a. Hardware requirement**

- i. Network infrastructure (wired/wireless)
- ii. Client Computers
- iii. Server computers
- iv. Web server computer(s) and support hardware (back-ups, redundant drives, UPS, etc.)

**b. Software requirement**

- i. Web portal (Managing the information)
- ii. Mobile Application (Remote access)

**c. User requirements**

Gathering these requirements is very important in that they will serve as a satisfaction rubric of the final product. When user requirements are well defined not only will the development team have sufficient information to develop a strategy. The developing also would have something to refer to in preventing scope creep. They are written early in the

validation process, typically before the system is created. They are written by the end-users, with input from Quality Assurance.

For example:

- i. System A accepts UserID, Password, and allows three attempts.
- ii. System B produces the Summary Report.
- iii. Only Administrative users can use System C concurrently without noticeable system delays.
- iv. System D can print on-screen data to the printer.

#### **4.3.2 Non-functional Requirements**

They specify criteria that judge the operation of a system, rather than specific behaviours, for example: “Modified data in a database should be updated for all users accessing it within 2 seconds.”

Some typical non-functional requirements are:

- i. Look and feel requirements
- ii. Usability and human requirements
- iii. Performance requirements
- iv. Operational and environment requirements
- v. Maintainability and support requirement
- vi. Security requirements
- vii. Cultural and political requirements
- viii. Legal requirements

### **4.3.3 Behavioural requirement**

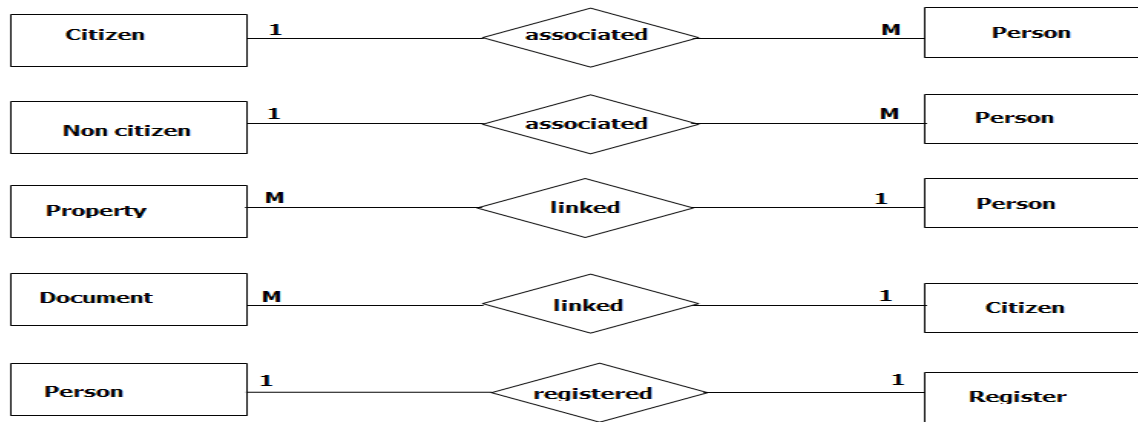
Behavioural requirements on the other hand, describe all the cases where the system uses the functional requirements are captured in use cases. Functional requirements are supported by non-functional requirements, also known as quality requirements, which impose constraints on the design or implementation such as performance requirements, security, or reliability. Generally, functional requirements are expressed as those the system must do "requirement", while non-functional requirements are those the system shall be "requirement" to do [58][59][60][61][62]. The plan for implementing functional requirements is detailed in the system design and the plan for implementing non-functional requirements is detailed in the system modelling.

## **4.4 System Modelling**

Systems models is an elegant conceptual tools that provides satisfying insight into PRNIS function. A common type of systems modelling is function modelling, with specific techniques such as the Functional Flow Block Diagram. Another type of systems modelling is architectural modelling which uses the systems architecture to conceptually model the structure, behaviour, and more views of a system. The first step is to determine the kernels which are typically PRNIS nouns, Citizen, Noncitizen, Property, and Document.

### **a. The Entities:**

- i. Citizenship
- ii. Noncitizen
- iii. Biometric
- iv. Property
- v. Document



**Figure 10** The Entities Relationship

**b. Identifying the key attribute per Entity**

- i. Citizen(PK, Sname,Fname, Others, MotherID,FatherID, DoB, Sex, PlaceofBirth, Nationality, DateofDeath, PlaceofBurial)
- ii. Non\_Citizen(PassportNo, ExpiryDate, Name, Permit, Status, DateofDeath)
- iii. Biometric(BioID, Picture, FingPrint, Iris, Facial)
- iv. Property(ProID, Name, Location)
- v. Document(DocID, Name, DateAttained)

b. The ER model for PRNIS

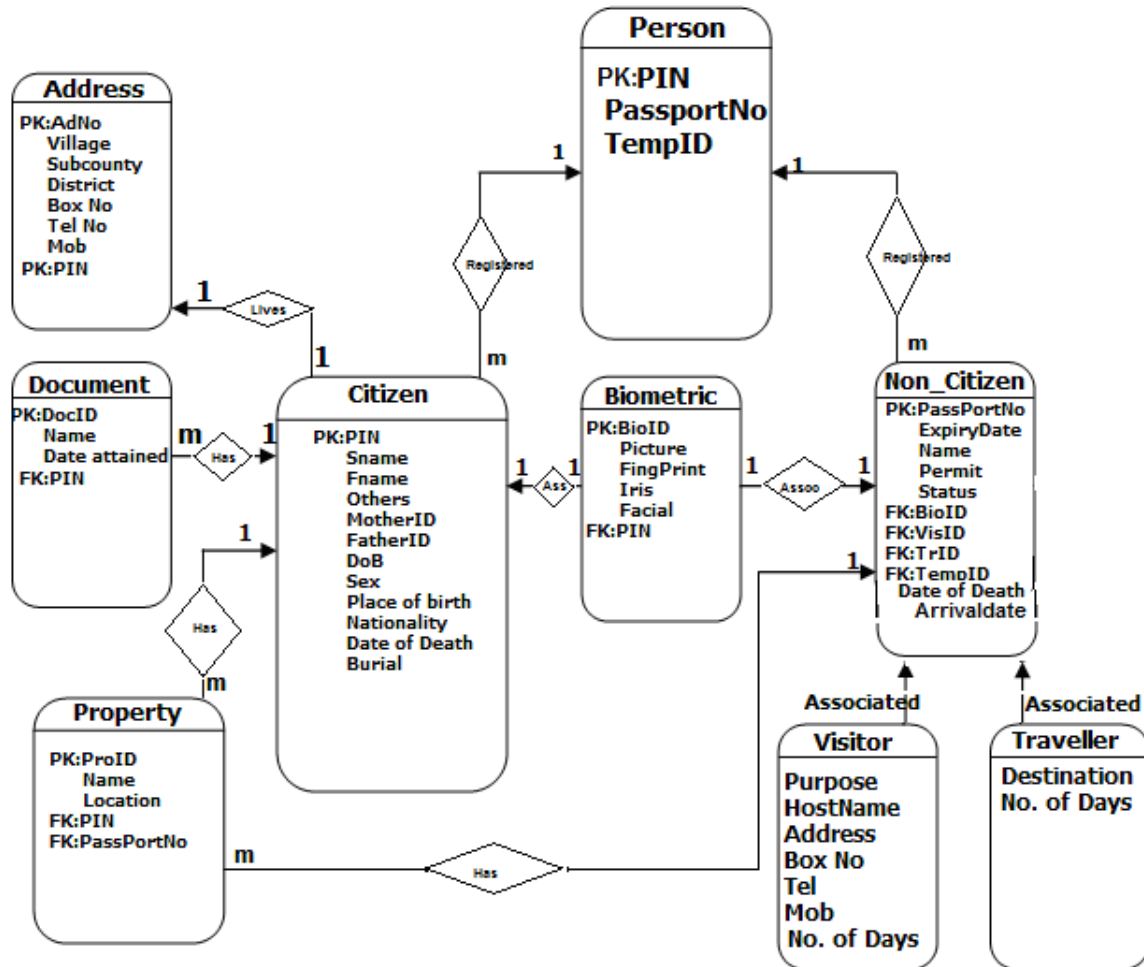


Figure 11: Entity Relation diagram

Entity-relationship (ER) diagram is the graphical representation of entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems. An entity is a piece of data-an object or concept about which data is stored and a relationship is how the data is shared between entities.

d. The Relationships



A Citizen record (a person) is associated with a minimum of 0 properties to a maximum of many properties.



