EFFECTIVENESS OF THE MALAWI INTEGRATED BORDER CONTROL SYSTEM

MASTER OF SCIENCE IN INFORMATICS THESIS

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UNIVERSITY OF MALAWI

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Master of Science in Informatics Thesis

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DECLARATION

This thesis is my own original work and it has not been submitted to any other institution for similar purposes. Acknowledgements have been duly made where other people's work have been used. I bear the responsibility for the contents of this paper.

Signature:_____

Annie Tionge Kaonga

Date:_____

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

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Main supervisor

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Second Supervisor

DEDICATION

To my husband Chikumbusko for always being there for me during the time of this study. I also dedicate this thesis to my kids Tapona Annie and Wongani Thulani for enduring my frequent absence during the whole study period. To my late mum and dad, you will always be my heroes for laying the basic educational foundation for me.

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ABSTRACT

Border management information systems are used throughout the world in order to enhance border control and migration management. In 2013, the Department of Immigration in Malawi also introduced its own border information system known as the Integrated Border Control System (IBCS) with the aim of using specialist technology for border control tasks such as clearing passengers and detecting illegal immigrants mainly due to the increase in traveler volume as well as to deal with the use of fraudulent identities. Despite the importance of such a system, no study on its effectiveness has been conducted since its introduction. The main objective of this study was therefore to evaluate the effectiveness of the IBCS in facilitating clearance of travelers at the two international airports, Kamuzu and Chileka in Malawi. The study was guided by the Delone and Mclean Information Systems success model. It employed a mixed method approach to collect data from 52 users of the system. The study found that the system was effective in facilitating clearance of travelers since the quality of the system was good and produced information which was relevant to their day to day duties. However, the system required some modifications and additional features. The findings also reiterate the need for management support to deal with the challenges of using and extending the use of the system to other border posts.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ABC	Automated Border Control
ATS	Automated Targeting System
BMIS	Border Management Information System
CBP	Customers and Border Protection
CIA	Chileka International Airport
DHS	Department of Homeland Security
DNA	Deoxyribonucleic Acid
D&M	Delone ad McLean
eMCS	enhanced Movement Control System
EU	European Union
GoM	Government of Malawi
IATA	International Air Transport Association
IBCS	Intergrated Border Control System
ICAO	International Civil Aviation Organisation
ICT	Information and Communication Technology
ID	Identity
INTERPOL	International Criminal Police Organisation
IOM	International Organisation for Migration
IT	Information Technology
IS	Information System
KIA	Kamuzu International Airport
MIS	Management Information System
MRA	Malawi Revenue Authority

MRTDs	Machine Readable Travel Documents
PI	Prohibited Immigrant
PIRS	Personal Identification and Registration System
SA	South Africa
SIS	Schengen Information System
SLTD	Stolen and Lost Travel Documents
TAM	Technology Acceptance Model
TBL	Techno Brain Limited
TPS	Transaction Processing System
TSDB	Terrorist Screening Database
UN	United Nations
UNHCR	United Nations High Commission for Refugees
USA	United States of America

CHAPTER 1

INTRODUCTION

1.1 Border management

Border management is "*the facilitation of authorized flows of persons, including business people, tourists, migrants and refugees across a border and the detection and prevention of irregular entry of non-nationals into a given country"* (Ushakov, 2015). International standards require a balancing between facilitating the entry of legitimate travellers and preventing those that enter for inappropriate reasons or with invalid documentation (International Organization of Migration, IOM, 2002). Apart from persons, border management also involves processing of goods at the points of entry and exit.

In order to manage borders effectively, countries implement different border control mechanisms (Ushakov, 2015) such as imposing visa requirements and enhancing immigration and border management structures to control the flow of people and goods in so doing, enhancing and maintaining the security of the state. Border agencies such as customs, police and immigration services are responsible for such duties.

1.2 The importance of borders

Borders are crucial to any country. Proper mechanisms on countries' borders help to control the influx of illegal immigrants, assist a country in revenue generation over

imported and exported goods and also help to contain communicable diseases by screening immigrants among several other responsibilities. Thompson (2007) and Dorrance (2015) state that there is no national security if countries' borders are not secure. To maintain a secure border, investments include more staffing, improved detection and removal capacity, information technology and tactical infrastructure (border fencing, roads and stadium style lightning) (Rosenblum, 2012).

For any meaningful immigration reform, border security plays a key role in prevention of both terrorism acts or drug trafficking. One of the most important mechanisms put in place at a country's border is a control system.

1.3 Border control systems and their objectives

Border control can be described as a measure taken by countries to regulate and control the movements of people and goods at their borders (Nieminen, 2018). A border control system has two main objectives which are (1) to assist eligible travellers by providing an efficient gateway to a country and also (2) to provide a barrier and disincentive to entry for those seeking to circumvent migration laws. The design of controls for entry and exit at borders is based on a number of factors which include the physical characteristics of the border and the borders permeability (Alden, 2012). Unlike in western countries where physical borders have been enhanced, African countries have not sufficiently secured their borders (African Union, 2012).

1.4 The importance of Information Technology in border control systems

As the world is advancing, Information Technology (IT) is considered to be a driver of various operations, and Information Systems (IS) are being used in almost every industry (Rosca *et al*., 2010). Immigration departments are among the many organizations that are utilizing IS in order to deal with the various challenges that are involved in border and migration management. These include increases in traveller volume both internationally and locally as indicated below in Figure1.1 and Figure 1.2, respectively and international crime. These challenges are putting pressure on border security personnel to modernize their security protocols, enhance or abandon manual identification checks and adopt more secure technology to prevent the fraudulent use of identity documents (International Air Transport Association, IATA, 2013).

Border management in the context of this research comprises passport control which is the process of clearing travellers who enter or leave a country.

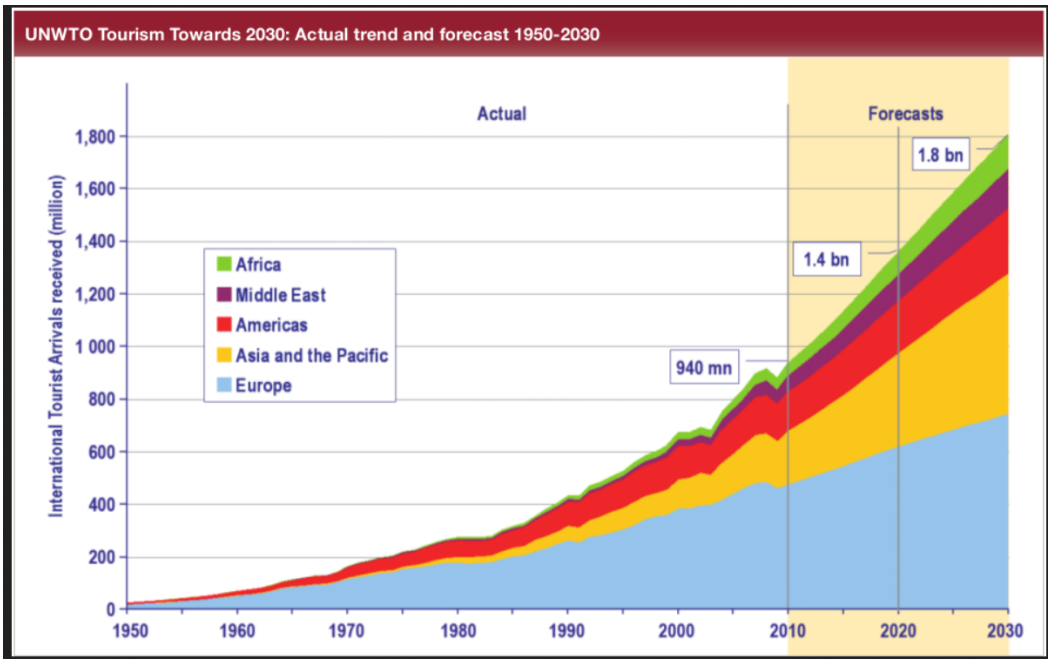
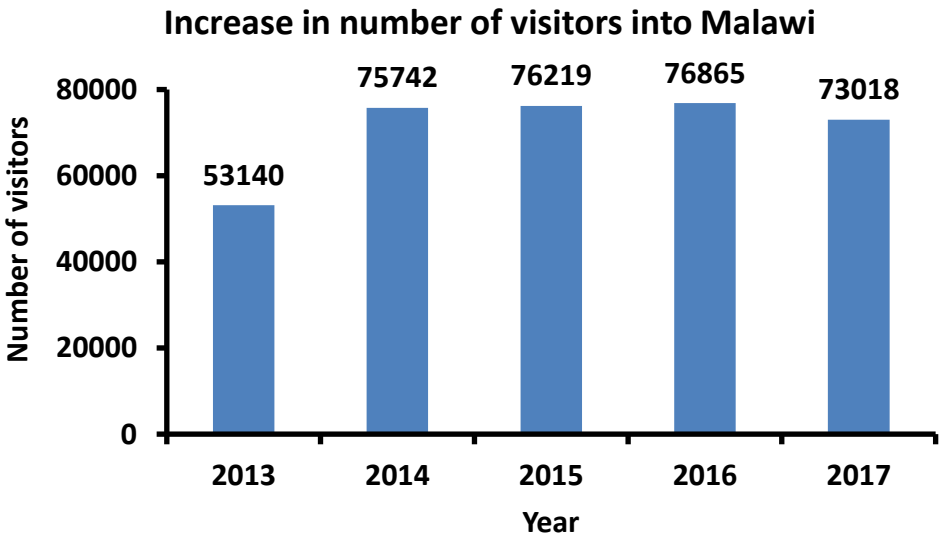


Figure 1.1: Trend in international travel

Source : United Nations World Tourism Organisation (2016)



Note: 2017 data is up to September

Figure 1.2: Increase in the number of visitors into Malawi

Source: IBCS Report (September 2017)

Passport control aims at protecting the state from unauthorized entry of those considered not to be of benefit under visa policy rules or whose entry would not be in the national interest (Kostro and Mann, 2013). Employees of a government immigration department known as passport control officers review the travel documents presented by citizens, residents and other travellers to determine whether or not they have the right to enter or leave the country. The process of clearing travellers is done physically by immigration personnel using their judgement on the documentation or identity presented and the person in front of them or through the use of advanced technologies where a database and other hardware such as scanners and biometric readers are used. As a result, various border management information systems are being implemented to speed up processing time and ensure that travellers' data is available whenever needed in order to enhance border security.

Access to reliable and sophisticated information is at the heart of a nation's ability to protect its borders. According to Kalyan (2017) biometrics are unique to each person, hence the risk of theft, duplication, sharing or forging is eliminated. The increased incorporation of biometrics gives border officials the ability to identify and process illegal visitors at greater speeds. Biometric technology empowers officials with accurate data that delivers at near instantaneous speeds. Strengthening the security of the nation's borders is a critical component of immigration reform. With the help of biometric technology, identity verification improvements can enhance border security and help build the economy.

Technologies such as biometrics have become a reliable way of identification and verification (Jain *et al*., 2004) allowing for timely and effective clearance of people at the same time which is difficult to meet using traditional methods. Jain *et al*. (2004) define biometrics as the automatic recognition of individuals based on their physiological and/or behaviour characteristics. Commonly used biometrics are: Deoxyribonucleic acid (DNA), ear, face, fingerprint, gait (peculiar way one walks), hand and finger geometry, iris, keystroke (each person types on a keyboard in a characteristic way), odour, palm print, retinal scan, signature and voice.

1.5 Border management information systems (BMIS)

Border management information systems are used for identification and verification management as far as the control of persons is concerned. They enhance the processing

of bona fide travellers so that unauthorized persons are denied entry (IOM, 2002). The processes include checking for a match between the identity of the traveller in front of the officer at the point of embarkation or at the border, the information recorded in the traveler's travel documents and any visas or permissions, and the information regarding that traveler's identity and status (IOM, 2002). A detailed flow of tasks is as below:

i. Establishing the validity of the travel document by ensuring that it is not expired, counterfeit, or altered (for example by photo-substitution or insertion of pages)
ii. Establishing the validity of the visa and ensuring that it is not counterfeit or altered
iii. Establishing that the identity of the person presenting for clearance is the same as the person holding the travel document and visa
iv. Ascertaining bona fide intentions to abide by the conditions of the visa or the authorization to enter
v. Checking that there has been no change since the granting of the visa such that entry is no longer in the national interest
vi. Considering and granting visas at the border
vii. Referring to the appropriate authority those persons requiring consideration of protection claims
viii. Referring for removal those persons who are denied admission
ix. Collecting data on the movement of people through the border point
x. Collecting information on irregular movements and on migrants smuggling and trafficking of persons.

BMIS are usually used together with the physical clearing system.

1.6 Border management information systems in Africa

Several countries have adopted their own border management information systems. An informal report in South Africa (SA) indicates that the SA government implemented the enhanced Movement Control System (eMCS) at its entry/exit points in 2015 aimed at monitoring migration and reducing cases of travellers using fake or stolen identification documents. The system captures travellers' fingerprints and has facial recognition capability likewise; the Namibian government has introduced the Electronic Border Control Management System to make identification of immigrants

and Namibians simpler and faster. The system captures the biometrics of a person such as face for facial recognition and fingerprints.

Furthermore, the International Organization for Migration (IOM, 2011), has implemented the Personal Information and Registration System (PIRS) in fourteen African countries (Namely Burundi, Democratic Republic of Congo, Guinea Conakry, Islamic Republic of Mauritania, Kenya, Liberia, Republic of Congo, Sierra Leone, Somalia (Puntland), South Sudan, United Republic of Tanzania, Uganda, Zambia and Zimbabwe) and will also be implementing the same in Central Asia and Central America. Likewise, the system was implemented in Malawi at its Songwe border in the northern region. IOM (2011) state that PIRS is designed to collect, process and store traveller's information at entry and exist border posts, including bio-data for the purpose of identification, authentication and migration data collection and analysis. The system also enables border officers to search and cross-check data, with direct access to national and international databases hence fostering information sharing and improving inter-service coordination. The system reports enable a particular Government to understand migration dynamics and patterns.

1.7 Malawi integrated border control system (IBCS)

The Malawi Department of Immigration was established in 1964. It is governed by an Immigration Act, Citizenship Act, the Laws of Malawi and the Malawi Constitution. It falls under the Malawi Government Ministry of Home Affairs and Internal Security. In the past the department existed first under the Malawi Police Service and thereafter under the Office of the President and Cabinet. The duties of the department are as follows:

i. Control people entering and leaving Malawi in order to uphold security
ii. Issue travel documents to eligible people in accordance with the International Civil Aviation Organisation (ICAO)
iii. Process and issue Malawi citizenship, residence and work permits and visas in accordance with existing policies
iv. Monitor, track, apprehend, deport and repatriate illegal immigrants in order to promote security of the country and safeguard jobs for natives (GoM, 2015, UNHCR, 2015)

Therefore, at the core of immigration activities in Malawi is to keep the country's borders secure which is very important to internal security.

Border control in Malawi is done by a number of organizations which have different roles at the border posts. These include; The Malawi Revenue Authority (MRA) which clears goods coming in and going out of the country; the Malawi Bureau of Standards which checks if the quality of goods coming in and going out the country conform to standards; the Malawi Police Service which checks that there are no criminal activities at border posts; the Department of Immigration which clears passengers coming into and going out of Malawi. The process of clearing passengers by the Department of Immigration partly involves the processing of passenger documents at the airports and land border posts. Previously the process of processing passengers was done manually. However, in 2013 the Malawi Department of Immigration implemented the Integrated Border Control System (IBCS) (Nyirenda, 2016) at its airports to improve efficiency in clearing both departing and arriving passengers. IBCS was developed by Techno Brain Limited (TBL), a software company with offices in Malawi but headquartered in Kenya. According to Techno Brain (2015) the Malawi IBCS is a biometric based system which helps immigration officials to identify and verify large number of passengers in a short time, detect and prevent security threats, protect the safety of passengers, control illegal immigration of passengers travelling in and out and ensure safety and security of the country. The IBCS is a system specifically tailor made for Malawi.