A Biometric record is associated with only one citizen (Person).



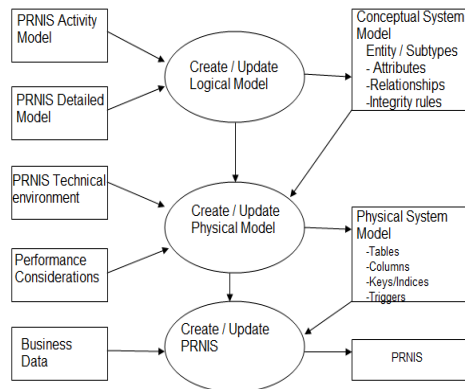
A Citizen record (a person) is associated with a minimum of 0 documents to a maximum of many documents.



A Biometric record is associated with only one non-citizen (Person).

#### 4.5 PRNIS Modelling Process

The **Figure. 13**: illustrates the way system model is developed based on the requirements for the PRNIS, perhaps in the context of activities. The PRNIS model consists of entity types, attributes, relationships, integrity rules, and the definitions of these objects. This is then used as the start point for interface.



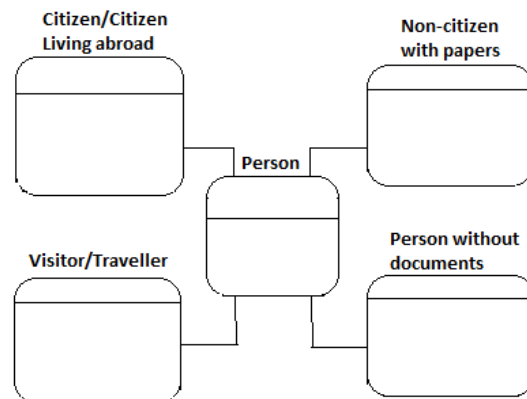
**Figure 10:** Illustrates PRNIS models development

[http://upload.wikimedia.org/wikipedia/commons/f/f4/4-3\\_Data\\_Modelling\\_Today.jpg](http://upload.wikimedia.org/wikipedia/commons/f/f4/4-3_Data_Modelling_Today.jpg) (modified)

#### 4.6 Conceptual System modelling

PRNIS conceptual modelling presents graphical models of the system based on the fact-finding results from the interviews. It also provides accurate visual representation which includes all major entities and relationships that are used during the planning phase.

The summary-level **Figure. 13**: typically describes an entire PRNIS project. Due to its highly abstract nature, it is referred to as a conceptual model, because it defines a set of requirements in terms of governance and data governance; therefore, it is necessary to integrate in a framework population register for harmonization.



**Figure 11:** Conceptual model for PRNIS

It is assumed that, in creating an information system, a conceptual model is developed as part of the requirement specification from which data model would be derived later on, in the design phase [63]. Thus, mapping between conceptual models and data models are one of the most vital transformation in the development of an information system [64]. Transformation between well known and used conceptual model, the entity relationship diagrams and class diagram model is based on three basic concepts, the entity types, the attributes and relationships. The conceptual model's objective is to convey the fundamental principles and basic functionality of the system in which it presents. It is developed in such away to provide system interpretation for the user and satisfies the following objectives:

- i. Enhance an individual's understanding of the representative system.
- ii. Facilitates efficient conveyance of system details between stakeholders.
- iii. Provides point of reference for designers to extract system specification.
- iv. Document the system for future reference and provide a means for collaboration.

Therefore, it plays an important role in the overall system development life cycle.



#### **4.7 Logical System Modelling**

Logical system modelling defines the detailed structure of the elements in PRNIS and the relationships between elements. It refines the elements introduced by the conceptual system model and forms the basis of the physical system model. However, it adds further details to conceptual model elements and refines the structure of the domain; and can be defined using Entity-Relationship. The benefit of this model is to provide a foundation on which to base the physical system model and subsequent system implementation.

**Figure 14:** shows what the PRNIS does and depicts the system independent of any technical implementation. It is referred to as the business model because it focuses in on the actual requirements; maintains a current and accurate demographic list of all individuals who reside within the geographical catchment of the territory. It indicates that an individual can be added to the register or rejected, thus equates to a registration of events, e.g. new born, individual changes or other updates such as moves from outside of the geographical catchment to within the catchment or individual moves from a country outside of Uganda's territory. An individual's information can be updated depending to the circumstances change. An individual can be removed from the register to equate to un-registration events e.g. individual dies or changes the citizenship.

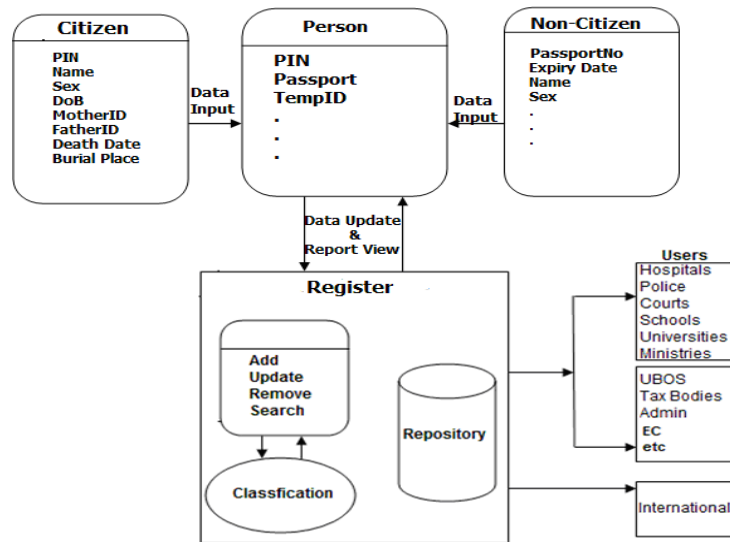


Figure 14: PRNIS Logical modelling

### 4.7.1 Data Modelling

A data model is a conceptual representation of the data structures that are required by a database. The data structures include the data objects, the associations between data objects, and the rules which govern operations on the objects. The data model focuses on what data is required and how it should be organized rather than what operations will be performed on the data. To use a common analogy, the data model is equivalent to an architect's building plans.

The data model focuses on representing the data as the user sees it in the real world. It serves as a bridge between the concepts that make up real-world events and processes and the physical representation of those concepts in a database. There are two major methodologies to create a data model; the Entity-Relationship (ER) approach and the Object Model [65].

The data model focuses on what data should be stored in the system while the functional model deals with how the data is processed. To put this in the context of the relational database, the data model is used to design the relational tables. The functional model is used to design the queries which will access and perform operations on those tables.

In this case, the data model gets its inputs from the planning and analysis stage and the modeller, along with analysts, collect information about the requirements of the system by reviewing existing documentation and interviewing end-users. As part of the components, the data model has two outputs. The entity-relationship diagram which represents the data structures in a pictorial form. The second component is a data document, which describes in detail the data objects, relationships, and rules required by the system. The dictionary provides the detail required by the system developer to construct the physical system. **PRNIS data modelling** (Refer figure 11).

In summary, data model is a plan for building a system, it must be simple enough to communicate to the end user the data structure required by the system yet detailed enough for the system design to use to create the physical structure. The Entity-Relation Model (ER) is the most common method used to build data models for relational databases. The next section provides a brief introduction to the concepts used by the ER Model.

#### **4.8 Physical System Modelling**

A physical system model is a representation of a system design which takes into account the facilities and constraints of PRNIS. The lifecycle of PRNIS is derived from a logical

system model, though it may be reverse-engineered from the implementation. A complete physical system model includes all PRNIS artefacts required to create relationship between tables or to achieve performance goals, such as indexes, constraint definitions, linking tables, partitioned tables or clusters. This model is also used to compute storage capacity; and includes specific storage allocation details for the system. However, it is a fully-attributed model that is dependent upon a specific version of a system persistence technology.

The target implementation technology is an SQL system storage component with the following common characteristics.

- i) Describing system requirements for PRNIS.
- ii) Integrating with other physical system models via a repository of shared entities.
- iii) Includes other physical objects such as views, primary key constraints, foreign key constraints, indexes, security roles, store procedures, file stores, etc and;
- iv) Physical system model diagram shows only a percentage of the metadata contained within PRNIS.

A visual abstraction of the system structure is an important benefit of defining a physical system model that derives the system schema from the model; this is possible due to the richness of meta-data captured by a model and its close mapping to aspects of the system schema, such as tables, columns, primary and foreign keys. Like other modelling artefacts, physical system models can be used for a variety of purposes, from high-level conceptual models to physical data model. Physical system modelling is conceptually similar to design class modelling, the goal being to design the internal schema of a

database, depicting the data tables, the data columns of those tables, and the relationships between the tables.

The diagram is given as the stereotype Physical System Model, that the class boxes represent tables, without the diagram stereotype would have needed to use the stereotype Table on each table. Relationships between tables are modelled using standard notation, although not shown in the example it would be reasonable to model composition and inheritance relationships between tables. Relationships are implemented via the use of keys. **PRNIS Physical model** (Refer to figure 11).

**a. Converting ER diagram model to Table**

**Citizen** (PIN, Sname, Fname, Others, MotherID, FatherID, DoB, Sex, PlaceofBirth, Nationality, DateofDeath, PlaceofBurial)

**Noncitizen** (PassportNo, ExpiryDate, Name, Permit, Status, DateofDeath)

**Biometric**(BioID, PIN, Picture, FingPrint, Iris, Facial)

**Property** (ProID, PIN, PassportNo, Name, Location)

**Document** (DocID, PIN, Name, DateAttained)

Each table is represented by a Class; columns, including Primary and Foreign Keys.

System normalization is a process in which attributes within a system model are organized to increase the cohesion of tables and to reduce the coupling between tables.

The fundamental goal is to ensure that data is stored in one and only one place. This is an important consideration for system developers because it is incredibly difficult to store objects in a relational database if an attribute is stored in several places. The tables in

**Figure 11:** above are in third normal form (3NF).

A key is one or more data attributes that uniquely identify a row in a table, is called a composite key. Hence a primary key is the preferred key for an entity type whereas an alternate key known as a secondary key is an alternative way to access rows within a table. Therefore, in a physical database a key would be formed of one or more table columns whose value(s) uniquely identifies a row within a relational table. Primary keys are indicated using the <<PK>> stereotype and foreign keys via <<FK>>.

The physical system model shows where and how system components will be deployed, hence it is a specific map of the physical layout of the system. A deployment diagram illustrates the physical deployment of the system into a production or test environment. It shows where components will be located, on what servers, machines or hardware. It may also illustrate network links and LAN bandwidth.

Entity	Attribute	Type/Seize	Validation	Key	Description
Citizen	BirthNumber	Autonumber			
	PIN	Number (13)	2014010199910	pk	Generated from date
	Fname	Text (15)	Required		
	Sname	Text (25)	Required		Indexed
	OtherName	Text (10)	Optional		
	DateofBirth	Date	28-Jan-2014		
	Sex	Text (1)	M/F		
	MotherID	Number (13)	2014010199910		Presence check/Indexed
	FatherID	Number (13)	2014010199911		
	PlaceofBirth	Text (20)	Required		
	DateofDeath	Date			
	PlaceofBurial	Text (20)			
	Noncitizen	PassportNo	AphaNumeric		pk
Fname		Text (15)	Required		
Sname		Text (25)	Required		
OtherName		Text (10)	Optional		
Expirydate		Date	28-Jan-2014		Indexed
PermitNo		Number (9)			
IssueDate		Date			
PerExpiryDate		Date			
Status		Text (10)			
DeathDate		Date			
Biometric	BioID	Number (10)		pk	
	Picture				
	Fingerprint				
	Iris				
	Facial				
Document	DocID	Number (10)		pk	
	DocName	text (25)			
	DateAttained	Date			
Property	ProID	Number (10)		pk	
	Description	Text (20)			
	Location	Text (20)			

**Table 2: Data dictionary for PRNIS**

## CHAPTER FIVE

### System Design

#### 5.0 Introduction

*The System Design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. PRNIS design could be seen as the application of system theory to product development. It describes the PRNIS requirements, operating environment, system and subsystem architecture, files and database design, input formats, output layouts, human-machine interfaces, detailed design, processing logic, and external interfaces.*

#### 5.1 The system perspective

The PRNIS is a Web Application System for Population Registration and National Identification System. It is designed to maximize population counting by providing tools to assist in automating the processes which otherwise performed manually. By maximizing the efficiency the system provides real-time process in capturing birth and death, migration and produce instant reports. The system will facilitate communication between citizens and authorized user via public website, sms and e-mails.

The system needs both Internet and Global Positioning System (GPS) connection to capture, fetch and display information. The information system is maintained in a database, which is located on a web-server. It interacts with the GPS-Navigator software which is required to run on the user's mobile phone, a service that is provided by mobile phone service providers in conjunction with the stakeholders.

The PRNIS a self-contained system uses mobile application, which is the main focus of the system and web portal; there is also a server-side component which is responsible for database and synchronization of services. The mobile application is used to send and view information in PRNIS while the web-portal is used for managing the information in the PRNIS and the system as a whole. Below is a diagram of the PRNIS system which illustrates the interactions between the server and client applications.