The IBCS was specifically developed for the following purposes: -

i. To overcome human limitations in validating the travel documents
ii. To ensure highest level of document validation through multiple security checks
iii. To check immigrants' admissibility to the country against check lists databases
iv. To ensure quickly shared fraud attempts among all the national borders
v. Verification of personal ID through biometrics (i.e. fingerprint)
vi. Automate the back-office workflow

The system allows scanning of travellers' passports, and extracting all the necessary information which is automatically saved in the database of the IBCS. It also captures travellers' biometrics such as fingerprints and photographs which are later verified when the traveller appears the second time and on other subsequent visits.

Prior to the implementation of the IBCS system at Kamuzu and Chileka International Airports in Malawi, travellers were being cleared without the use of any automated system as is the practice with all the land border entry/exit points. Initially Songwe Border Post in northern Malawi (border between Malawi and Tanzania) was using the PIRS implemented by IOM (IOM, 2013) but it is no longer in use due to some technical problems.

PIRS is a border management information system that has been implemented in a number of countries in Africa (IOM, 2011). The system was designed to enable states with no or inadequate data capturing system to equip themselves and have the operational means to take up the challenge of enhanced migration management. The system collects, processes and stores travellers' information, including bio-data, at entry and exit border points (IOM, 2011). In Malawi, the system was implemented at Songwe Border Post in 2012 (IOM, 2013). However, it has to be noted that throughout the time of this study (since December, 2016 to be specific) the PIRS at Songwe Border Post was not functional, as such passengers were still being cleared manually.

The introduction of Information Technology (IT) typically comes with the promise of helping to manage scarce resources, increase efficiencies, reduce workload, and increase work productivity. In the context of developing countries, the lure of these promises is magnified given the existing conditions and inefficiencies (Kimaro and Nhampossa, 2007). However, in the absence of regular evaluations of the systems, the original challenges before information system usage may not be completely taken care of.

According to Goldkuhl and Lagsten (2012) evaluation of information systems is a very important topic of study and practice. This is because evaluation involves assessment of how successful the system fulfils its objectives (Platisa and Balaban, 2009). Since the IBCS is linked to the security of Malawi as a country, evaluation on the effectiveness of the system is very important so that the shortfalls are taken care of and opportunities are enhanced.

System effectiveness is usually measured in two fold; the goal-centred view (which compares performance to the objectives) and the systems-resource view which is conceptualized in terms of resource viability such as human resource and technological resources (Halmilton and Chervany, 1981). In this study, technological resource which

is indicated as the quality of the system or service was considered as a measure of effectiveness.

1.8 The Delone and Mclean (D&M) Information System success model

In this study, the Delone and Mclean information system success model was used to evaluate the Malawi IBCS. The Delone and Maclean information system success model was proposed in 1992 (Delone and McLean, 1992) through a synthesis of previous research involving information system success so as to turn it into a more coherent body of knowledge and provide guidance for future researchers. The model can be used to measure the success of a whole IS or a single sub-system (Delone and Maclean, 2003). For instance, it has been tested and validated in studies assessing the success of banking systems (Wang, Katlu and Alkaya, 2015), health information systems (Saghaeiannejad-Isfahani 2015), educational information systems (Sirsat and Sirsat, 2016), e-government systems (Khan, 2010), and much more (Petter, Delone and Malcean, 2008, Delone and Maclean, 2003).

In the model, systems quality variables measure success at technical level, information quality variables measure success at semantic level while use, user satisfaction, individual and organizational impacts measure effectiveness success (Delone and Mclean, 2003). The model provides a guide as to how an information system can be evaluated or assessed and it has been cited in over 1000 articles in refereed journals (Al-adaileh, 2009). Furthermore, the model is used to assess the success of information systems, therefore, it was also appropriate to use it in this research. It is pertinent to mention that most of the studies assessing success based on the D&M model have been carried out in developed countries, with none to our knowledge, explicitly validating the model in the context of border management systems in developing countries. The major objective of this study is, therefore, to validate the updated D&M model for assessing the success of the border management information systems in Malawi, a developing country. Guided by the model, the research implored on users' attitude towards the system quality, information quality, user satisfaction and net benefits of IBCS.

1.9 Problem statement

The use of fraudulent identities is a continual weakness with respect to both immigration control and counterterrorism systems (Kostro and Mann, 2013). As a result countries are adopting new methods for identifying travellers primarily through biometric data such as photographs, fingerprints and retinal scans. This data is matched with passport, visa and passenger data to ensure that the name on the ticket matches the face presented.

In Malawi, all modes of transport had showed an increase in the number of visitors using them to enter the country from 2006 to 2009. Air transport had increased its share of travellers from 31.5% to 33.2% of all visitors in 2009 (World Bank, 2010). Figure 1.2 is data extracted from the IBCS reports which supports the fact that visitors into Malawi have increased over the years. The increase in migration into Malawi is also supported by migration profiles for Malawi compiled by IOM (Ndegwa, 2015).

The IBCS was implemented to deal with some of the risks associated with travelling to and from Malawi more especially to contend with the increase in volume of travellers and authenticity of travel documents. Since the system was implemented, no evaluation has been done on its effectiveness in facilitating organisational goals (Fletcher Nyirenda, personal communication, 10 Nov 2016).

The goal of this research is, therefore, to evaluate how successfully the integrated border control system (IBCS) achieves its objectives and to gather feedback on the system from its users. If the system does not work effectively then the country is exposed to the risks described above. This is based on the construct that the system was developed specifically for Malawi.

1.10 Research objectives

The main objective of this research was to validate the D&M model in the context of IBCS as it is being used in the Department of Immigration at its airport border posts in Malawi.

The specific objectives of this research were therefore to:

i. Examine the quality attributes of IBCS in supporting clearance of travellers at Chileka and Kamuzu International Airports in Malawi.

ii. Analyse feedback as regards to user experience with the system in all stages of IBCS use.
iii. Identify opportunities and challenges associated with the use of the system.

1.11 Research questions

The following research questions were addressed;

i. How effective (in terms of processing time, functionalities and availability) is IBCS in facilitating clearance of travellers at Chileka and Kamuzu International Airports in Malawi?
ii. In what ways has IBCS helped in detecting illegal immigrants in Malawi?
iii. What are the challenges in the effective use of the IBCS at Chileka and Kamuzu International Airports in Malawi?

In this study, effectiveness of the system was measured by virtue of looking at how satisfied the users are with the system in carrying out their daily activities. Evaluating effectiveness centres on users satisfaction with various aspects of an Information System. Therefore, to measure the effectiveness of IBCS, users satisfaction of the quality of the system and quality of information of the entire system was considered. User satisfaction as a measure of effectiveness of an information system has been reported by a number of authors including Thong and Yap (1996), Thong *et al*. (1993), Melone (1990) and Hamilton and Chervany (1981).

1.12 Justification

The project is still in its initial phase of implementation (Chileka and Kamuzu International Airport being pilot sites) and once system effectiveness is known, this study will help management to understand the value of the information system, know where to make improvements and motivate them to roll out the system to other busy borders. Additionally, most systems in Malawi government developed by the same consultant who developed the IBCS were reported to be non-functional, hence the motivation to assess the effectiveness of this system.

This study is important as it records essential user feedback on the use of the system in its current implementation, and identifies the strengths, weaknesses and opportunities in the Malawi IBCS while at the same time contributing to the body of knowledge about adoption of information systems in various activities. This is can be achieved mainly

through the analysis of feedback which can facilitate some enhancements. At the same time, there are a lot of similarities among border control systems such that the information gathered in this study will also assist in the improvement of other border control or related systems.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explores the various literature related to the study. Firstly, it looks at the control of borders before looking at the various information systems that are available in organizations. Then various information system models are also reviewed. The section also gives an overview of the IBCS.

2.2 Borders and border control

Zarnowiecki (2011) defines a border as an imaginary line, agreed between two countries and usually defined by geographic features (such as a river, water separation line, or mountain range). However a border may not necessarily mean a geographical periphery of a country but rather an international gateway which can be well inside a national territory such as airports, railway stations, and river ports on international waterways (Agnew, 2008). Borders then essentially become institution-based as they act as official points of entry of people and goods into a country where traffic is controlled to ensure compliance with its laws (Andreas, 2003; Zarnowiecki, 2011). Several players are involved at the border and these include customs, immigration, transport and port health officials among others. These agencies basically perform border control activities. Border control can be defined as the '*effort to restrict territorial access'* (Andreas, 2003). Nieminen (2018) also defines border control as the activity carried out at a border in response to an intention to cross or the act of crossing the border regardless of any consideration, consisting of checks and border surveillance. The main activities of border control are to; maintain control over cross border movement of goods, people and conveyance, provide an appropriate level of facilitation to travel and trade, and maintain regulatory control in a way that reduces the impact of interventional strategies as much as possible.

Government agencies in charge of border control face serious challenges with the growth of cargo volume and number of people moving across the borders as they need to safeguard national interests and facilitate trade at the same time (Koslowski, 2011).

The focus of this research is on border control by immigration officials which encompasses verification of people's identities while entering or leaving the country and confirmation of their legal authority, largely by checking their passports and visas.

2.3 Information Systems in organisations

The present study falls under the study of Information Systems (IS) in organisations. Therefore, it is important to understand what is an IS and its usage in an organisation. An IS as defined by Stair *et al*., (2008) is *a set of interrelated components that collect, manipulate, store and disseminate information and provide feedback mechanism to meet an objective*. The interrelated components revolve around gathering and capturing data (input), converting inputs into useful outputs (processing), producing useful information (output), and getting feedback that is used to make changes to input and processing activities. An IS can be manual or computerized and the latter is the focus of this research. A computerized information system (IS) is, therefore, a combination of hardware, software and telecommunication systems, which can support business or organizations' operations to increase productivity, and help managers make decisions.

To work effectively, an IS should have five main components which are hardware, software, data, process and human(s) (Open University Malaysia, OUM, 2014). IS are developed to aid individuals in performing tasks, and their proper utilization provides a competitive advantage to the organisation (Petter *et al*., 2008) . All the components of information systems are interrelated. This is shown clearly by Callaos & Callaos (2002) who state that for humans to be able to get proper results out of an information system, they need to know how to properly handle each of the components of the system. According to Harsh (2005), to transform data into information, processing is needed and it must be done while considering the context of a decision. This is because most often we are awash in data but lacking good information.

Organizations make use of IS and technologies to conduct business activities and organizational operations (Mousavi and Habiby badr Ababy, 2008; Laudon and Laudon,

2012). These IS's help organizations to achieve operational excellence, improve decision making and achieve competitive advantage in order to survive in the industry (Laudon and Laudon, 2012). Amongst the many fields in the industry, border security and management is one area that is utilizing information systems and advanced technologies to the maximum, hence the need for evaluation.

These is no unique classification of IS as different authors classify them differently (Al-Mamary *et al*., 2014). Some authors classify IS depending on the type of decisions taken at a particular level in an organization, while other authors depend on the different types of knowledge that are processed at various levels in the organization, and based on the people who use the systems. The classifications are further illustrated in Figure 2.1, where depending on the types of decisions that are supported; we have transactional processing systems, management information systems and executive information systems.

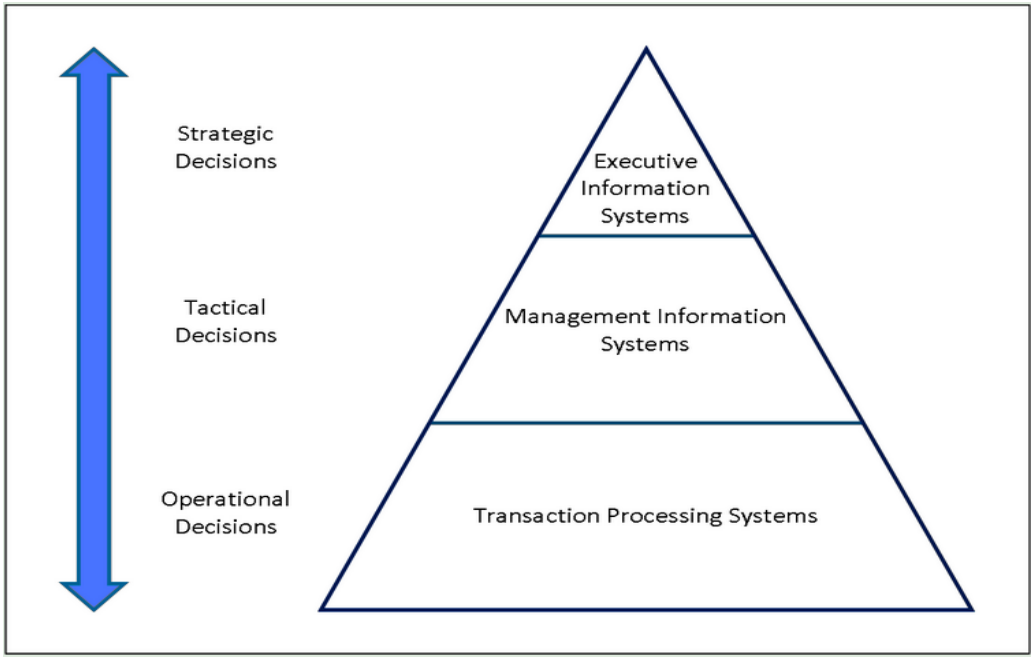


Figure 2.1: Classification of information systems

Source : Stair, Reynolds & Chesney (2008)

A transaction processing system (TPS) as defined by Laudon and Laudon (2012) is a computerised system that performs and records daily routine transaction necessary to

conduct a business. They are basically used at the lowest level of the organizational hierarchy by operational managers to keep track of elementary activities and transactions of the organisation (Stair *et al*., 2008; Laudon and Laudon, 2012).

On one hand, Management Information Systems (MIS) used by middle managers in monitoring, decision making and carrying out administrative activities are a kind of computer information system that collects and processes information from different sources (Laudon and Laudon, 2012). MIS comprise many of the different types of Information Systems found in commercial organizations today. Most border management information systems fall under this category. The Executive support systems, on other the hand, are used at strategic levels to support long-term, strategic decisions made by senior managers (Stair *et al*., 2008). They help executives and senior managers to analyse the environment in which the organization operates, identify long-term trends, and plan appropriate courses of action. The information in such systems is often weakly structured and comes from both internal and external sources. Executive Information Systems are designed to be operated directly by executives without the need for intermediaries and are easily tailored to the preferences of the individual using them (Al-Mamary *et al*., 2014) .

2.4 Factors to consider when evaluating information systems

Information Systems (IS) make it possible to improve organizational efficiency and effectiveness, which can provide an organization with some competitive advantage (Irani, 2002). Although this is the case, the lack of evaluation of an information system may lead to an organization not having full benefits of that technology. According to Wyatt and Wyatt (2003) the correct methods to evaluate an information system do not depend on what technology is being evaluated but on the questions the study is designed to answer, and how reliable the answers must be. In a study on health information systems evaluation, Yusof *et al*. (2008) concluded that evaluation is complex; it is easy to measure many things but not necessarily the right ones. Nevertheless, it is possible to consider, an evaluation framework with more comprehensive and specific measures that would incorporate technological, human and organizational issues. It is, therefore, important to understand all the aspects of an information system before an evaluation is done.

Heeks (2005) states that IS can be better understood using the onion ring model (Figure 2.2) below which stipulates that IS success does not only depend on technology but rather on information, people, organisational processes and its environment. Laudon and Laudon (2012) also concur with this by indicating that an information system can be better understood by looking at its broader dimensions which are organisation, management and information technology. Therefore, when evaluating an information system, all these components have to be critically looked into as they are interdependent.