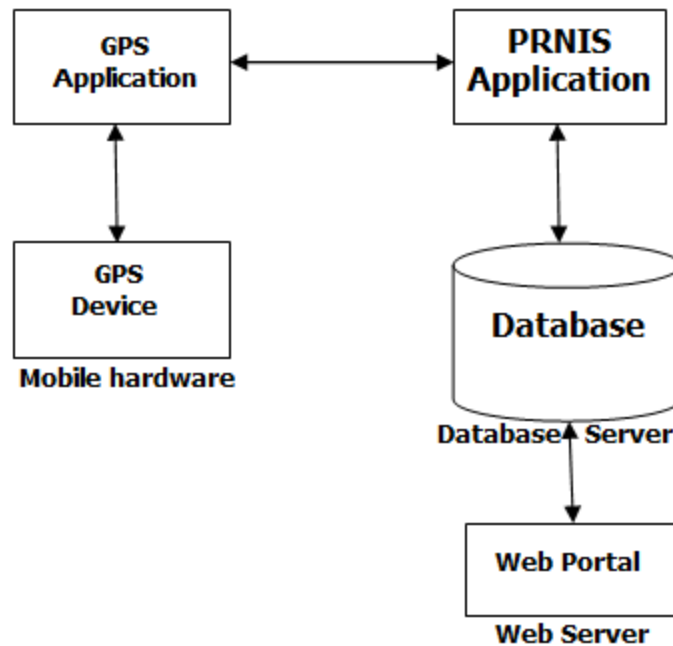


Figure 15: PRNIS Block Diagram



## 5.2 The PRNIS Environment

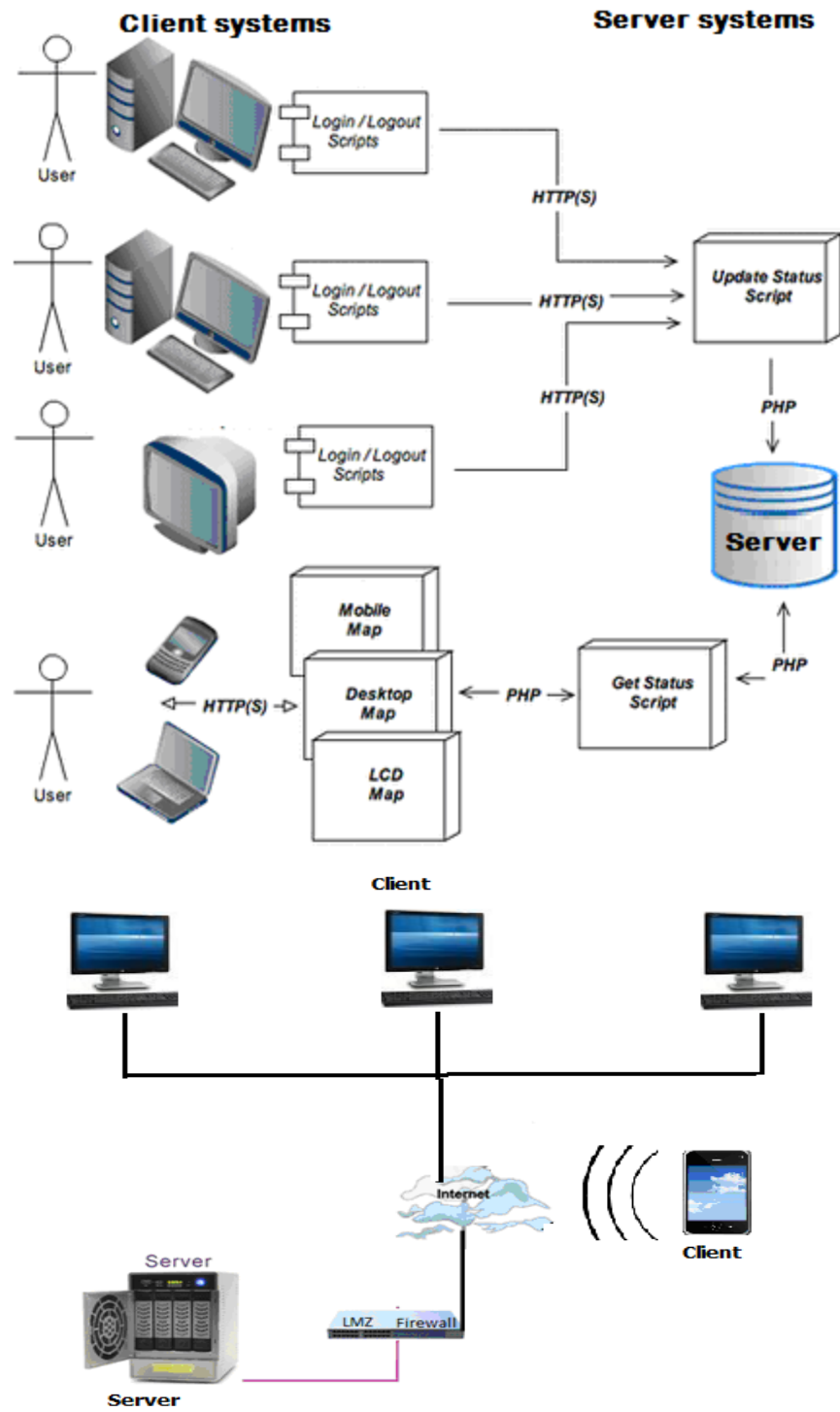


Figure 16: System environment

### **Server activities**

- i. Receives data and other transactions
- ii. Stores data
- iii. Provides data on demand

### **Client's activities**

- i. Create data
- ii. Initiate transactions
- iii. View current and history data
- iv. Synchronise with server
- v. Push and pull messages/reports from the server

The system is composed of three main components, a client-side, application which runs on handsets, another client-side web application runs on client computers and a server-side application which supports and interact with various client-sides features.

### **5.3 Architectural Design**

It is important for all functionality to be identified for the proposed system to contain the scope of the project. In this case, **Figure:** presents data flow diagram for registration functionality.

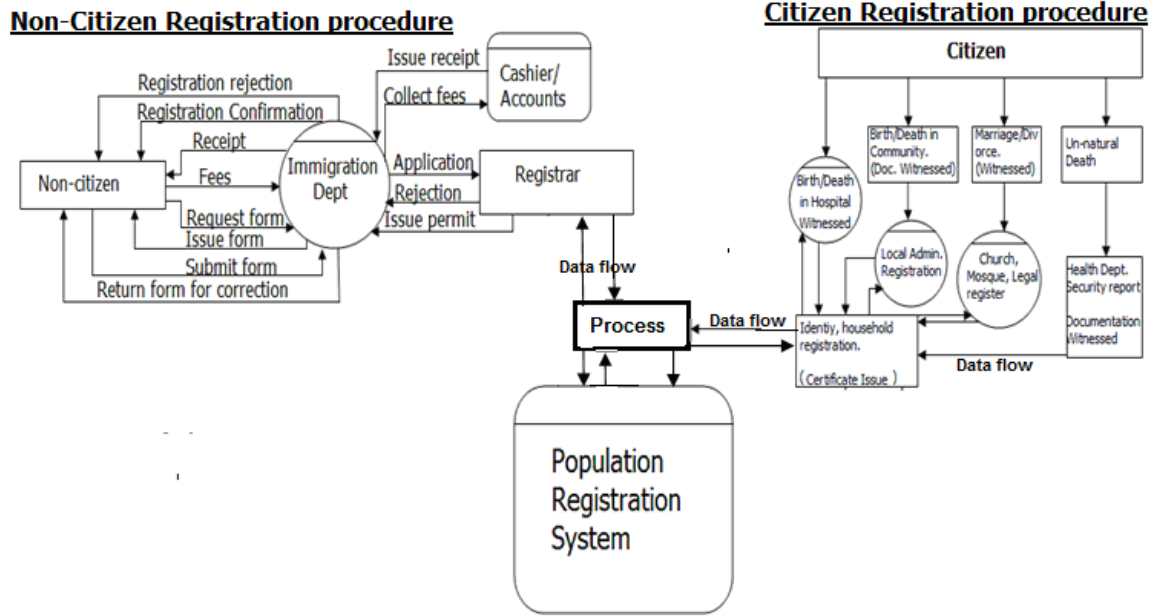


Figure 17: Registration Function Requirement

## 5.4 System Hardware Architecture

This section describes the overall system hardware and organization also includes a list of hardware components with a brief description of each item and diagrams showing the connectivity between the components.