The IBCS is used at airports in Malawi by Immigration Officers. Seen through the onion ring model, the effective use of the IBCS is linked to the border security processes, the IT infrastructure on which it is operating, and the process in which the system is being used. Security Border officers receive data and information from people and identity documents. This data and information has to be captured through the IBCS (a technological platform in itself comprising hardware and software) which in turn processes the information and both the user and the customer get the results. However, for the normal functionality of the system, there is need for a conducive environment. This conducive environment as shown in Figure 2.2 below comprises influencing factors and institutions.

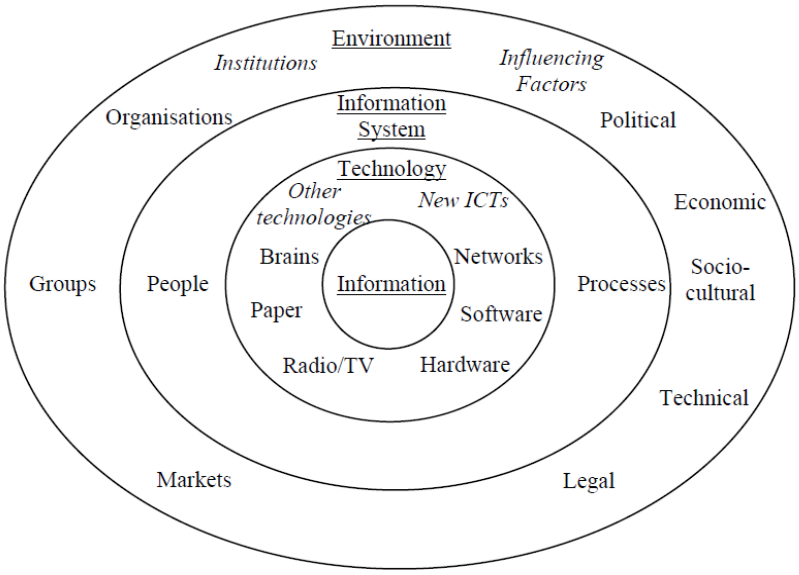


Figure 2.2: The Onion Ring Model.

Source: Heeks, 2005

On the influencing factors, the IBCS needs to be supported by political will, economic, socio-cultural, technical and legal factors. These factors tend to work together because if there is political will, the system will be supported by government economically, technically and legally (i.e. deliberate laws will be formulated which encourage the use of such systems) and also the system will be updated regularly to cater across all socio-cultural concepts.

However, all influencing factors have to be complimented by institutional support which looks at the day to day functionalities of the system. The Department of Immigration and its line Ministry (Ministry of Home Affairs and Internal Security) in Malawi play this role. The markets for IBCS in the Onion Ring Model are people or customers whose data is captured. In other words, the system needs people for it to function properly. These are both users and customers.

Most available literature on IS review in Malawi is in the health sector and tends to lean towards the District Health Management Information System. For instance, Chikumba and Ramussen (2016) studied the role of IT in the management and use of health information in Malawi and Burkina Fasso; Ministry of Health (Malawi) (2015) reported on improving quality of health data based on Health Management Information System (HMIS) and District Health Information System (DHIS2) in Malawi; Msiska and Nielsen (2017) used DHIS2 as a case study when looking at a framework to assess and address human capacities needed to leverage open source software platforms in developing countries. In most cases, these studies did not use the D&M model.

2.5 Border management information systems (BMIS)

Border management information systems are used for identification and verification management as far as the control of persons is concerned. They enhance the processing of bona fide travellers so that unauthorized persons are denied entry (IOM, 2002). The processes of identifying bona fide travellers include checking for a match between the identity of each traveller in front of the officer at the point of embarkation or at the border, the information recorded in the traveler's travel documents and any visas or permissions, and the information regarding that traveler's identity and status (IOM, 2002). A detailed flow of tasks is presented below:

i. Establishing the validity of the travel document by ensuring that it is not expired, counterfeit, or altered (for example, by photo-substitution or insertion of pages)
ii. Establishing the validity of the visa and ensuring that it is not counterfeit or altered
iii. Establishing that the identity of the person presenting for clearance is the same as the person holding the travel document and visa
iv. Ascertaining bona fide intentions to abide by the conditions of the visa or the authorization to enter
v. Checking that there has been no change since the granting of the visa such that entry is no longer in the national interest
vi. Considering and granting visas at the border
vii. Referring to the appropriate authority those persons requiring consideration of protection claims
viii. Referring for removal those persons who are denied admission
ix. Collecting data on the movement of people through the border point
x. Collecting information on irregular movements and on migrants' smuggling and trafficking of persons.

BMIS are usually used together with the physical clearing system.

2.6 Information systems in border security

In border security, information systems provide a computerized decision-making support to border control authorities. As is the case with the IBCS under study, IS are intended to increase the reliability and efficiency of border control technologies (Kenk *et al*., 2013). The main activities at the border include checks, surveillance and risk analysis (Le Guellec *et al*., 2018; Wilson and Weber, 2008). According to Kenk *et al*. (2013), information systems required to facilitate the control of cross-border traffic are large-scale personal information database systems combined with personal identity verification systems, which largely involve automated biometrics-based authentication methods. Similarly, such large-scale integrated systems enable the implementation of Automated Border Checks.

In addition, borders require surveillance systems that are used for borderline surveillance and could be categorised as sense-and-detect technologies. These technologies include different 'smart' sensing systems and detectors, as well as personal and vehicle detection and tracking systems incorporated into large-scale integrated IT systems that improve the monitoring and reaction capacities of border control authorities with the task of preventing irregular migration and cross-border crime (Alkhathami *et al*., 2018; Feremban, 2013; Girard *et al*., 2004). Thus, law enforcement personnel utilize the various technologies to monitor and protect borders, provide safety and comfort for travellers and citizens as well as collect and share traveller's data using the new techniques to verify identity more effectively (del Rio *et al*., 2016; Al-Raisi and Al-Khouri, 2008). The main focus of this research was on IBCS which is responsible for border checks. Border check is the process of verifying that all persons crossing the border fulfil the entry conditions. Some of the basic information systems required for this purpose are: Visa systems, Entry/Exit system, Alert list and Advanced passenger Information System (Wilson and Weber, 2008; Amoore, 2006; Salter, 2006; Salter, 2004).

2.6. 1 Visa systems

Visa systems are one of the recent advances in border control technologies (Burton and Stewart, 2010). The purpose of these systems in border management is to establish the validity of the visa and ensure that it is not counterfeit or altered. An example is the Visa Information System for Schengen states. In Malawi, the visa system is currently manual (Ernest Mbaluko, Personal Communication, 17 September 2016). Therefore, it is not linked to the border control system. However, whenever a traveller applies for a visa, his/ her details are checked in the IBCS to ensure that the person has no criminal record and is not in the country.

2. 6.2 Alert list system

This "alert list" must contain lists of persons such as war criminals, wanted criminals, suspected terrorists, or those who breached immigration conditions on a previous stay. It should also identify travel documents of concern, for example, stolen passports. An example of this system is the INTERPOL system on lost and stolen travel documents.

The IBCS is currently not connected with the INTERPOL system, however, it was noted that there are plans to have it connected.

2.6.3 Entry/Exit system

This system records entry and exit information of travellers as well as checking the integrity of produced travel documents. An example being the IBCS under study.

2.6.4 Advanced passenger information

This system collects passenger information ahead of inbound flights. To achieve effectiveness and enhanced security at the border crossing point, all the above mentioned systems must be integrated. In Malawi, the system is not automated however, the officers at the border receive a passenger manifest (this is a document that lists out names of passengers in a particular aircraft) beforehand.

2.7 Border Management Information systems in the world

There has been a tremendous increase and improvement in the border management information systems across the globe. Developed countries are currently implementing Automated Border Control systems (ABC) which verify traveler's identity without human intervention (Labati *et al*., 2015a; Rio, *et al*., 2016; Lehtonen and Aalto, 2017) In addition, the ABC's use biometrics such as facial recognition software, iris scans, and fingerprints to confirm the travellers identity unlike using bio-graphics only (Kephart, 2013). Some examples of border information systems in the world include; the Schengen Information System (SIS), the Automated Targeting System, and the Personal Information and Registration System (PIRS). Malawi has only recently moved from the manual operations to the computerized border control system that uses biometrics in order to identify and verify travellers. In the next sections we will discuss the three information systems mentioned.

2.7.1 The Schengen Information system (SIS)

According to European Commission (2014), the Schengen is an area of free movement without internal borders that now covers most of Europe. Citizens of the countries within the Schengen zone can freely move from one country to another. The Schengen area was initiated in 1985 when five European Union (EU) member states signing the

Schengen Agreement, thus marking the beginning of cooperation to dismantle control at their internal borders.

The Schengen Information System was established to allow authorities in this area to access and exchange information more effectively on specific types of alerts such as missing persons, stolen or lost cars, firearms and identity documents. It offers functionalities such as use of biometric identifiers (e.g. finger prints) and alerts on missing persons and vehicles. According to Karanja (2002) the purpose of the Schengen Information System is to allow checks on persons to be made quickly and efficiently at border controls in order to detect criminals and illegal immigrants moving into and from one Schengen country to another.

According to the EU (2015) the Schengen Information System is a highly efficient large scale system which, 1) enables border guards and visa issuing and migration authorities to enter and consult alerts on third-country nationals for the purpose of refusing their entry into or stay in the Schengen area, 2) supports police and judicial cooperation by allowing competent authorities to create and consult alerts on missing persons and on persons or objects related to criminal offences, and 3) enables vehicle registration services to check the legal status of the vehicles presented to them for registration certificates and number plates.

According to Pedersen (2015) as is the case with most systems, not much has been done on the effectiveness and legitimacy of the Schengen Information System. Most of the studies on this system have focused on its effect on liberty and human rights of passengers or travelers.

2.7. 2 The Automated Targeting system (ATS)

The Department of Homeland Security (DHS, 2008) states that Automated Target System is an intranet based enforcement and decision support tool that is the cornerstone for all USA Customs and Border Protection targeting efforts. Customs and Border Protection uses Automated Target System to improve the collection, use, analysis and dissemination of information that is gathered for the primary purpose of targeting, identifying and preventing potential terrorists and terrorist weapons from entering the USA. According to Dines (2009) the ATS is the program the DHS and Customs and Border Protection (CBP) have been using to monitor international

travellers and assign risk assessment scores to determine potential terrorist threats. The system, therefore, allows Customs and Border Protection officers to focus their efforts on travelers, conveyances and cargo shipments that most warrant greater scrutiny. To support the USA Customs and Border Protection (CBP) in identifying individuals and cargo that need additional review across the different means or modes of travel to, through, and from the United States, the Automated Target System provides the following basic functionalities (DHS, 2014):

i. *Comparison:* Automated Target System compares information on travellers and cargo arriving in, transiting through, and exiting the country against law enforcement and intelligence databases to identify individuals and cargo requiring additional scrutiny. For example, the Automated Target System compares information on individuals (identified as passengers, travelers, crew members, or persons appearing on documents supporting the movement of cargo) trying to enter the country or trying to enter merchandise into the country against the Terrorist Screening Database (TSDB), which the Automated Target System ingests from the DHS Watch list Service (WLS), as well as data concerning outstanding wants and warrants.

ii. *Rules:* The Automated Target System compares existing information on individuals and cargo entering and exiting the country with patterns identified as requiring additional scrutiny. The patterns are based on CBP officer experience, analysis of trends of suspicious activity, law enforcement cases and raw intelligence. For example, the Automated Target System might compare information on cargo entering the country against a set of scenario-based targeting rules that indicate that a particular type of commodity is rarely imported from a given country.

iii. *Federated Query:* The Automated Target System allows users to search data across many different databases and systems to provide a consolidated view of data responsive to a query about a person or entity.

Although studies on the Automated Target System are very rare and were not available during the time of this study, there tends to be common challenges for Automated Border Control (ABC) Systems. According to Labati *et al*. (2015b), the most important challenges in the design of ABC systems have to do with the development of better

anti-spoofing techniques, compatibility between systems, scalability of biometric systems, and methods for allowing the use of the e-Gates also to people with reduced mobility and visual impairments. Moreover, other challenges pertain to the capture of higher quality face and fingerprint images, and the design of less-intrusive iris biometric recognition technologies.

2.7.3 The Personal Information and Registration System (PIRS)

This system was developed by the International Organization of Migration (IOM). According to Andrijasevic and Walters (2010), the IOM activities range from the hosting of training seminars for local security and migration officials to the promotion of schemes to purchase and install cutting-edge surveillance equipment at a country's borders. According to IOM (2011), the Personal Information and Registration System has been designed to enable countries with no or inadequate data capture systems to equip themselves and have the operational means to take up the challenge of enhanced migration management. The system offers high quality performances at an affordable price and is suitable for installation in remote areas. The PIRS is a biometric system which operates on commonly available servers and personal computers, which are equipped with a passport reader, a webcam, and a fingerprint reader. According to Jain and Kumar (2012) unlike credentials (documents and Personal Identification Numbers, PINs), biometric traits (e.g., fingerprint, face, and iris) cannot be lost, stolen, or easily forged; they are also considered to be persistent and unique. As such biometric systems tend to be better off than other system. The PIRS aims to:

i. Improve border facilitation and control for exit and entry through real-time information gathering and connection to national and international alert lists including Interpol`s Stolen and Lost Travel Documents (SLTD) database
ii. Enable information collection, processing and dissemination in support of data analysis and migration intelligence
iii. Support enhanced migration and border management by informing the optimum deployment of human and financial resources at borders as well as efforts to strengthen and fine tune migration policies.

The Personal Information and Registration System perform the following functions:

i. Manual and automated capture of basic traveller information (entry and exit data) such as photo, fingerprint, vehicle/vessel/airplane
ii. Extraction and storage of travellers' data from travel documents and data from Machine Readable Travel Documents (MRTDs)
iii. Analytical, comparative and storage or retrieval data functions
iv. Uploading of travellers' data to headquarters data depository for consolidation·
v. Production of customizable reports at border posts for analytical purposes (reports can be daily/weekly/monthly/yearly and provide for nationality/sex/age)
vi. National and international alert list functionality, with different levels of access, to check traveller's data and ensure entries and exits are in line with national interests and policy. Personal Information and Registration System can notably be connected to Interpol's I-24/7 Global Communication on System and its Stolen and Lost Travel Documents database.

2.8 Border management information systems in Africa

Several countries in Africa have adopted their own border management information systems. An informal report in South Africa (SA) indicates that the SA government implemented the enhanced Movement Control System (eMCS) at its entry/exit points in 2015 aimed at monitoring migration and reducing cases of travellers using fake or stolen identification documents. The system captures travellers' fingerprints and has facial recognition capability. Likewise, the Namibian government has introduced the Electronic Border Control Management System to make identification of immigrants and Namibians simpler and faster. The system captures the biometrics of a person such as face for facial recognition and fingerprints.

Furthermore, the International Organization for Migration (IOM, 2011) has implemented the Personal Information and Registration System (PIRS) in fourteen African countries (namely Burundi, Democratic Republic of Congo, Guinea Conakry, Islamic Republic of Mauritania, Kenya, Liberia, Republic of Congo, Sierra Leone, Somalia (Puntland), South Sudan, United Republic of Tanzania, Uganda, Zambia and Zimbabwe) and will also be implementing the same in Central Asia and Central America. Likewise, the system was implemented in Malawi at its Songwe border in the

northern region of the country. IOM (2011) states that PIRS is designed to collect, process and store travellers' information at entry and exist border posts, including bio-data for the purpose of identification, authentication and migration data collection and analysis. The system also enables border officers to search and cross-check data, with direct access to national and international databases hence fostering information sharing and improving inter-service coordination. The system's reports enable a particular Government to understand migration dynamics and patterns.

2.9 The Integrated Border Control system (IBCS) in Malawi

The IBCS operates on commonly available servers and personal computers, which are equipped with a document reader, a webcam, and a fingerprint reader. Both software and hardware can easily be deployed in remote and low-capacity locations. IBCS's intuitive interface provides officers with defined fields to fill out. When connected to the document reader, the system automatically extracts the holder's information and bio-data from the travel document. Similarly, if the webcam and fingerprint reader are connected, the IBCS can capture travellers' photographs and fingerprints on the spot. The automation of data collection considerably alleviates border workload at borders.

Using this system, border officers can record, search and cross-check data. The captured information is stored on a central data depository which is housed at the immigration headquarters. The two airports (Chileka and Kamuzu International) have local servers which are connected directly to the central server which gets updates at least every day. The system features include:

i. International travel document verification
ii. Check list and fingerprint verification
iii. Entry and exit information that can be integrated with immigrants' information that serves as a central repository for all immigrant information
iv. The system automatically sends alert during verification process while checking the passenger details with that of wanted list / stop list / prohibited immigrants and repatriation list

While there are a number of similarities between the Malawi Integrated Border Control System and other systems (IBCS user manual), some differences also occur. For

example, unlike the Schengen Information System which is also used for missing persons, stolen or lost cars or firearms, the Integrated Border Control System is not used for this function. Also the Automated Target System is used to target specific individuals e.g. suspected terrorists which is not the case with the Integrated Border Control System. Additionally, the Personal Identification and Registration System has the capability to be implemented in remote areas which is also the case with the Integrated Border Control System which currently is mostly used at Malawi`s two main airports. However, implementation in remote areas requires special mobile equipment.

2.10 Innovations in border management

Manual passenger clearance has been the order of the day for decades. As technology is advancing, document forging, terrorism, organized crime and illegal immigrants are also on the increase, hence contributing to the amount of pressure associated with border processing (Frontex, 2011; Kenk *et al*., 2013). Additionally, passenger travel has also increased *(*Labati *et al*., 2015a), hence the need for new border architecture, which seeks to respond effectively to new demands for facilitating mobility while managing the risk associated with the cross-border travel. This has led to the introduction of Automated Border Control (ABC) systems. Taylor (2016) defines ABC Systems as "*a technology which allows for an automated border passage, and which is composed of a self-service system for performing tasks such as a passport check, and an e-gate which controls the act of border crossing"*. According to the European Commission, an ABC should be able to perform the following border control functions: travel document authentication, verification that the traveller is the rightful holder of the document in his possession, database checks, and automated verification that the entry conditions are fulfilled just like a border officer would handle them but this time around all these functions are performed without the intervention of the officer.

SITA (2014) postulates that ABCs rely on the use of e-passports and biometric verification, such as face, iris or fingerprint, combined with a risk assessment of the traveller. These ABCs are in form of e-gates/smart gates or kiosks. E-gates basically replace manual border counters. Instead of queuing up to be cleared by an immigration officer, travellers queue up for the e-gate, then enter a secure and private enclosure with barriers either side of them. Once the document and biometric checks are completed successfully, the front door opens to let the passenger through. Alternatively, a kiosk

requires the traveller to still speak to a border control officer for a final check. Kiosks can automate the travel document checks, identity verification and customs declaration as well as integrating with backend systems that perform a risk assessment. Once that is done, a printed receipt shows the traveller's details, including facial image and a status indicator which is finally given to the border control officer for final check (SITA, 2014).

2.11 Information system success

According to Kuppusamy *et al*. (2009), over the years there has been an increased call to justify IS investment in organizations. Investment in IS poses some form of problems to an organization in terms of hardware and software incompatibility, information overload and job insecurity feelings among the workers due to fear that they may be replaced by machines. These problems may have an adverse effect on productivity and dampen the growth of other IS applications. Information system success is, therefore, an important aspect to an organisations growth. Hastie (2006) states that IS success can be broadly put into project and product success. Project success is a measure of the effectiveness of the organisations processes for implementing new IS projects up to the point of deployment of the new system to the end user community. Product success is the measure of the value the delivered system returns to the organisation after completion of the project and when it is deployed to the eventual users to become part of the characteristic way business is conducted in the organisation.

Many businesses today are totally dependent on IS to enable them carry out their everyday activities. Therefore, IS projects must be successful if the organisation is to survive and prosper. IS success may mean a system that is able to align itself with the beliefs of the intended audience regarding usefulness and utility and systems that deliver accurate, useful and relevant information to the right stakeholders in an appropriate and timely manner. Measuring IS success or effectiveness is critical because it helps the organisation to understand the value and efficacy of management actions and IS investments.

2.12 Information systems success models

A greater number of IS failures are still emerging despite huge expenditures. Therefore, the measurements of investments and developed systems success are very important

(Smolnik and Riempp, 2009). Literature provides several definitions and measures of IS success however, there is no ultimate definition of success (Zaied, 2012). Petter *et al*. (2008) posits that IS success is so complex, interdependent and multidimensional, hence difficult to define. According to Zaeid, (2012) and Manchanda *et al*., (2013) models of measuring IS success include:-.

i. Technology Acceptance Model (TAM)

The model predicts user acceptance to technology. It indicates the relationship between external variables, perceived usefulness, perceived ease of use, attribute toward use and actual use. The model provides information on how the designed choices influence user acceptance of technology. According to this model, a system is useful to the users if they are willing to use it. The model can be applied to measure the acceptance of a specific software for, example, Pranic *et al*. (2010) applied this model to evaluate acceptance and effectiveness of biometric technologies in airport security. The research focused on how travellers perceived biometric technologies as both acceptable and effective in making travel safer. The focus of this research is not on system acceptance, therefore, this model was not appropriate.

ii. Delone and Mclean Information System Success Model (D & M model)

This model identifies six variables of IS system success which are; system quality, information quality, use, user satisfaction, individual impact and organizational impact.

iii. Updated Delone and Mclean Model

This is an updated version of the original Delone and Mclean Model. In this model, variable use was replaced by usefulness, service quality was introduced and individual and organizational impacts were replaced by benefits.

iv. Gable *et al*. (IS impact) Model

This model is based on the Delone and Mclean Model. It adopts constructs represented by Delone and Mclean as causal and process related. The model depicts that individual impact and organisational impact are explicitly and intentionally measured at the same time as system and information quality but they are not mediated by use as in the Delone and Mclean model. It measures IS success or impact. IS impact is a measure at a point

in time of the stream of net benefits from IS, to date and anticipated as perceived by all key-user groups.

v. Integrated Success Model

This is developed from the Technology Acceptance Model (TAM) and Delone and Mclean model. Ten dimensions are proposed for measuring IS success which are behaviour intention, information quality, management support, perceived ease of use, perceived usefulness, service quality, system quality, training, user satisfaction and user involvement.

Of all the available models, the Delone and Mclean IS model (s) (D & M IS model) is one of the most commonly used as it can be applied in the evaluation of IS in different contexts (Hellsten and Markova, 2006).

2.13 Overview of the Delone and McLean IS success theory

The D&M IS success model was developed through a comprehensive review of literature (Delone and McLean, 1992). In 1992 DeLone and McLean in their paper "Information Systems Success: The Quest for the Dependent Variable" examined almost 100 research articles published in the 1970s and 1980s in an attempt to prescribe a single model for IS success. The model recommends that when measuring IS success, researchers should "systematically combine" measures from the six IS success categories; system quality, information quality, use, user satisfaction, individual impact and organisational impact.

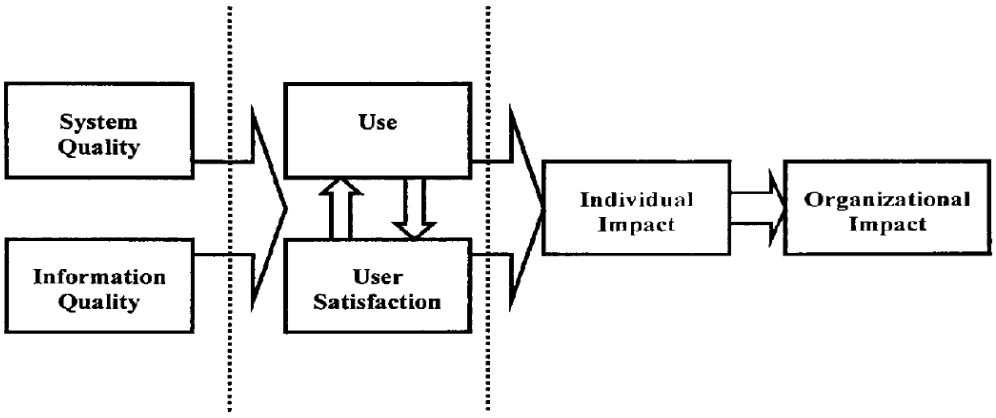


Figure 2.3: The D&M IS success theory

Source; Delone and McLean, 2002

System Quality and Information Quality are depicted as affecting both IS Use and User Satisfaction, which in turn are direct antecedents of Individual Impact. According to DeLone and McLean's taxonomy, system quality belongs to the technical level, and Information Quality belongs to the semantic level. IS use, user satisfaction, and individual impact belong to the effectiveness-influence level. D&M cite Shannon and Weaver (1949) defining the *technical* level of communication as the accuracy and efficiency of the communication system that produces information. The *semantic* level is the success of the information in conveying the intended meaning. The *effectiveness* level is the effect of the information on the receiver.

D&M proposes that these six dimensions of success are to be interrelated rather than independent because they have important implications for the measurement, analysis, and reporting of IS success in empirical studies. A temporal, process model studies an IS from its beginning when the system exhibits various 'degrees of system and information quality'. The experience that comes from the use of the system has an impact on the user's behaviour which in turn results in an organisational impact. This is illustrated in Figure 2.3. In *contrast*, a causal or *variance* model focuses on studying causal relationships between these success dimensions. For example, higher system quality is expected to lead to higher user satisfaction and use. This means that although these variables may be measured in isolation, the researcher should always be mindful of their interdependent nature and should consider possible interactions between them and how that affects the dependent variables of success. Measuring the IS success is a complex task due to this multidimensional and interdependent nature of these variables (Petter *et al*., 2008) and the researcher is encouraged to choose those success dimensions and measures that are most appropriate for the context of the study. The dimensions and measures chosen should not be large in number so that the research result can be compared and its findings validated.

The model was enhanced in 2003 (Delone and McLean, 2003) by adding a third dimension, "service quality" to the two original system characteristics, "system quality" and "information quality" (Figure 2.4) Individual and organisational impacts were combined into one variable "net impact".

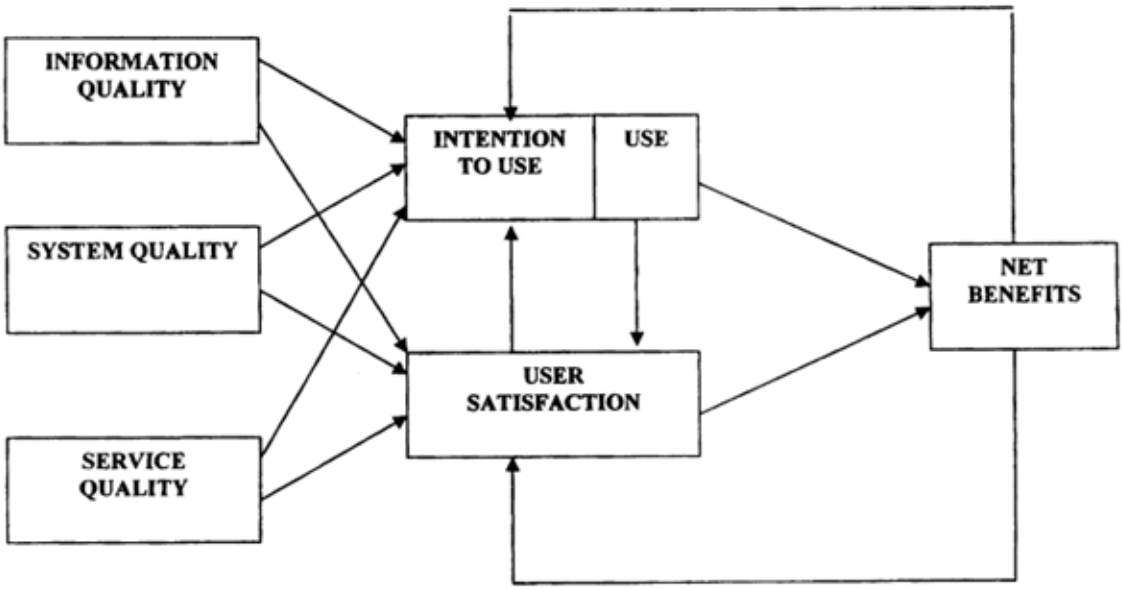


Figure 2.4: The Updated D&M IS success theory

Source: Delone & McLean, 2003

Although D&M model incorporated the "service quality measure" in addition to the other two measures, one can take the view that service quality is a subset of system quality. This measure is more appropriate in measuring the success of a whole IS department as opposed to individual systems. As we are interested in studying the success of a single system we will apply the initial D&M model. Applying the updated D&M model to the whole IS department is an interesting future work that can build on our research.

2.14 Dimensions of Information System success and possible measures

In the studies reviewed by Delone and McLean (2003), the associations between "system quality", "use", "information quality" and "individual impacts" were found to be statistically significant.

2.14.1 System quality

System quality refers to the measures of the information processing itself. According to D&M system quality also refers to how well the hardware and software work together.

Different researchers operationalize this construct in different ways i.e. convenience of access, flexibility of system, integration of system, system response reliability, response time, ease of use, and ease of learning. In this research, the selected elements are **response time, ease of use, ease of learning**, **organisation of interface**, **system availability and functionality**.

2.14.2 Information quality

Information quality refers to the quality of information the system produces (Delone and McLean, 2003). This study operationalized information quality in terms of the **accuracy**, **timeliness**, **completeness**, **relevancy** and **usefulness**, and **suitability** of the information generated by the IBCS system.

2.14.3 System use

System use refers to the use and exploitation of outflows from the information system (Mamma, 2010). This construct is a measure of success mainly in systems where use is voluntary. In IBCS, use is mandatory, therefore, this construct was not measured. Instead, perceived usefulness of the IBCS was considered.

2.14.4 User satisfaction

Satisfaction is the overall effective response to a perceived discrepancy between prior expectations and perceived performance after consumption (Zaied, 2012). This is considered one of the most important measures of system success, often measured by overall user satisfaction. It was assessed in the study by capturing overall user satisfaction with the IBCS. As stated in the introduction section, user satisfaction is directly linked to the effectiveness of a system.

2.14.5 Individual impact

This refers to the impact of the use of an information system on the performance of duties by a person within their work environment. According to DeLone & McLean (2002), this impact could be a strong indication that the information system offers to the user a better understanding of the content of their decisions, an improvement with regards to their decisions about productivity, a change in their operations, as well as a change in understanding the importance and usefulness of the organization's system

(Mamma, 2010). On this construct, the researcher looked at how the system has helped the users to improve their day to day work.

2.14.6 Organizational impact

Organizational impact examines how the results of the individual impact affect the operation of the organization, while also measuring the efficiency of the organization as a complete entity (Delone & Mclean, 1992). In this study, the researcher looked at the impact of IBCS to the organization as a whole in terms of providing customer service, timely decision making and achievement of organizational goals. Table 2.1 below defines what each dimension in the model measures.

Among several other studies, the D & M IS success model has been used in the evaluation of: knowledge transfer success (Halonen and Thomander, 2008); knowledge transfer in a virtual learning environment (Halonen *et al*., 2010); e-commerce (Molla and Licker, 2001: Rouibah *et al*., 2014); a police organization in Sweden (Tona *et al*., 2012), among others. Published work relating specifically to border control system evaluation is scarce. The researcher was unable to find published papers in which the success of border control system was assessed using the D&M or similar models.

However, several researchers have used the Delone and Mclean model of information systems success to evaluate success and effectiveness of various information systems in private and public institutions.

Kutlu and Alkaya (2015) evaluated the net benefits of IS success in the banking sector. In their research, they looked at the relationship and interaction of the IS success variables and found that success was dependent on 3 independent variables which are information quality, service quality and user satisfaction. Unlike Delone and Mclean, they did not find a significant relationship between the variables of “use”, “system quality” and “success”. On the contrary, Sirsat and Sirsat (2016) in their research on validating the Delone and Mclean model on education information system of Maharastra state in India, they found that the system was successful on all variables.