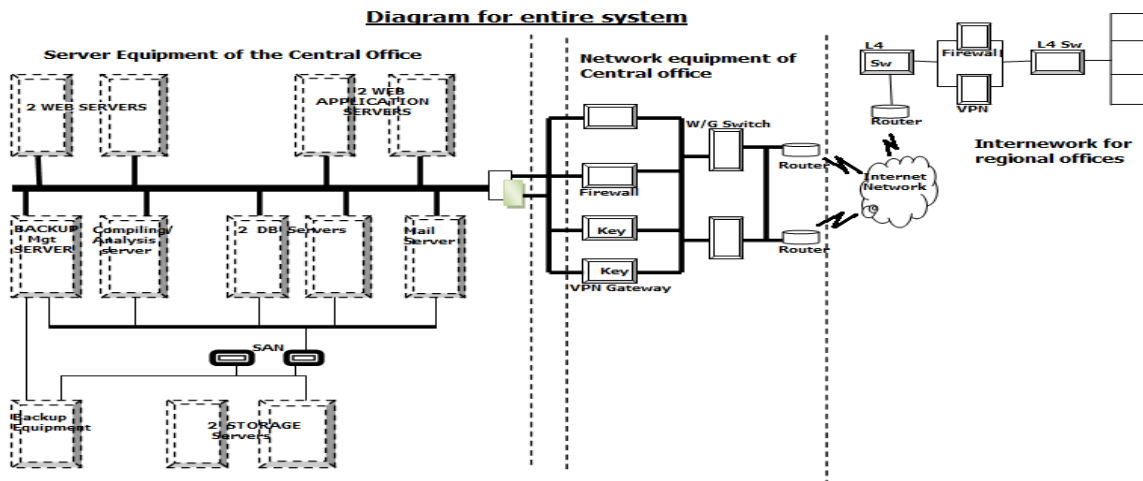


Figure 128: Diagram for the entire System

ii. Hardware specification and requirement

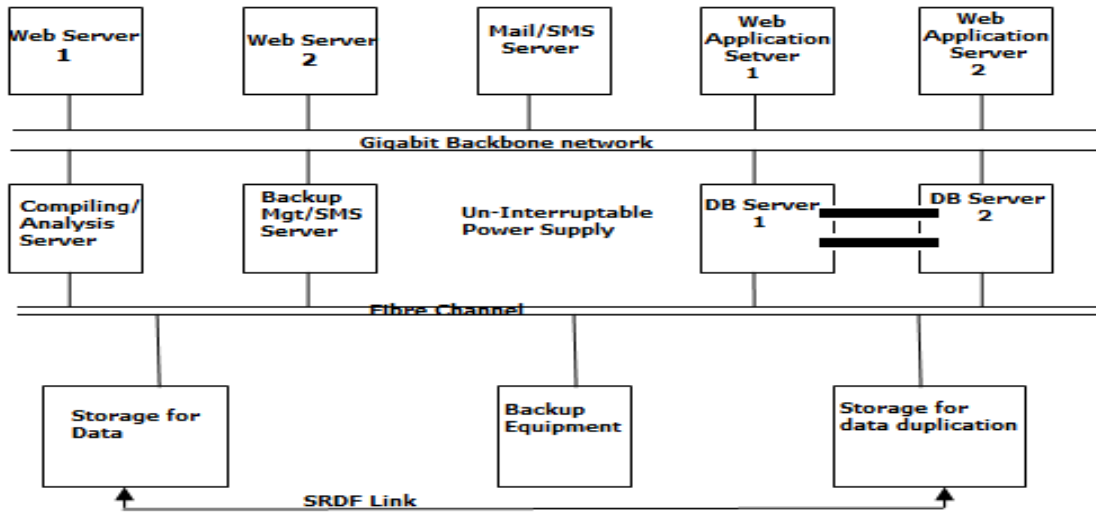


Figure 19: Diagram for hardware

iii. Data communication and network requirements

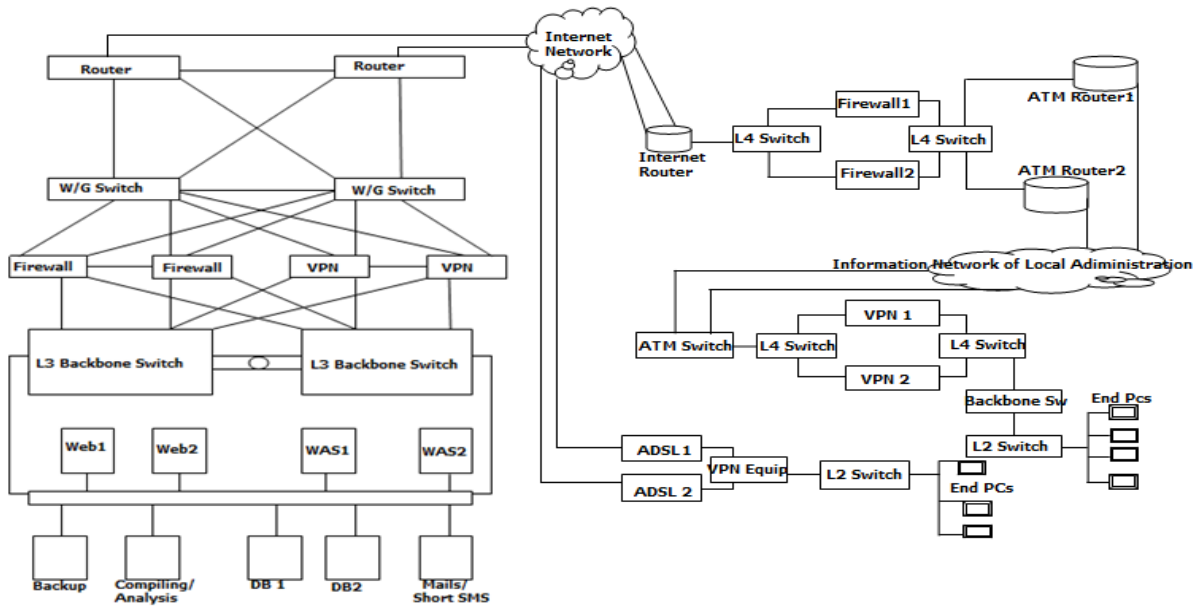


Figure 20: Diagram for PRNIS network

#### iv. System security requirements

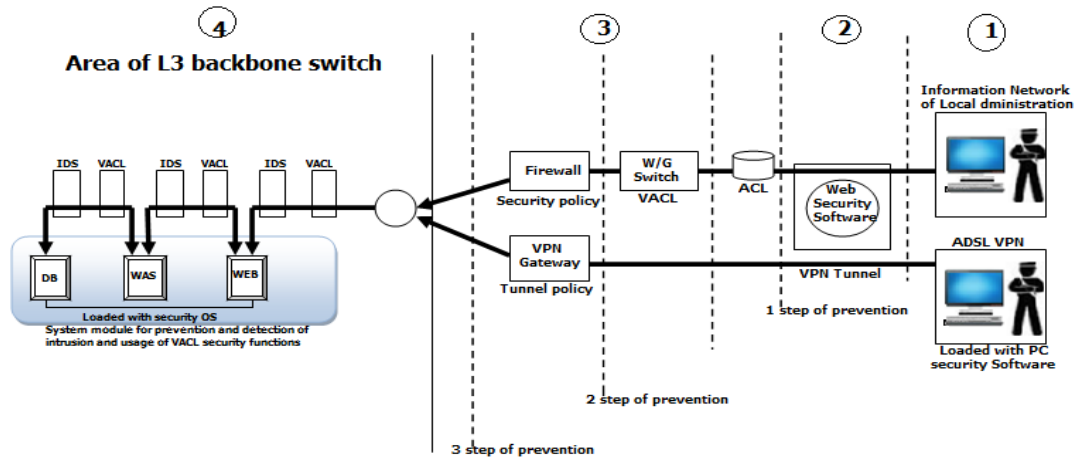


Figure 21: Diagram for PRNIS security

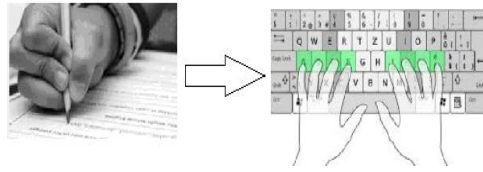
### 5.5 System Software Architecture

The software architecture of a computing system is the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships between them. Therefore, it is the most crucial determinant of success or failure of the system. Without an adequate architecture that delivers required function as well as quality attributes, the project may fail. However, an architecture must be understood so that others designers of finer grained components, implementers, testers, performance engineers, security analysts, builders of interfacing systems can build systems from it, analyze it, maintain it, and learn from it.

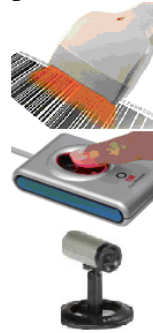
#### 5.5.1 Defining system input requirements

Designing the system, starts with input, that is anything that allows the user access, get data into a system's facilities, is considered input; include the login screen and the input screens is a two-part process.

- i. Data must first be captured (manual data capture and input).



- ii. Data must be input into the computer (automatic data capture and input).



These input processes are typically used to capture data into the PRNIS which include forms, code reader/scanner, card reader, fingerprint reader and camera.