The model was also used to evaluate a hospital information system by Chatzoglou *et al*.(2012). In the Chatzoglou *et al*., (2012) research, user satisfaction was the key measure of success. Information quality, system quality, service quality and user

background were used to measure user satisfaction. Their findings were that user background, information quality and service quality directly and positively affected user satisfaction. System quality was found to influence user satisfaction indirectly.

Table 2.1: Dimension of IS Success

Dimension	Description	Measures
System Quality	How good is the system in regards to its operational features (Mamma, 2010)	Resource utilization, investment utilization, reliability, response time, aggregation of details, human factors and system trust and accuracy
Information Quality	The degree and manner in which staff utilize the capabilities of an information system (Petter *et al*., 2008)	Amount of use, frequency of use, nature of use, appropriateness of use, extent of use and purpose of use
Use	The degree and manner in which staff and customers utilize the capabilities of an information system (Delone and McLean, 2003)	Amount of use, frequency of use, nature of use, appropriateness of use, extent of use and purpose of use
User satisfaction	Users level of satisfaction with reports	Satisfaction with system performance, reports
Organizational impact	Examines how the results of the individual impact affect the operation of the organisation	Improved service delivery
Individual Impact	Impact of use on the performance of duties of an individual	Improved performance, a change in user activity, the user's perception of the usefulness of the information system

Similarly, Khan (2010) used the Delone and Mclean IS success model to evaluate the Swedish electronic tax system (Skatteverkuet). The study used an online questionnaire, whereby citizens' responses were gathered regarding the overall use of the system. The findings of the study revealed that the system under study was quite successful through citizen's point of view and six constructs of the Delone and Mclean IS success model were interrelated, except for the two hypothesized links between information quality and use, and service quality and use.

On the other hand, a study by Baraka *et al*. (2013) used the Delone and Mclean IS success model to evaluate the performance of call centers. The study eventually led to the development of a call center performance index which was based on the weighting of the different dimensions of the Delone and Mclean IS success model. In the study, it was noted that user satisfaction, system quality, service quality and net benefits are to be prioritized.

Other studies have shown that a modification of the Delone and Mclean IS success model brings better results. For example, Zaied (2012) modified the dimensions of the Delone and Mclean IS success model and the Technology Acceptance Model by adding two additional success dimensions (Management support and Training). This led to the generation of an integrated model for evaluating IS success. The proposed model was validated by an empirical study based on a questionnaire. The results indicated that information quality has a strong significant influence on IS success (81.9%) followed by behavioural intention (80.2%), perceived usefulness (78.8%) and user involvement (70%). The overall results showed that the proposed model can be beneficial for decision makers in organizations on evaluating the implementation of information systems.

Furthermore, in a study by Roky and Al Meriouh (2015), the Delone and Mclean IS success model was used to evaluate an information system (IS) dedicated to the automotive industry (XPPS). It was noted that information quality plays a key role in increasing user satisfaction and intention to use of the system; there is a significant relationship between the quality of service and the use of the IS; there is a strong link on both intention to use and using of the system on individual impact; there is a positive influence of the individual impact on the organizational performance.

In this research, therefore, the D& M model was validated in the context of the IBCS. The researcher concentrated on the relationship of the six variables which are system quality, information quality, intention to use, user satisfaction and net benefits (individual and organizational impact).

2.15 Use of D & M IS success model in this study

The D&M model was used as it is, however, this study concentrated on selected attributes in each dimension. This is consistent with how other researchers have used the D&M model by attaching selected attributes to each of the six dimensions of the model.

The original D&M model found that system quality and information quality affect use and user satisfaction either singularly or jointly. It also found that the amount of use can have a positive and negative effect on the degree of user satisfaction and vice versa. According to Delone and McLean (2003), system quality focuses on the desired characteristics of the information system itself and measures include ease of use, ease of learning, convenience of access, realization of user requirements, usefulness of system features and functions, data and system accuracy. The researcher also took into account these characteristics.

This study focussed on user perception, ease of use, ease of learning, convenience of access and usefulness of features and functions. In the D&M model, information quality refers to the extent to which the information produced by a system conveys the intended meaning. Measures of information quality include: importance, relevance, timeliness, reliability and content. This study further looked at the impact of these quality measures (information quality and system quality) over use of IBCS and its impact on the departments' achievement of goals in providing security at the border points.

2.16 Conceptual Framework

As illustrated in the conceptual framework in Figure 2.5, the researcher focused on how system quality and information quality affect use and user satisfaction in IBCS. Furthermore, the research also aimed at determining how all other factors contribute towards net benefits of the Immigration Department.

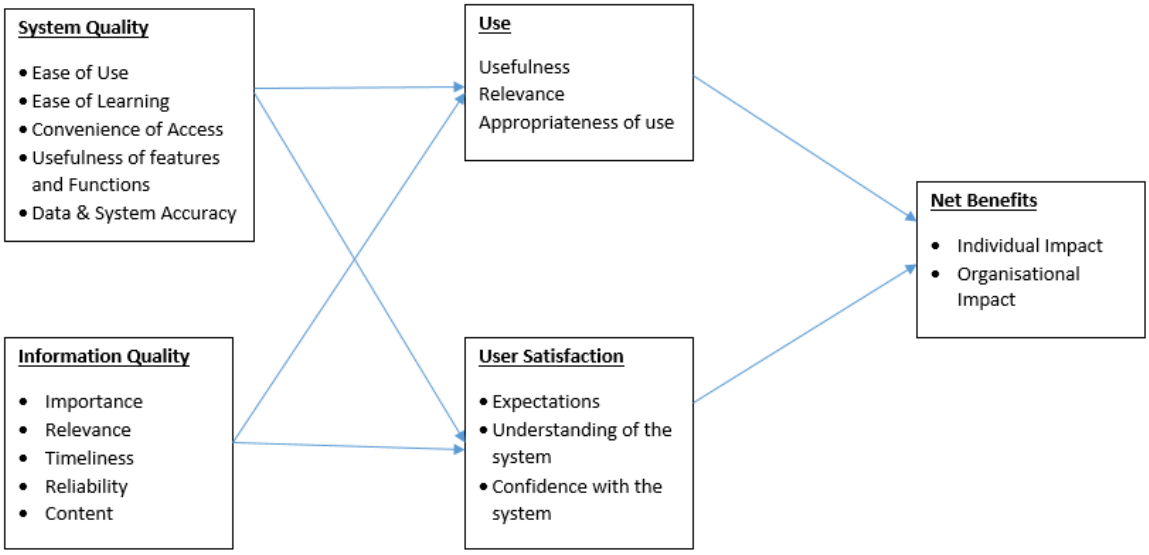


Figure 2.5: Conceptual Model guiding the research

2.17 Assessment of information systems and their effectiveness

Studies on the assessment of the effectiveness of border management information systems are not as common. This is attributed to issues of security required for such types of systems as extreme diversion or sharing of information for the border management systems could be a potential threat to the security of a country. Although comparisons can be made between border management information systems with other types of systems, there are some challenges. According to Premkumar and King (1992), there are significant differences in planning, organizational support, and performance characteristics of Information Systems among organizations with different roles for Information Systems. This means that if the information systems are for different organizations (which may indicate different roles of these systems which in most cases could be tailor made for a particular organization), a comparison of their effectiveness has to be done with a view in mind that the systems are different. As such, in this study where a comparison is made between the IBCS and other systems, care is taken to mention what exactly the other systems are used for. For example, most of the information systems evaluation (which includes general assessments and also studies on effectiveness) has been done in the health sector. Some of the challenges identified in these evaluations are that the results that come out of such studies in some cases provide little useful information to the users of the system (Heathfield *et al.*, 1998). As indicated in the introduction section, since user satisfaction is taken as a surrogate for

information system effectiveness (Melone, 1990), in this study IBCS effectiveness is also being looked at in terms of user satisfaction. The effectiveness of an information system can also be looked at as a situation whereby the system is able to meet its intended objectives (Hamilton and Chervany, 1981). Even going by this definition, it still falls back on the issue of user satisfaction. This is because if a system is able to achieve its intended objectives, there is a high probability that the user will be satisfied. According to Ives *et al*. (1983), the challenges of user satisfaction include the use of single item rating scales that have been criticized as unreliable as they provide little information as to what the user finds dissatisfying. As such, multiple item user information satisfaction has become increasingly important. The challenges with most of these is that they are not validated.

CHAPTER 3

METHODOLOGY

3.1 Introduction

When conducting research one has to be guided by a certain philosophy as depicted in research methods literature. A research philosophy depicts important assumptions about the way an individual views the world (Saunders *et al*., 2009). Epistemology concerns what constitutes acceptable knowledge in a field of study (ibid). This research falls under the study of information systems in organisations, therefore, acceptable knowledge in information systems evaluation was applied. In this case, the researcher applied the onion ring framework which articulates that an information system comprises of various aspects which need to be considered when understanding and assessing information systems. Additionally, Delone and Mclean model stipulates that when measuring information systems' success, the researcher should look at all the six dimensions of the model. This also guided this research.

3.2 Approach

This research followed a case study strategy. A case study according to Eisehardt (1989) focuses on understanding the dynamics present within single settings. The study concentrated on a system within an organisation which is the Department of Immigration and more specifically on the Integrated Border Control System (IBCS). Usually a case study is undertaken within a particular period of time which suited this study as it had time limits. The choice of the IBCS was based on convenience apart from the fact that the system represents a typical situation in a developing country. In developing countries, there are a number of challenges as regards IT issues. These challenges range from inadequate training and hardware and lack of review for the existing systems. As such this study adds up to the little literature available for IT systems in developing countries.

The D&M IS success model, as earlier explained, states that system quality and information quality affect use and user satisfaction which thereafter affect individual and organisational performance. To measure system quality, a questionnaire, interviews and observations were used. The following aspects of 'system quality' (the desired characteristics of the system): ease of use, ease of learning, system features intuitiveness, flexibility and reliability were measured by use of a questionnaire. Where necessary, interviews were conducted to clarify some of the information received through the questionnaire. System response time was measured through observations.

To measure information quality i.e. characteristics of output, the following aspects were measured: relevance, timeliness, reliability, completeness and usefulness of reports. On this construct, a questionnaire was used. The researcher also conducted interviews with relevant officials such as research and planning officers and repatriation officers in order to get more insight on the quality of information extracted from the system.

An information system that performs according to organisations' objectives has a positive impact to the organisation. Therefore, in this research a questionnaire was used to gather data on how the IBCS has impacted the department. Evaluating effectiveness centres on users' satisfaction with various aspects of an information system, therefore, to measure the effectiveness of IBCS, users satisfaction with system quality and information quality of the entire system was considered.

A mixed method approach to assess the effectiveness, reliability and success of the integrated border control system was applied. This is where both qualitative and quantitative methods of data collection and analysis are used. The study opted for the mixed methods in order to utilize the benefits derived from both methods in answering the research questions. This is because integrating qualitative and quantitative data collection and analysis strengthens the validity and quality of data analysis and research findings. Qualitative data collection and analysis, allows the researcher to understand some aspects of a social life (Saunders, Lewis, & Thornhil, 2009). Complementarily, observations allow the researcher to study things in their natural setting and make sense of what people think about a particular situation (Creswell, 2009). The approach also requires the researcher to be the key instrument of data collection as such, he/she utilizes this benefit by observing the system and inquiring more on how the system operates alongside what capabilities it has in order to gain more insight of the system.

When measuring the time taken to clear travellers at both the departure and entry counters, the quantitative data collection was more appropriate.

3.3 Study sites

The research was conducted in Blantyre and Lilongwe cities in Malawi. Specifically, the research was conducted at the Immigration Headquarters in Blantyre, at Chileka International Airport (CIA) immigration office, also in Blantyre, and at Kamuzu International Airport (KIA) immigration office in Lilongwe. These sites were chosen because despite being convenient to the researcher, these are the only sites where the IBCS has been rolled out and is being used in Malawi. Furthermore, the IBCS was chosen amongst all other border control systems in the world because this system was custom made for Malawi and it is the first time that the country is using an automated system at the entry and exit points.

3.4 Sample size and sampling technique

Sampling is usually determined by the purpose of the study and population size (Saunders *et al*., 2009). It is also dependent on availability of resources such as time and money. In this research, the researcher targeted the IBCS users, IT personnel, Officers in Charge and the Border Affairs Officer. Therefore, purposive sampling technique was used. This technique enables the researcher to select respondents or participants that are appropriate in answering the research questions and in the end meeting the research objectives (Saunders *et al*., 2009). Saunders *et al*. (2009) also state that purposive technique focuses on one particular sub-group in which all the sample members are similar and the group is studied in great depth which is the case in this study. In this case, only those who use the system were targeted for either questionnaire or interview. Therefore, 7 IT personnel, 2 Officers in charge, 1 Border Affairs Officer and 50 IBCS users in the three locations (i.e. KIA, CIA and Headquarters). Additionally, since the officers are subjected to transfers from one station to another, snow ball sampling was used to identify users who may have used the manual system as well as the automated system in order to compare the effectiveness of the two systems and if the automated system is, to the great extent, meeting its intended objective. Two officers were identified at Mwanza, two at Songwe and one at Dedza Border Posts. Saturation was reached at 5, therefore, the researcher could not look for more samples to give information on the effectiveness of the two systems.

3.5 Data Collection Tools

Combining several data collection methods (also known as triangulation) provides a more holistic and better understanding of the phenomenon under study (Babbie and Mouton, 2001). This study focused on determining the success of the IBCS through the six dimensions of the information systems' success model as depicted by Delone and Maclean. The dimensions include system quality, information quality, use, user satisfaction, individual impact and organizational impact. The following methods were used to collect data on the various dimensions:-

3.5.1 Questionnaire

Questionnaires help in the systematic collection of information (Eaden *et al.*, 1999). In this research, a questionnaire containing different questions on system quality, information quality, use and user satisfaction was administered to system users at KIA and CIA and Immigration Headquarters. The questionnaire (Appendix 1) had three parts; the first part was aimed at collecting demographic information of system users such as gender, age range and how frequent they use the IBCS. The demographic information was sought to establish the descriptive characteristics of the sample. The second part contained Likert scale questions requiring the users to rate their level of agreement on 'ease of use', 'usefulness of IBCS', 'ease of learning' and 'user satisfaction' on a scale of one to five aimed at getting user experience on their day to day use of the IBCS. The third part contained some open ended questions which gathered some detailed information on user's opinion about the system, its strengths and challenges.

A total of 46 responses were collected out of the 58 questionnaires that were sent. This represents a response rate of 79.3%. Out of the total respondents, as summarized in Table 3.1, a majority of them were males (69.6%) while the rest were females (30.4%). This indicates that the respondents had a representation of both gender though males were more represented than females.

Table 3.1: Sex of the respondents

Gender	**Count**	**Percentage**
Female	14	30.4%
Male	32	69.6%
Total	**46**	**100%**

A few individuals chose not to return the questionnaires despite several reminders. The main challenge was that the users were only available at the office during flight times (which was also critical to service delivery) and hence they chose to complete the questionnaires at home leading to non-responses. Nevertheless, the following measures were taken to reduce the non-response rate: the questionnaire was piloted and tested; the questionnaire was clearly designed and in simple to use layout; the researcher was present on site to answer queries raised by participants and collect the completed questionnaire; the researcher gave out additional copies to those that lost the questionnaire; and the researcher offered to fill the questionnaire on behalf of respondents where necessary

3.5.2 Semi-structured interviews

Semi-structured interviews were conducted with Officers in Charge (CIA and KIA) and information technology (IT) personnel in order to get an overview of the system and how it is helping the department to achieve its objectives. The researcher also interviewed the border affairs officer on how the system has simplified generation of reports and its impact on border affairs.