### **5.5.2 Designing On-Screen Forms for Data Input requirements**

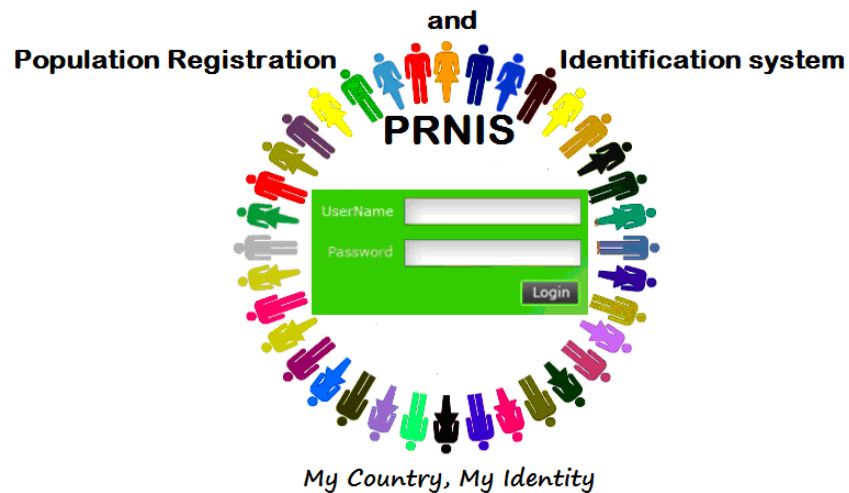
The Screen form has a variety of controls text inputs, Option/radio buttons, tick/check boxes, drop-down menus and buttons.

### **5.5.3 Data Validation Techniques requirements**

As data entered into the form, it needs to be checked for accuracy. Two techniques used validation and verification. When data is input to PRNIS, it is a good idea for the system to check that the data is sensible. Different validation checks can be used on different fields, depending on the type of data being entered.

- a. **Presence Check:** Is data actually present in a field, or has it been missed out?
- b. **Range Check:** Is the data value within a set range? (Month is between 1 and 12)
- c. **Length Check:** Is an item of text too short or too long?
- d. **Type Check:** Is the data the correct type? (Text not allowed in numeric field).
- e. **Format Check:** Is the data in the correct format? (Date should be dd/mm/yyyy).

#### 5.5.4 Snapshot of the input



#### 5.5.5 Designing the System Processes

The functions of a Process Model show the relationships between activities and the information that is used to perform each process. Another use of the process Model is data discovery and validation. Hence, it is developed with knowledge of the subject area under consideration. This structured approach reflects a hierarchical design whereby each process is gradually refined to reflect greater levels of detail. The result of applying the system process modelling technique is an understanding of the activities in the environment and their use of information.

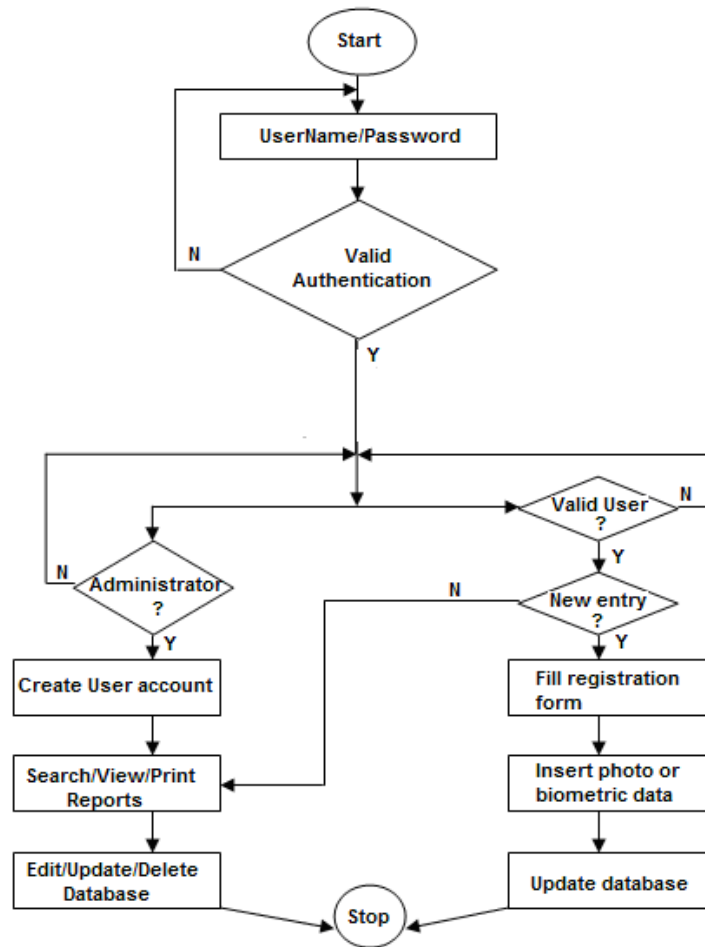


Figure 13: PRNIS Process Flow Model

While this model has not gone into the more sophisticated features of semantic data models, it presents a framework of understanding for PRNIS Process model. Although uses simple graphical constructs, adherence to modelling rules required to produce a fully refined semantic data model. Furthermore, a variety of tools and techniques may be used to validate and test a model including system based analysis of the underlying logic of the model.



### 5.5.6 Designing Data and File Structures

PIN	Surname	FirstName	OtherName	MotherID	FatherID	DateofBirth	Sex	PlaceofBirth	DateofDeath	BurialPlace
1968101099931	Ssegawa	Andrew	Kiggundu	1944040109040	1938070690621	10-Oct-1968	M	Rubaga Hosp		
2014010100111	Jumba	Philip	Kevin	1975052515930	1968101099931	1-Jan-2014	M	Rubaga Hosp		

A data and file structure is an organised collection of data which stores data to be used by a system. It specifically refers to information used as input, or written as output by PRNIS. More precisely, when designing a system, the designer considers:

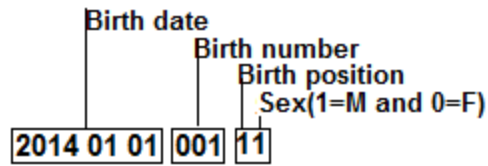
- i. The type of data being stored (numbers, text, dates, etc.)
- ii. The size of the data (how long is a typical name, etc.)
- iii. The field names to use and
- iv. How many records will need to be stored?

#### **i. Designing how the data will be processed**

The system developer needs to design the actual steps for the processing of the data (the algorithm). This part of the design is outside the scope of PRNIS modelling, but I clearly state the process for Personal Identification Number.

- ii. **Identification Number:** Each person who is registered in the population records must have a personal identity number as an identifier code. A system based on date of birth and three digits birth number plus one digit for birth position in the family and one for sex. A person who has once been given a Personal Identity Number retains it for life unless it has to be corrected as a result of some error in numbering. So the personal identity number is not changed on, for example, moving into or out of Uganda.

The personal identity number consists of the following parts:



A person, who was born on **01<sup>st</sup> Jan, 2014**, was the first to be registered for that day and being the first born in the family, the PIN appears in this format.

ii. **Birth number:** The birth number consists of three figures. It is a number ranges from 001 - 999 shows the number of people born on the same day. The combination of the figures for the date of birth and different numbers for those born on the same day ensures that all people receive different identity numbers.

iv. **Birth position:** This figure makes it possible to check the position of the new born in the family and links a child to the mother. The last number toggles between 0 and 1 indicating either M or F.

v. **Allocation of personal identity number:** At the registration, person concerned inputs the date and the position in the family. The system allocating a personal identity number to a child will determine the first child to be registered in the system and assigns the birth number. The personal identity number can widely used as an identity code not only in population registration but also in other administrative areas.

### 5.5.7 Designing the System Outputs

There are two types of output from PRNIS that need to be designed, on-screen report and printed report. On-screen report is similar to designing an on-screen form. There are a number of things that are considered.

- i. Show all of the necessary fields
- ii. Have fields that are the right size for the data
- iii. Have easy-to-understand instructions (if needed)
- iv. Make good use of the screen area available
- v. Make good use of colours and fonts to make the data clear

An example of a well-designed on-screen report.