Interviews with IBCS users at various levels were conducted to understand the various functions of the software and how they interact with it. This information complemented the data collected using a questionnaire. The researcher used an interview guide (Appendix 2) and in some cases asked random questions depending on the gaps that were identified in preliminary results. This method was chosen because it gave more freedom to both the interviewer and the interviewee to ask and give further elaboration on issues, hence collecting more qualitative information as well as generating user perspectives.

3.5.3 Observations

Observations enable the researcher to gather data on what is currently happening (Kothari, 2004). Observations are important in research because they allow the researcher to see what the people are doing as well as what they say they are doing.

This method was used to gather data on system quality especially ease of use and response time of the system. The researcher observed how users were interacting with the different functions of the system and record how long it took to process travellers in peak and non-peak periods. Observations also supplemented data collected through interviews.

3.5.4 Document analysis

The researcher studied user manuals and other available documents for IBCS and PIRS in order to analyse the functionalities and features available in both systems so that proper conclusions could be drawn.

3.6 Ethical consideration

Taking into consideration that the Department of Immigration is a security entity and that any information collected was to be used for educational purposes only, the following ethical issues were put into consideration:

i. An introductory letter (Appendix 3) from the college was obtained to show that the researcher was a student of the University of Malawi.
ii. A clearance letter (see appendix 4) was obtained from the Chief Immigration Officer in order to have access to the system and permission to interact with officers from the study sites.
iii. Study objectives were clearly articulated so that respondents were aware of what is to be achieved and their involvement in the research.
iv. The researcher also sought consent from various respondents who responded to the questionnaires and interviews. Returning the questionnaire was not mandatory as a result there were some individuals who did not return the questionnaires.

3.7 Data analysis

According to Creswell (2009) and Adams (2007), data analysis mainly concerns making sense of data and making the data understandable to others. Adams (2007) further states that it is challenging to analyse data collected through interviews, observations and written documentation. However, the data that was collected in this research was analysed both quantitatively and qualitatively. Interview data relating to the use of the system was recorded on paper and common themes were categorised and summarised accordingly.

Quantitative data was recorded in Microsoft excel and Statistical Package for Social Sciences (SPSS) and descriptive statistics such as frequencies, percentages and charts were drawn depending on the construct being analysed.

To find the association between variables, Pearson correlation coefficient was used on quantitative data. In this case all the attributes relating to system quality, information quality, use, user satisfaction and net benefits were grouped together, respectively and a mean was calculated in SPSS. Thereafter, the data was analysed by Pearson correlation coefficient.

3.8 Scope and limitations

The study focused on assessing the reliability and success of the IBCS depending on user's perception. It was also aimed at assessing the performance of the IBCS installed at the two international airports in Malawi. There is another system used at Songwe Border Post called the PIRS. However, the assessment of PIRS at Songwe did not materialize because during the study period, this system was not functional.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Some information about respondents

The study looked at age of respondents as a way of understanding the demographics of the respondents. Table 4.1 indicates that a majority of the respondents (52%) were aged between 30 and 39 years followed by 30% of the respondents aged between 20 and 29 years while 9% were aged between 40 to 49 years. This question was not mandatory as such 9% of the respondents chose not to disclose their age. However, this question was necessary because of its association with computer usage.

According to Table 4.1, at the time of the study, the majority of the computer users were aged between 20 to 39 years old. Most government schools in Malawi are yet to introduce basic computer literacy into their curriculum and the level of computer literacy in the population at large is low (World Health Organization (WHO), 2014). However, after the introduction of the National ICT Policy in 1998, there has been a general improvement in ICT infrastructure as compared to the period before this time (Isaacs, 2007) and the education system has been incorporating ICT issues in its curriculum. It is highly likely that those in the age bracket of 20 to 39 years were exposed to computers whilst in school, hence the high usage rate as found in this study. Additionally, it has to be noted that Malawi has a young population with the majority being below 45 years of age (United Nations, UN, 2013). Although from the findings, it can be concluded that there are people of different age groups among the users of the IBCS.

Table 4.1: Age of the Respondents

Age (years)	Frequency	Percentage
20 -29	14	30%
30-39	24	52%
40 – 49	4	9%
59 and Above	0	0%
Not indicated	4	9%

4.2 Users' computer competence

The study also analysed users' computer competence or flexibility with using computer systems. The question required the respondents to choose amongst Novice, Moderate/fair and Expert users. In response to this question, as indicated in Figure 4.1 below, 70% of the respondents were moderate/fair users, 17% rated themselves as experts while the remaining 13% were novice users. This result basically indicates that most users did not require much support as far as using a computer was concerned. It was important to understand the competency level of users because Malawi as a country has very low levels of ICT access in educational institutions (Isaacs, 2007) and this may even affect the work force as a result. It is, therefore, important for institutions to expose their personnel to ICT so as to ensure that ICT related work is not affected.

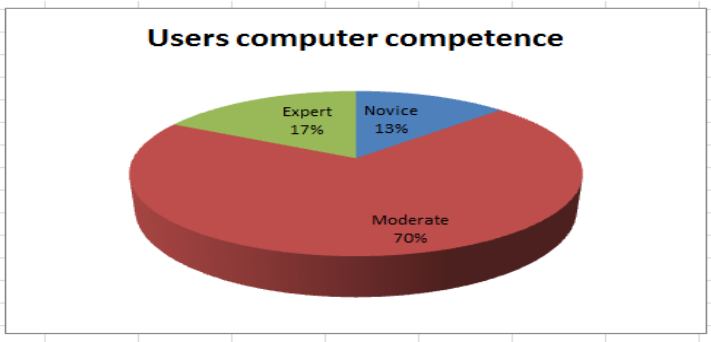


Figure 4.1: User' computer competence

These results are based on the individual self-assessment and are to be understood as such. No test to determine the level of ICT competency was administered. Nevertheless, the results are useful. No doubt the users ranked themselves with respect to how confident they were in using the existing technology which includes the IBCS system

at work. The level of confidence is proportional to the level of use. However, a Pearson correlation analysis between user competence and amount of use showed no relationship (Appendix 5).

4.3 System Evaluation

This section summarizes the findings of an investigation into the user evaluation of the different dimensions of the system.

4.3.1 General Information about the system

In an attempt to understand the various roles and job positions that users have in IBCS, it was found that respondents had different job positions and these were linked to the ranks that existed in the department. The job position also entails the tasks that one performs in the system.

As shown in Table 4.2 below, a majority of users (52%) were Immigration Assistants and these are the lowest ranked in the department's organizational chart. These are frontline officers who are expected to do the basic job as far as the IBCS is concerned. Immigration Officers with a ranking of 22% were discovered to be supervisory officers who would conduct specific tasks especially those tasks referred to them by Immigration Assistants.

Table 4.2: Table of job positions

Job Position	Frequency	Relative frequency (%)
Immigration Assistant	24	52%
Senior Immigration Assistant	6	13%
Assistant Immigration Officer	6	13%
Senior Assistant Immigration Officer	0	0%
Immigration Officer	10	22%
Principal Immigration Officer	0	0%
	46	100%

Apart from the different job positions, the users also have specific tasks that they perform in the system. According to the respondents, the tasks are dependent on the position that one holds. Table 4.3 and Table 4.4, indicates the distribution of tasks depending on the various job positions for senior and junior officers.

Table 4.3: Task distribution for junior officers

Job Position	Tasks
Immigration Assistant	• Travel Document and check list verification (Entry) • Travel Document and check list verification (Exit) • View Entry and Exit Details • Search Passenger Details • Interview Passenger
Senior Immigration Assistant	• Travel Document and check list verification (Entry) • Travel Document and check list verification (Exit) • View Entry and Exit Details • Search Passenger Details • Interview Passenger

The results in Table 4.3 and Table 4.4 show that there are some tasks that are specific to a certain job position. For instance, an Immigration Officer, apart from being able to perform tasks that can also be done by Immigration Assistants, also performs other tasks such as deporting passengers, checking reports and issue detention warrants.

Table 4.4: Task distribution for senior officers

Job Position	Tasks
Assistant Immigration Officer	• Travel Document and check list verification (Entry) • Travel Document and check list verification (Exit) • Record schedule of entry and exit • View Entry and Exit Details • Search Passenger Details • Interview Passenger
Senior Assistant Immigration Officer	• Travel Document and check list verification (Entry) • Travel Document and check list verification (Exit) • View Entry and Exit Details • Search Passenger Details • Interview Passenger • Restrict Passenger • Record carrier movement • Check reports
Immigration Officer	• Travel Document and check list verification (Entry) • Travel Document and check list verification (Exit) • View Entry and Exit Details • Search Passenger Details • Interview Passenger • Restrict Passenger • Record carrier movement • Check reports • Deport passengers • Issue detention warrant
Principal Immigration Officer	Mainly supervisory but can perform any task apart from system administration

In response to the question about how regular one uses the system, 75% of the respondents chose the option of *often*. The results indicated that the users actually use the system to accomplish tasks within the department. Figure 4.2 shows a distribution

of how the users responded. As far as information systems are concerned, system use has an impact on effectiveness because as Delone and McLean (2016) put it, a positive experience with 'Use' will lead to greater 'User Satisfaction.`

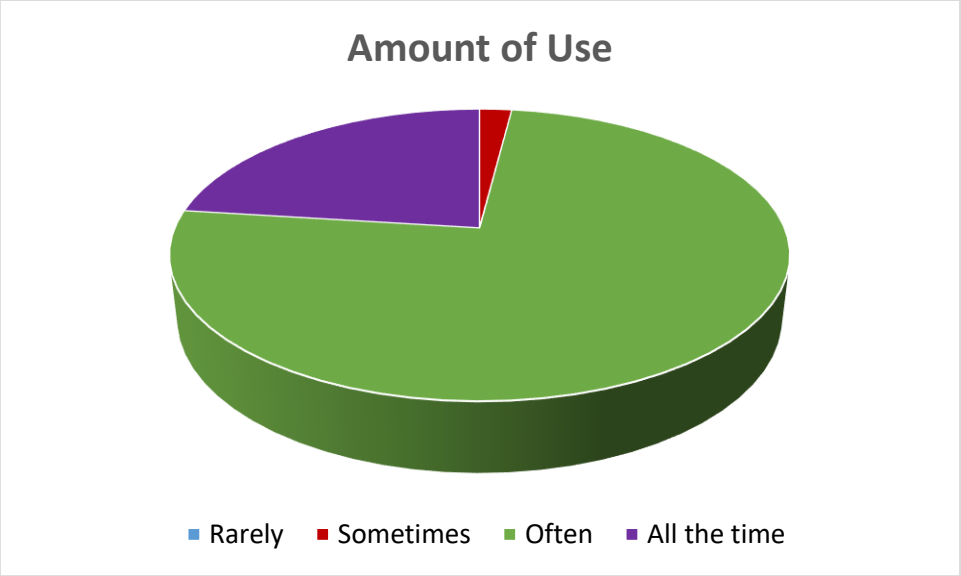


Figure 4.2: Amount of system usage

4.3.2 User understanding of the system

The study also wanted to check respondents' understanding of the system, therefore, a question on which particular task a user performed were framed and the respondents were asked to write down the steps that are followed to carry out that particular task. Table 4.5 shows that 27% of the total respondents did document verification and scanning of travel documents while 18% did data de-duplication and 14% did deportation of prohibited immigrants and clearing of restricted persons. The choice of specific tasks was spread across different tasks and it is reasonable to assume that respondents choose to write down those tasks whose steps they were most knowledgeable of and they most likely perform more regularly. One way of identifying that the system is successful is when the users actually use the system.

Table 4.5: Tasks in IBCS

Task	**Frequency (N) of respondents**	**Percentage of total respondents**
Document Verification and Data Entry	12	27%
Deportation of prohibited Immigrants	6	14%
Scanning Travel Document	12	27%
De-duplication	8	18%
Clearing Restricted Person	6	14%

The steps for document verification and data entry as captured by most of the respondents were as follows:

i. *Log in the system*
ii. *Click on entry verification*
iii. *Select type of traveller*
iv. *Scan passport*
v. *Get fingerprints*
vi. *Enter passenger details*
vii. *Get photo*
viii. *Save details*
ix. *Stamp in passport*

Most respondents were able to write the steps in doing a particular task, therefore, this showed that the users understood the system.

Table 4.6 : Attendance of training

Formal Training attended	Frequency	Percentage
Yes	14	30%
No	32	70%

The results in Table 4.6 show that 70% of the respondents did not attend formal training on IBCS while 30% did attend. This further indicates that on-job training might be considered necessary and that users could easily follow the steps on how to use the system as shown above. However, it can be recommended that trainings be made available to users before using the system and troubleshooting scenarios need to be included in the manual and explained during the training sessions. On the job training is also essential as using the system in live scenario might provide useful information to the trainers and those maintaining the system. The training among others should be in the following areas; Basic trouble shooting principles, minor hardware repairs, training in IBCS usage, quality control for border systems and security issues in border systems.

4.3.3 System quality

Quality can be simply defined as the degree of excellence of something. For an IS it could imply that the system is fit for its intended use or purpose. The quality of a system is based on how easy the system is to use and achieve the desired results. According to Petter *et al*. (2008), the quality of a system is linked to system use and user satisfaction. In this study (as indicated above), 75% of the users indicated that they use the IBCS often with 23% using the system all the time (overall 90% `high` use rate). Although this is a mandatory system such that the evaluation of the use is tricky, even in mandatory systems, if the system quality is poor, the users are discouraged (Thong *et al*., 1993). In this study, users agreed that the system was easy to use, easy to learn, useful in their job and generally the functionalities of the system were good. In other words, the users were satisfied with the quality of the system. It can, therefore, be concluded that system quality of IBCS is generally good.

4.3.4 General features of the system

Table 4.7 summarizes how users rated the general features or functionalities of the system which are a contribution to system quality. Table 4.7 indicates that the majority of the respondents agreed that they had no problems logging into the system, they were able to capture passenger details easily, they could validate documents within the expected time, they could easily create reports, that the user interface was well organized and buttons for various modules were easy to find.

However, close to 40% of the respondents found the interface disorganised. This finding points to the fact that there is need to review the interface layout and structure in view of user feedback. A timely and accurate use of the system is crucial in this case. Similarly, 30% of the users reported that they experience difficulties in capturing passenger details. This could be linked to the issue of the downtime of the system; it could also be contributed by the organisation of the interface or due to issues regarding the hardware, e.g., malfunction or delays resulting from the biometrics scanning devices.

Table 4.7: Responses to the general features of the system

Functionality of IBCS							
	Participants Agreement (in Percentage)						
User capability with:	**Stron-gly Agree**	**Agree**	**Not Sure**	**Disa-gree**	**Strongly Disagree**	**Strongly Agree +Agree**	**Strongly Disagree + Disagree %**
Logging in the System	40.9	40.9		9.1	9.1	81.8	18.2
Capture Passenger Details	34.8	34.8		13	17.4	69.6	30.4
Validating Travel Documents	21.7	39.1		4.3	34.8	60.8	39.1
Creating reports	52.4	23.8		4.8	9.5	76.2	14.3
Get All Necessary Reports	36.8	36.8		21.1	5.3	73.6	26.4
Reliable Results when Searching	39.1	43.5		13	4.3	82.6	17.3
Interface is Well Organized	21.7	39.1		26.1	13	60.8	39.1
Buttons are easy to find	45.5	27.3		18.2	9.1	72.8	27.3
System is always up	4.5	27.3	13.6	36.4	18.2	31.8	68.2

The features in Table 4.6 are system quality measures and they affect user satisfaction as well as system success in general. Despite other users being dissatisfied with some general features, overall the functionalities of the system were satisfactory.

One other general system feature of the IBCS that was evaluated was system availability. In this attribute the respondents (68.2%) disagreed to the system being always up and running. A follow up interview with ICT officers indicated that the down times were mainly associated with network problems from the service providers and not the actual system itself. This could be associated with poor ICT infrastructure in Malawi.

The above attributes are associated with the functionalities of the system, therefore, it can be concluded that the users agreed to the system having good functionalities to assist them undertake their day to day activities.

4.4 Usefulness of the IBCS to one's job

Figure 4.3 below shows the respondents' level of agreement on usefulness of IBCS. The question required respondents to agree or disagree with whether the IBCS was useful to their job. All the respondents (100%) agreed to this item since 70% of the respondents strongly agreed and 30% agreed. At least 57% of respondents strongly agreed and 30% agreed that the IBCS enabled them to accomplish tasks faster than they would do with the manual system. On the same 13% of the respondents disagreed with this statement. On whether the system does everything they would expect it to do, a majority of respondents were either not sure or totally disagreed with the statement. A follow-up that was made to this question indicated that respondents expected the system to have other functions such as an automatic pop up feature that would alert them to individuals on Prohibited Immigrants (PI) list and stop list.

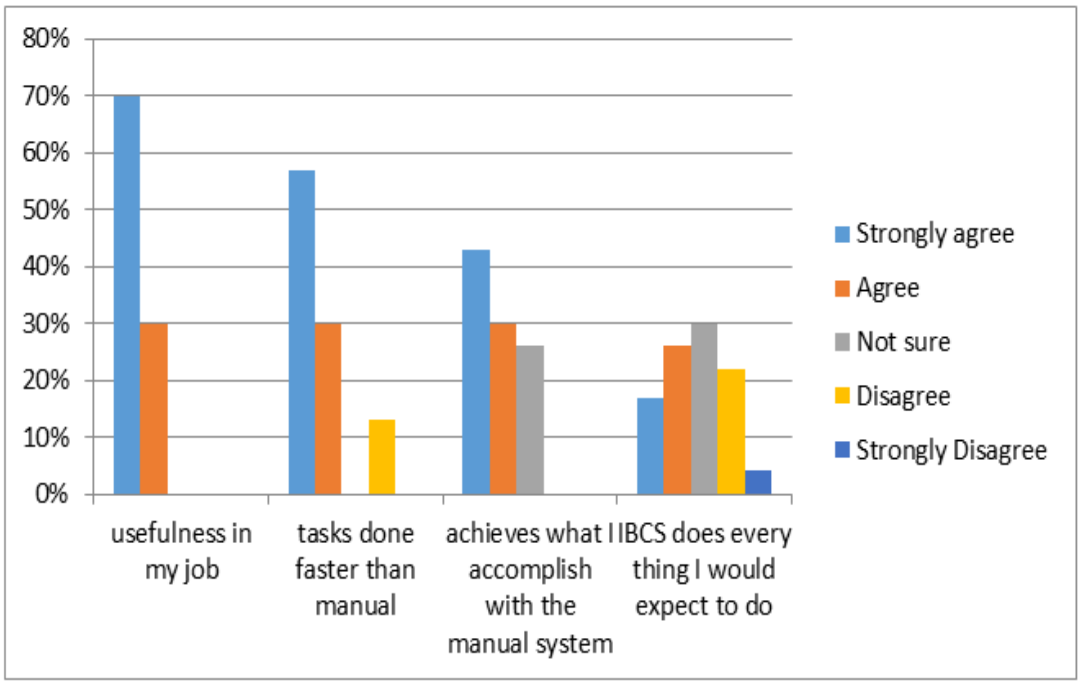


Figure 4.3: Usefulness to one's job

4.5 Ease of Use

Ease of use and ease of learning can be explained as the degree that learning and using the system will be perceived as effortless by the user. This is an important part of system quality since effort can be seen as a limited resource that all people can choose to allocate in what way they like. Hence, IS that are perceived as effortless by users are more likely to be accepted by users (Davis 1989; Rivard *et al.* 1997). Furthermore, ease of use also enhances efficiency of users´ IS use (Doll and Torkzadeh, 1988). Figure 4.4 below indicates that 44% and 39% agreed that the system is easy to use, 8 percent disagreed while 9% were not sure of the systems' ease of use. The study concludes, therefore, that the system is easy to use because a majority of respondents agreed to this.

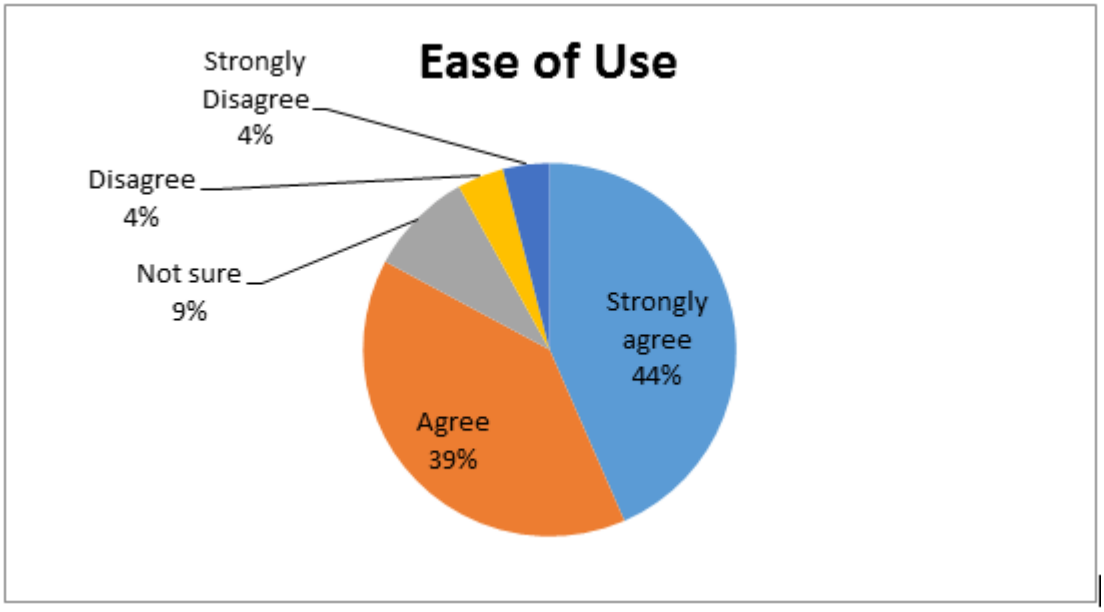


Figure 4.4: Ease of use

On the same construct of ease of use, the study also sought users' opinion on whether they could use IBCS without written instructions, if the modules were arranged in accordance to flow of tasks, if users did not find problems looking for buttons to accomplish a task, if the font size (size of text) was good, if users could correct mistakes easily and if they could successfully complete tasks every time. The responses are presented in Table 4.8.

Table 4.8 show that the respondents were in agreement with almost all of the attributes that measured ease of use except for item on "I can correct mistakes quickly and easily", which indicates that 26% of respondents were not sure and 34% disagreed with the statement. It can be concluded that the system did not provide a way to correct mistakes. In order to get clarification on the same attribute from the ICT officers, it was discovered that once a passenger has been saved in the database, the user could not reverse a transaction for security reasons. It has to be noted that an important indication of system success is system usage (Mardiana *et al.*, 2015). A system that is not used by the users is considered having an interaction failure.

Table 4.8: Attributes on ease of use

QUESTION	Strongly agree	Agree	Not sure	Disagree	Strongly Disagree
IBCS is easy to use	43%	39%	9%	4%	4%
Use without written Instructions	22%	43%	22%	9%	4%
Modules are arranged according to flow of tasks	26%	43%	22%	9%	
Do not find problems looking for buttons	35%	48%	13%	4%	0%
Font size is good	48%	43%	9%	0%	0%
Can correct mistakes easily	9%	30%	26%	30%	4%
Complete tasks successfully every time	13%	52%	0%	26%	9%

4.6 Ease of learning

The respondents were asked on whether they have attended any training relating to IBCS. In response to this question, 70% did not attend any formal training while 30% had some formal training. The formal training took only 2 days and it was done by the providers of the system. The rest did on-the-job training offered by ICT officers.

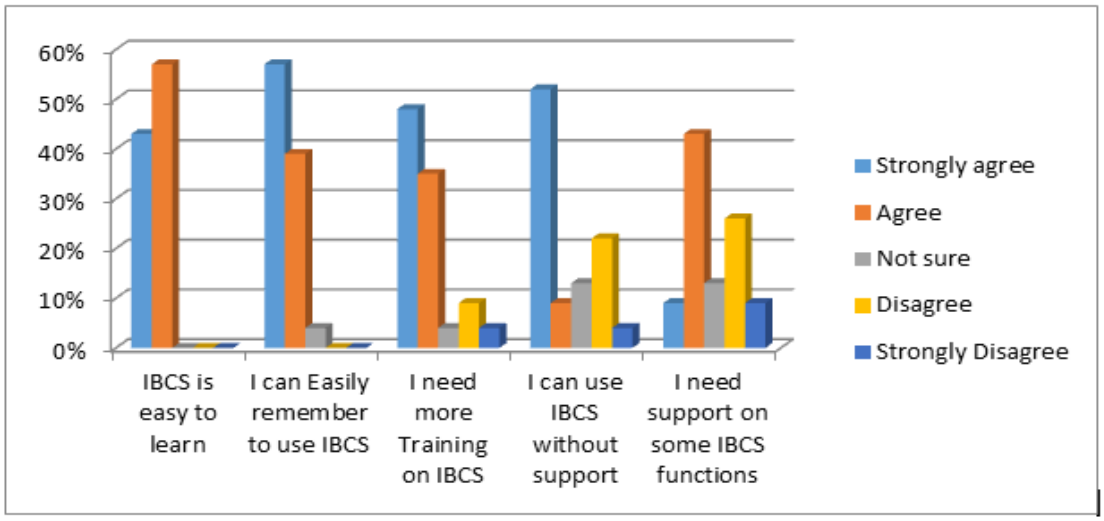


Figure 4.5: Ease of learning

On whether the system was easy to learn, 100% of respondents agreed. According to the graphical presentation in Figure 4.5, 83% (48% strongly agree + 35% agree) of the respondents agreed that they needed more training on how to use the IBCS. On the need for support on some IBCS functions a majority (52%) of respondents agreed that they needed more support on how to use some of the functions of the system.

4.7 Information quality

The type of information that the system produces is considered to be of paramount importance to the organization. Table 4.9 displays respondents' opinions towards the chosen attributes of information quality as far as the IBCS is concerned.

Table 4.9: Responses on attribute on information quality

Question on Information Quality	Mean	Median	STD Deviation
IBCS detects over-stayed immigrants	4.30	5	0.97
Prohibited Immigrants are easily detected	4.17	4	0.94
IBCS provides accurate information	3.87	4	1.01
IBCS provides reliable information	4.04	4	0.88
IBCS provides complete information	3.74	4	1.01
The report format is as expected	3.74	4	1.01
IBCS provides up to date information	3.83	4	0.89
Reports produced are useful for decision making	4.17	4	0.65
Reports produced are useful for problem identification	3.78	4	0.95
Reports can be easily compared to past information	3.91	4	0.90

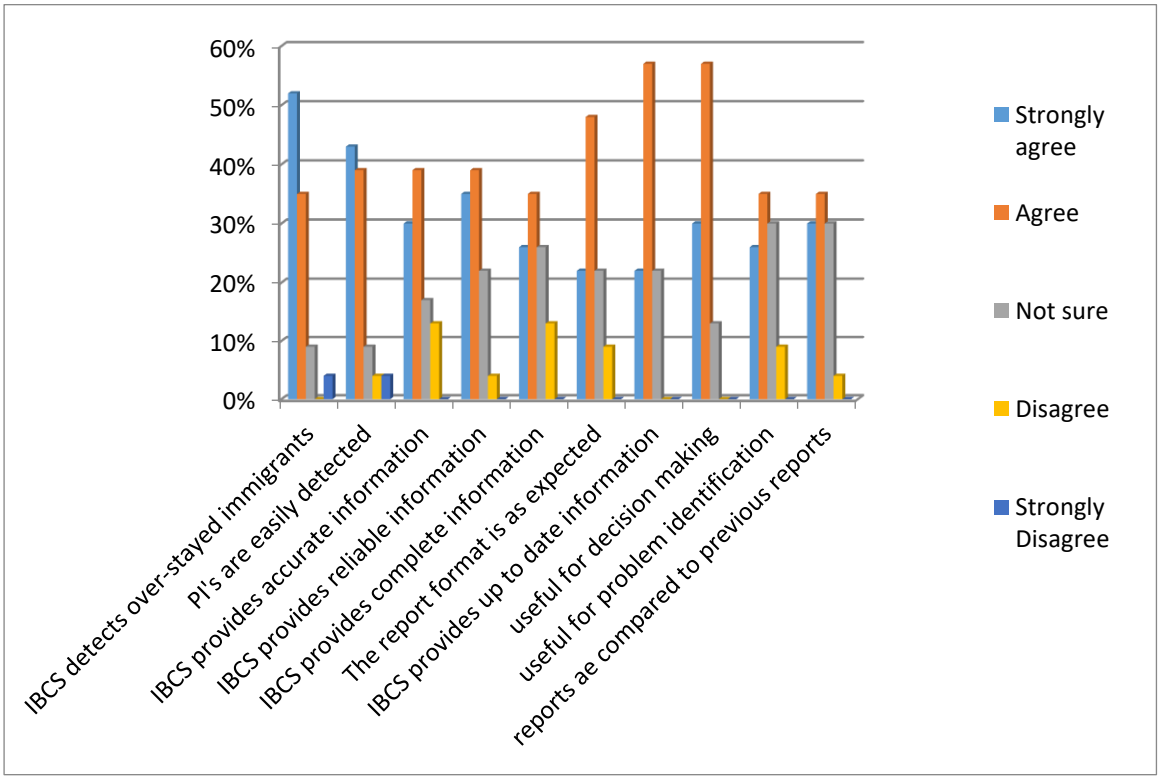


Figure 4.6: Information quality

As shown in Figure 4.6, the results show that respondents agreed to a great extent that the IBCS was able to detect overstayed immigrants (mean = 4.3) and prohibited immigrants (mean = 4.17). They also agreed that the system provided accurate (30% +39%), reliable (35%+39%), complete (26% +35%) and up to date information (22%+57%). It is also evident from the findings that the respondents were happy with the report format (22% +48%). However, 30% of respondents were not sure whether the reports provided by the system were useful for problem identification.

A follow up interview on why users were not sure whether the system was useful for problem identification found that most users were just mere operators meaning that they were not mainly concerned with the reports. Some of the responses were as follows:

"*My duty is just to capture travellers, the issues of reports are mainly handled by the research and Planning unit at Head Office*"

"*Our bosses are better placed to handle a question on whether the system helps in problem identification*"

A further follow up interview on whether the system helps in problem identification and importance of the IBCs system reports found that the system and its outputs are helping the organisation in several areas. However, the respondents were not comfortable to say specifically how, due to security reasons. One of the respondents said "A*s first line of defence, a lot happens at the border and the introduction of the system has eased the way we handle issues. You just ask for a report and everything is there and more importantly no one can undo an 'entry' or 'exit' in the system. There is a lot but not for public consumption."*

4.8 IBCS impact on an individual and the organization

To measure the impact of the IBCS on an individual the users were asked to agree whether or not using the system helps them improve their work and to rate if the system was an important tool in their daily work. In response, the respondents agreed to a great extent as shown in Table 4.10.

Table 4.10: Impact on an individual

QUESTION	Strongly agree	Agree	Not sure	Disagree	Strongly Disagree
The quality of work is improved by using the system	43%	57%	0%	0%	0%
IBCS is an important tool in my work	57%	43%	0%	0%	0%

The study also investigated the impact of the system on the organization. On this item, users were asked to rate if the system helped in providing timely customer service, whether or not the system helped management in making decisions on border issues, achievement of strategic goals, timely problem solving and whether or not the system provided a platform for information sharing between borders on travellers and illegal immigrants. The results are shown in Figure 4.7.