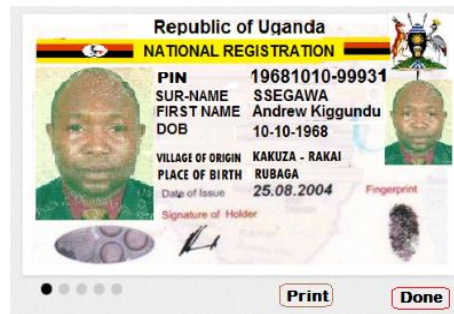


Figure 23: Sample Identity Card

The printed report is just like an on-screen report, except that the report needs to fit a piece of **printer paper**, rather than the screen. The report might also include page numbers, a header / footer, etc.


<b>Death Certificate</b>		Ref No:2009/09/10/122
<b>Sur-Name</b>	Comya	
<b>FirstName</b>	Ephrahim	
<b>Others</b>	Bob	
<b>Gender</b>	M	
<b>DoB</b>	28-Feb-1922	
<b>DoD</b>	10-Sep-2009	
<b>Registered by</b>	Dr. Lyazi DW	
<b>Witnessed</b>	Ocyola Lucy Wife	<b>PIN:1922022803511</b>
<b>Burial Place</b>	City council Cemetry Lusaze	

Figure 24: Sample Death certificate

## CHAPTER SIX

### Discussion, Conclusion and Recommendations

#### 6.0 Introduction

This chapter summarizes the findings, makes recommendations and generates conclusions, based on the analysis of the results of the study. The descriptive method was applied by the investigator and designed interview guide as a primary instrument for data gathering. Preliminary research, observation and interviews were conducted to further increase the understanding of the subject matter.

#### 6.1 Sample open-ended interview guide:

1. Article 18b of the constitution states that “The state shall register every event such as birth, death, marriage, to include migrations occurring in Uganda”, briefly tell us how this is implemented?
2. Can you estimate how many birth registration reports reach your office at the end of the day?
3. How can you evaluate the birth and death registration in Uganda?
4. How many death reports are registered in your office on monthly basis?
5. What are the objectives for birth and death registration?
6. Most of birth, death registrations are done for purpose of acquiring certificates, what other uses of data?
7. Marriages are recorded at respective denominations. How often are these submitted for registration?
8. How often does your office register divorce cases?
9. What do you consider the strength/weakness of the registration procedure in Uganda?
10. How can we identify a citizen and a non-citizen of Uganda?
11. What details should be captured during registration?

12. How can we differentiate and identify residents, migrants from visitors?
13. Are these data publicized for public viewing? In what gazette do the data published.
14. With legal provisions in place, what are the implications if registration becomes compulsory?
15. With your own judgment, do you see census, survey, civil registration doing good work for recording and providing accurate population statistics in Uganda?
16. Do you agree or disagree that population registration is more efficient compared to other practices such as National census, civil registration and survey?

## 6.2 **Discussing Population Registration**

Population registration has a very long tradition. Nobody knows precisely the time when rulers started registering as well as counting their subjects. The earliest references to registration are described in the Gospel according to Luke Chapter 2, which happened at the time Caesar Augustus, emperor of Rome, also during Quirinius governor of Syria. If that population registration and counting had not taken place, Jesus birth and place would not have been known. Gradually, the registration of personal data like birth, marriage and death was often administered by churches. Clergies registered the baptism of children, marriages in churches as well as funerals of their parishioners. Thereafter, cities, municipalities and local chiefs registered their citizens and non-citizens in territories respectively [18], [19] [20].

The reliability of these registrations was modest and the quality of such registrations depended highly on the accuracy of person in charge and the administrators had often to rely on the information provided. After the introduction of this system, birth, marriage or death of a person could in principle be proven by a certificate. An extremely important

step in creating a more reliable system of the identity of persons was made by introduction of registers of civil status.

### **6.2.1 Discussing the PRNIS**

The Population Registration and National Identification System (PRNIS) is a uniform database of the personal data of citizens and non-citizens. Hence the models created in this study lay the foundation for a reliable PRNIS. When fully implemented, the data should be used for performing the tasks assigned to institutions of the state and the local governments as well as physical and legal persons. In this model, legal and physical persons have access to the data in the PRNIS only in case of legitimate interests. The administration and issuance of the data in the PRNIS is based on the requirements of the protection of personal data.

### **6.2.2 Need for PRNIS in Uganda**

Many countries are confronted at some point or another with the need to provide a reliable and verifiable means of identification and authentication for their citizens and residents. The reasons are diverse and vary from country to country:

- i. Fighting identity fraud,
- ii. Border control and immigration flows,
- iii. Verification of entitlement to services and benefits,
- iv. Crime prevention,
- v. Anti-terrorism, and
- vi. Organizing of elections.

Proper identification of citizens becomes a central issue when faced with the need to issue secure identity documents such as passports, ID cards, entitlements, social benefits, voters' cards, driver's licenses, turning an e-government strategy into reality, organizing fair and transparent elections or improving the citizen satisfaction of any government service. Unique and unambiguous identification of citizens and residents is a corner stone of an efficient public administration.

A Population Registration and National Identification system (PRNIS) in Uganda should store records of personal information of all citizens and non-citizens residing on the territory of a state that meet the requirement for registration as set out in the relevant legal framework. The data stored in the PRNIS should be registered in a unique, uniform and transparent way, based on documentary evidence certifying vital life events. Since registration is unique and uniform for determining the kind of information stored and how is stored in the PRNIS, and transparent in a manner that ensures citizens' trust in the state's handling of their personal data, the need for appropriate data model for PRNIS such as has been developed in this study can not over-emphasized.

Population Registration in Uganda would provide benefits to the entire state, public administration by allowing it access to legally valid personal information required to improve services and provide quality products to citizens in all policy areas, i.e., health, labour, justice, education, welfare, property ownership, Passport, driver licenses, voting and emergency services. In return, citizens are provided with quicker and better quality of services.



A PRNIS that delivers these benefits must be properly modelled and designed such that:

- i. First, it requires that for each individual residing on the territory, there should be only one file in the register containing his/her personal information “one person-one file”.
- ii. Secondly, for the purpose of providing access to the data for individuals and other institutions, it is necessary to create conditions for the subsequent multiple uses of registered data by electronic means “register once - multiple use of information”.

Establishing the first objective for running an efficient PRNIS should ensure that a person is only registered once in the register, and any duplication of data should be prevented. This is the essence of completing the necessary cardinalities in the entity relationship (ER) model. Once the “one person, one file” objective is ensured, then does the second objective, “register once - multiple use of information”, becomes important. The use of personal information stored in PRNIS by public institutions, as may be defined by law should ensure optimal use within the public administration and within the framework of data protection as well as other legal safeguards. The first objective ensures data quality; the second objective ensures the proper use of data by all public institutions, thus leading to an improvement in services.

As shown, a centralized PRNIS requires the adherence to, among others, the following main principles:

- i. Based on a chosen administrative division and territorial bodies, personal information is collected, verified and registered at the level of the local authorities.

- ii. Registered information is communicated electronically to and maintained at the central level. The local level is responsible and accountable for the collection, verification and registration of citizens and non-citizen. The maintenance of registered data, or the responsibility and accountability for the data quality in the PRNIS, is done at the central level.

#### **6.2.4 Legal framework**

Registration and maintenance of data is based on a sound legal framework, thus PRNIS must be based on well developed laws, by-laws, instructions and procedures. For example; a sound and comprehensive legal framework is fundamental to the establishment of a well-functioning population registration system. A population registration Act, and associated set of Rules and regulations, should provide:

- i. adequate definition of duties and responsibilities of a citizen as well as the government;
- ii. a clear administrative hierarchy for the collection and submission of data;
- iii. nomination of responsible individuals at each level in the hierarchy, with adequate delineation of responsibilities;
- iv. responsibilities of central agencies for collation, analysis, and publication of vital statistics; and
- vi. provisions for public access to individual records as stipulated in the law.

### 6.2.5 Elements for an identity scheme

A national identity scheme is built on three pillars: a unified population register, a concept of unique identifiers and secure identity documents. They are like an ecosystem in which each element depends on and reinforces the other elements.

- i. Unique Identifiers:** if legally allowed, enable government agencies to exchange information without bothering or involving the citizen.
- ii. Secure identity documents:** cannot be issued without a reliable means of credential validation and are useless without unique identifiers attributed to the document holder. Conversely, unique identifiers are meaningless if the citizen is unable to easily convey his/her identity to a public service.
- iii. Population register:** the content of a population register is unreliable if citizens cannot be properly identified.

These elements have been incorporated in the PRNIS model and design to ensure uniformity of registration is performed in the same way by every local office, ideally based on a computerized system. It is recommended that uniformity in collecting, verifying and registering citizens' civil status data at the local level is essential to ensuring data accuracy.

This means that clear procedures for the registration of place of residence and civil status events should be in place. Relevant local authorities need to be trained on the registration procedures and to apply them in a uniform manner. The uniformity of the population registration, data collection, updating, verification and registration procedures should be

validated by a software platform that runs the PRNIS. Uniformity will be controlled by means of system log files and audit trails, based on performance indicators presented through regular information updates to the management of the PRNIS.

### **6.2.6 PRNIS components**

A modern population register is built on and surrounded by a whole plethora of an integrated form of a coherent system for enrolling, registering and storing citizen and non-citizen data. The principal components of PRNIS include:-

- i. Relational database containing biographic and biometric data.
- ii. System and network infrastructure, high available servers and storage systems on a large bandwidth network.
- iii. Applied cryptography to apply integrity, confidentiality and authenticity of the data set.
- iv. Public Key Infrastructure (PKI) for issuing and managing digital certificates.
- v. Smartcard technology for electronic ID cards, passports.

### **6.2.7 Principal functionalities**

The primary function of a PRNIS is to consolidate the relevant identity information in a central, unified database. This database only contains the strict minimum of information required for the identification of citizens but can also optionally contain additional information on marital status, parent-child relationships.

Taking into consideration the subtleties and complexity of interaction between citizens and public institutions as well as between citizens and private companies, it is often

considered useful to manage additional information such as mandates, attributes and privileges associated with certain persons.

Once the population register is established it becomes the unique reference source for identity information. In turn, the population register can be used to create other temporary registers, e.g. for elections, demographic analysis, issuance of ID-cards, passports, driving licenses, entitlement cards, etc.

### **6.2.8 Quality, reliability and accuracy**

The quality, reliability and accuracy of the population register depend on two critical factors:

- i. Quality of the procedures applied to feed the register with the data; initial registration, verification of existing credentials, biometric enrolment, declaration of birth, death, marriage, divorce, changes in the civil status or other attributes related to a person.
- ii. Level of the security measures to protect the integrity and confidentiality of the data as well as the supervision and traceability of all actions and queries on the data set.

These factors were also taken into consideration in this design.

### **6.2.9 The PRNIS benefits**

Specific benefits accruing from a modelled PRNIS are diverse and some of them include:-

- i. Higher accuracy and coherence in the information managed by various government agencies, reducing the effort and time to retrieve, correlate and correct information.
- ii. Significant reduction of fraud, especially relevant in social benefit schemes.
- iii. More efficient and easier exchange of information between government agencies.
- iv. Better identity management.
- v. Reliable register of the civil status of all citizens and residents.
- vi. Shorter implementation time and lower cost for establishing attribute registers :
  - a. entitlement registers for social benefits, medical care, etc
  - b. driver's licenses
  - c. Passports
  - d. Elections
  - e. national and regional tax collection
  - f. property registers
  - g. military draft lists
- vii. Fast and reliable statistical analysis
- viii. Immigration and emigration
- ix. Demographic trends
- x. Evolution of civil society such as marriages, divorces, children per family.

Correct data in the PRNIS provides information that enables the state to better perform its obligations. Based on the data in the register, it is possible for the state to more precisely plan the use of monetary resources and manage the development process. It also guarantees the existence of exact information that allows administrative agencies to conduct business with the residents more smoothly.

#### **6.2.10 PRNIS Features**

The central population register is in constant interaction with the enrolment front Web applications and central PRNIS infrastructure together with identity document production unit. The register also accommodates information queries from external parties.

The key functions of the register, apart from storing the citizen data sets are :

- batch import of registration data
- extraction of lists, e.g. for electoral lists per region or municipality
- automated input and output via standardized web services
- a web front end for intranet and extranet users to query, view, add or modify information in the register
- automated communication with an external front Web application to detect multiple registration attempts by the same person
- an interactive application to resolve potential double registrations

A system of population registration must maintain up-to-date information which gives the authorities a snapshot of specific population-related information at any point in time. To ensure the continuous and effective operation of a population-registration system,

registration should be mandatory for the entire population of the state. It is also recommended that a record of life events pertaining to those of the country's citizens who are temporarily residing outside its borders be maintained as this is included in the model.

Populations are constantly changing by virtue of births, deaths and changes of place of residence; so if a population-registration system is to function properly it needs to operate on a permanent basis. This means that the entity responsible for the registration system should have sufficient administrative stability and operate within a sound legislative framework. Hence, it is recommended that a Population registration Act and Regulations in Uganda be effectively enforced. Population registration can only be effective and efficient if it stores data that is relevant to the identity, life events and place of residence of data subjects, or data that are essential to guarantee their human rights, civil rights and social benefits. In order to ensure that the data present in the system at any point in time are relevant, the records need to be continually added to, and updated.

### **6.3 Contribution to the body of knowledge**

This study has contributed the following to the body of knowledge:

- Formulation of a theory for deriving an accurate size of population (see section 1.8).
- Identification of requirements for appropriate Population Registration and National Identification System in Uganda.
- Logical modelling and designing of Population Registration and National Identification System in Uganda.



#### **6.4 Future work**

A general introduction of the potential and challenges of population data in Uganda was presented in Chapter 1. This thesis has demonstrated the potential of efficiently creating a model for a developing Population Registration System. However, this has been exploited within the context of perceptual theories of ascertaining accurate population data. This dissertation has focussed on the development a system that reduces duplication, falsification and manipulation of population information and provides legal proof of identity of citizens, as well as non-citizens. Hence can be used to create a repository for the compilation of vital statistics. The implementation and evaluation of such a system should be implemented using a fast, reliable and secure platform.

#### **6.5 Conclusion**

Life is a journey with beginning and ending events. Birth and death open and close this journey with common miles of distance happening in between; such as entering into life partnership of having children. Over time United Nations (UN) has called on for societies to have their events registered. In developed countries today, life events such as birth, death, and civil partnership are recorded using civil registration systems. Information held in these systems has become a fundamental building block on which societies are constructed. The data can be used to analyse and maintain variables such as fertility, mortality, and migrations. Civil registration which should be in line with United Nation standards are dully proposed for the rights and administrative purposes on one hand; and statistical for demographical on the other.

The primary purpose of this study is to create system model, and a appropriate design for PRNIS in Uganda, this should in turn form the basis for developing Population Registration and National Identification as a repository and source for legal documents that are used to establish and protect the civil rights of individual in Uganda. This is because registration is key foundation for enjoyment on any right in any democratic society. After the formal registration therefore, a person becomes visible to society. By having a reliable population registry for example, the correct information on the citizen can be passed on to relevant ministries, agencies, to support rule of law, improving the quality of service to citizens is an important element of democratisation.

Being registered is a pre-requisite for providing services to the population and perhaps fights against those involving in organising crimes. Registration gives access to civil, political, economic, social and cultural rights. Thus, a person's identity is established before the law, which earns ones legal law to be recognised in the society.

## **6.6 Recommendation**

In summary, the following recommendations for the Population Registration and Identification in Uganda are made:-

- This model should form the basis for a Population Registration and National Identification development in Uganda.
- The model should available to all stakeholders for further verification and review if need be.
- The existing laws regarding registration (CAP, 309) should be effectively implemented.
- There should be uniformity in data collection and registration.

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