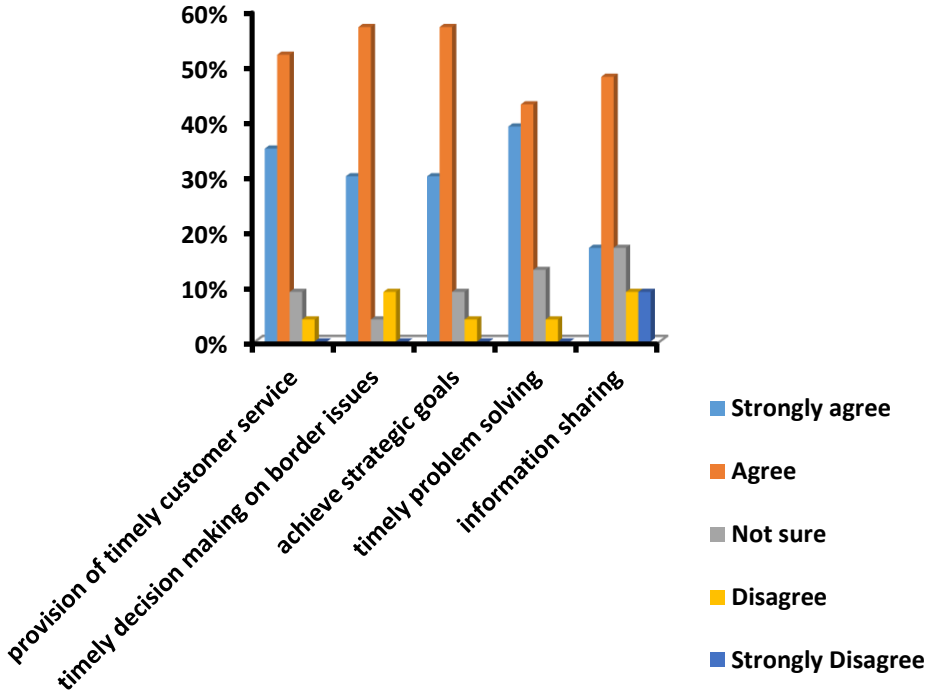


Figure 4.7: Impact on an organisation

The results in Figure 4.7 show that the users agreed to a great extent that the system was providing timely customer service, helped in timely decision making on border issues, helps the department to achieve strategic goals and timely problem solving. However, despite the system being able to aid information sharing, a high percentage of people (40%) disagreed with the fact that the system supports information sharing. This was the case because the respondents felt that since the system has not been implemented in all the busy border posts then it was a challenge since a person who has entered through one of the airports could exit through one of the land borders posts, which have no information system, thereby leaving a gap in the system.

4.9 Effectiveness of IBCS

According to the observations done at various times of clearing both arriving and departing passengers, clearing time differed from one officer to the other depending on user's experience with the system. Table 4.11 and Table 4.12 indicates the average processing time for different categories.

Table 4.11: Arrivals

	Malawian(regular traveller)	Malawian (first time travellers)	Returning Residents (Regular Travellers)	First time visitors (with Visa requirement)	Regular visitors (Without Visa)
Minimum	30 seconds	60 seconds	60 seconds	2min 20sec	1min35 seconds
Maximum	40seconds	70 seconds	80 seconds	3minutes	2min

Table 4.12: Departures

	Malawian(regular travellers)	Malawian (first time travellers)	Returning Residents (Regular Travellers)	First time visitors (with Visa requirement)	Regular visitors (Without Visa)
Minimum	30 seconds	60 seconds	60 seconds	2min 20sec	50 seconds
Maximum	45seconds	90 seconds	90 seconds	3minutes	60 seconds

Interviews done through snowball sampling with officers that have ever worked at the two international airports and have now been transferred to land border posts where there is no information system to enable them clear the passengers indicated that on average it took not less than 1 minute to clear travellers, which tarries with the actual situation on the ground. It was also found that it took more than three minutes to clear travellers who come from countries categorized under 'high risk countries'. In such cases, the immigration officer uses personal judgement to decide whether the traveller should be cleared or not and this poses a very high security risk.

The respondents also indicated that it was difficult to identify those travellers who were declared prohibited immigrants (PI) with the system being used at the land border posts. Reports also indicated that with the implementation of the IBCS, prohibited immigrants

were easily detected especially when they tried to return to the country through the two international airports. This is possible through the centralized database that keeps information of those declared PI. Efforts to have figures of PI identified through the land border posts proved futile as the Research and Planning Officers alluded to poor record management as a major challenge.

4.10 Analysis of responses relating to user feedback

On the issue of user feedback, the users were asked the following question, `*What do you think is lacking in the system that is more important in accomplishing daily activities*`.

A majority of the respondents did not give their opinion on this question. However, from the few that responded, they suggested that the system should have a pop-up feature that would notify the users of illegal and overstayed immigrants. The system should also automatically detect an applicant who has changed their passport number using fingerprints so that the database does not have duplicate entries of the same person.

4.11 Strengths and benefits of the system

The users were asked what they thought were the strengths and benefits of the IBCS. Regarding the strengths of the system, a majority of the respondents spoke about improved record keeping and improved customer service which is related to information quality of the D&M Model. The following statements from respondents are examples that illustrate this point:

i. "Records are permanent"
ii. "Safer storage of records"
iii. "Job made easy than manual"
iv. "Duplicate entries are recognized"
v. "Detects overstayed persons and individuals on stop/check lists"
vi. "Improved customer service"

4.12 Challenges of the IBCS

On the challenges, the respondents outlined a number of challenges which can be grouped into four categories**. The first category is connectivity or network problems.** The study found that there were frequent downtimes as far as network was concerned.

This has an impact on system quality. However, if service quality was considered as a measure to be evaluated in this research then more information would have been sought. This, therefore, calls for a further study into the service quality aspect of the IS department. **The second category is Hardware failure**. **The third category is System response time**. The system was rated to be very slow especially when capturing an individual for the first time. **The fourth category is lack of extension to other busy borders.** The system has not been extended to land border posts**.** There was need to extend the system to other borders unlike having it at the airports and headquarters.

Below are some of the responses as captured by respondents:-

"*Failing to save"*
"German and American passports are difficult to detect"
"Gadgets need replacement"
"Speed"
"System is very slow"
"Takes time to load fingerprints for new travellers"
"Connectivity problem"
"Server problem"

Despite the system being successful in several areas, challenges also exist and it takes management responsible for this to consider coming up with resolutions to eradicate them. The issue of network connectivity can be considered as a general problem in Malawi as observed by Bichler (2014) who found that connectivity issue is an enormous barrier for the diffusion of ICTs in Malawi. However, the Government of Malawi is putting in place measures to ensure that connectivity keeps on improving (Foster and Shkaratan, 2010).

On hardware failure and extending the system to other border posts, the immigration management needs to commit some resources to ensure that equipment is replaced frequently and whenever they have broken down.

The study has observed that IBCS is a system that can be relied upon as far as clearing of passengers is concerned. Therefore, the Department of Immigration through Government must lobby for resources to ensure that the system is extended to all borders.

System response time has a greater impact on user satisfaction. Very slow systems often demotivate the users especially in information systems where customers and, in this case, travellers are concerned. It is important that immigration management should consider upgrading the system to ensure that processing time for travelers is minimal.

4.13 The relationship between dimensions of IS success

The D & M model posits that there are relationships among some of the variables in the IS success model. However, the strength or direction of the relationship may differ (Petter *et al*., 2008; Mardiana *et al*., 2015). In order to define the relationships between variables in this study, a correlation analysis was run in SPSS. According to Mukaka (2012) correlation refers to the method of assessing a possible two-way linear association between continuous variables. In this case correlation coefficient of -1 indicates a perfect negative linear relationship between variables such that, as one variable increases in its value, the other variable decreases in its values. There is a general guideline on correlation coefficient which says: Correlation coefficient values between 0 and 0.3 (0 and -0.3) indicate a weak positive (negative) linear relationship between variables. While correlation coefficient values of between 0.3 and 0.7 (-0.3 and -0.7) indicate a moderate positive (negative) linear relationship and finally, correlation coefficient values between 0.7 and 1.0 (-0.7 and -1.0) indicate a strong positive (negative) linear relationship between variables (Ratner, 2011).

In this work, the study used Pearson correlation analysis to identify the relationships that existed within the constructs. As shown in Table 4.13, the researcher tested correlations between information quality, system quality, use, user satisfaction, individual impact and organisational impact. The results show that there was a positive correlation between system quality, information quality, use, individual impact and organizational impact. According to Gorla *et al*. (2010), system quality represents the quality of information processing itself which is characterized by employment of state-of-the-art technology and a system that offers key functions and features (denoted as IS excellence), and software that is user friendly, easy to learn, and easily maintainable (denoted as IS value). A system that provides quality information encourages the users to use it translating into high individual user impact. If the individual impact is higher, then the organizational quality will be higher. However, it has to be noted that the links among the factors (information quality, individual impact and organizational quality)

is not always clearly established because of co-founding factors, for instance, individual impact may be affected by a user's attitude towards the system such that even if the information quality is good but if the user's attitude is negative, then the individual impact may still be low.

Table 4.13: Correlation among variables in the IS success

	Use	User Satisfaction	Individual impact	Organisational Impact
Information Quality	.401**	.426**		.549**
System Quality	.449**	.697**		.533**
User satisfaction			.527**	.157
Use			.308*	.567**

From Table 4.13, it can be seen that there is a positive association between information quality and use at .401; information quality and user satisfaction at .426 and information quality and organisational impact at .549. Similarly, the findings indicate a positive correlation between system quality and use (.449); system quality and user satisfaction (.697) as well as system quality and organisational impact (.533). Furthermore, a strong positive correlation was found between use and individual impact (.308), use and organisational impact (.567) and user satisfaction with individual impact (.527). However, the relationship between user satisfaction and organisational impact was found to be very weak.

From these findings, it can be concluded that the system quality and information quality of the IBCS affect use and user satisfaction which is in line with McLean (1992), Seddon (1997), Rai *et al*. (2002), and DeLone & McLean (2003) who arrived at similar conclusions. Furthermore, system quality and information quality had a positive impact to system use.

The findings generally show that there was positive association between system quality, individual impact, information quality and organizational impact with user satisfaction. This means that overall the users were satisfied with the system which points to the fact that the system is generally effective (since as outlined in the introduction section, user

satisfaction points to the fact that a system is effective) in the carrying out of tasks at the airports.

4.14 Main findings and discussion of the findings

The main findings of this research are as follows: The system quality of the IBCS, according to user perception, was very good. However, the system needs a critical analysis and proper adjustment to further enhance users experience and satisfaction. Secondly, the information quality of the IBCS, according to user responses, was also good with most respondents positively affirming that most of their information needs were adequately taken care of. Further, the users articulated a few challenges that management needed to seriously address to ensure that the system is sustainable and gives a true picture of migration data countrywide. In agreement with the literature, system quality and information quality affect use and user satisfaction which eventually have a direct impact on an individual and the organization. Finally, the system is generally effective in clearing of travellers at Malawi's airports.

The study observed that the users were able to use the system despite the system not always being up and running. However, it was observed that the IBCS brought an overall positive impact as far as clearing of passengers is concerned which was also the main objective of setting up the system. Furthermore, the users found the IBCS to be useful although it could not alert them with a pop-up for overstayed and illegal immigrants. Smart (2009) states that system quality is a predictor of success, therefore, considering the positive responses from the IBCS users on the various attributes that were measured, the IBCS is successful as far as quality of the system is concerned.

It was also observed that IBCS improves the work of individuals and also has a general positive impact on the organization i.e. Department of Immigration. As such the IBCS cannot be underestimated as it provides timely customer services and timely decision making among others. Additionally, there are a number of opportunities that can be explored using the system as discussed and recommended earlier in the document. This observation concurs with Delone & McLean (2016) who denote that "information quality" must be an important measure of information system success. Similarly, information quality contributes to user satisfaction and is strongly associated with system use and net benefits.

As indicated above, the D&M IS success model points to six attributes of information systems which are all interrelated (Delone and Mclean, 2003). For example, system quality and information quality would encourage or discourage users of the system, hence will determine whether the users will be satisfied with the system or not. The use and user satisfaction of the system have a positive or negative impact on the individual or organization. Although it is difficult to have a system that will comply to the letter with all the attributes of the Delone and Mclean IS success model (as further discussed through the studies that have used the model below), it is important that a system should be very close to complying with the six attributes of IS success. Generally, based on the attributes of the D& M IS success model, the IBCS can be deemed as a reliable system because it complies with most of the attributes of the model.

Since the Delone and Mclean IS success model has been used in various sectors i.e. private sector (Roky and Al Meriouh, 2015; Zaied, 2012; Khan, 2010), and several government departments (Baraka *et al*., 2013), it points to the fact that this model is applicable to various sectors. Also as seen from the reviewed literature on the use of the Delone and Mclean IS success model, the links between the six attributes of IS success depends on an individual system. However, what is coming out clearly is that the quality of a system has a direct link to how it will be frequently used or not which has an overall impact on an individual and also the organization. This was also noted in the IBCS.

4.15 Lessons learnt from the IBCS that can be useful to information systems in developing countries

A border control system such as the IBCS (which is the case with many other information systems) is a system of crucial importance to a country (Skok *et al*., 2001, Adeoti-Adekeye, 1997, Porter and Millar, 1985). Like other developing countries, Malawi has experienced a fast growth in ICT systems introduced against a background of low ICT skills (Chaputula, 2012, Johnson, 2011, Piatkowski and van Ark, 2005, Awang, 2004). This can create a scenario where systems are introduced at a faster pace than the growth of the ICT skills of its users. However, with increase in use and on-the-job training, if basic equipment is available and staff are taught the minimum level of understanding of a system, then the system becomes useful in their day to day affairs.

In many developed countries, information systems of such complexity and importance as a border control system has, have been introduced gradually over several years and in pace with other advances in technology across society. Hence the period of adjustment of users to systems such as the IBCS has followed a slightly different pattern of adoption and effectiveness. As such, there is a need to test the know theory of system effectiveness and adoption. Moreover, the user base of systems like the IBCS are large government bodies such as the police and the immigration personnel, and these form closed organisations with limited access to outsiders. Our study contributes to the literature by researching this unique context in which we document the perception, use, practices and feedback regarding technology by a select type of user, namely the uniformed users, the police/immigration officers.

It is also important for a system that is linked to the security of a country to have individuals performing different tasks as is the case with the IBCS. The more sensitive tasks should be left to senior officers as is the case with the IBCS. Likewise, all log in details should be kept within the system so that if something wrong happens, it should be possible to trace the individual who did a particular task. These issues are applicable to almost all border control systems (and not only to those in developing countries).

In summary, this study documents user satisfaction (as a measure of effectiveness of the IBCS) and thus contributes to similar studies reported by a number of authors including Thong and Yap (1996), Thong *et al*. (1993), Melone (1990) and Hamilton and Chervany (1981).

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

An assessment of the success of the Malawi Department of Immigration Integrated Border Control System (IBCS) was conducted in this study. The success of the IBCS was measured based on the attributes of the D&M Model. The D&M model postulates that when measuring IS success, there is a need to systematically combine measures from six IS success categories which are: use, user satisfaction, information quality, system quality, individual impact and organizational impact.

The system is used very often and is also easy to use as indicated by 75% and 83% of the respondents, respectively. This was confirmed by the fact that the users were able to write down the steps on how to use the system. The findings of this study show that the extent and purpose of the use of the system depends on the job rank whereby highly ranked Immigration Officers' main job in the IBCS is supervisory in nature apart from deporting passengers, checking reports and issuing detention warrants. Overall, the system is deemed to be very useful though there were concerns to do with mistakes made whilst using the system which cannot be easily rectified as indicated by 60% of the respondents. This, however, was taken as a security feature as it is not good to have users easily changing the contents of the system.

The users were also satisfied with the system in that it could easily capture passenger details, validate documents and create reports among others. However, like any other system, it has some shortfalls, for example, it was not always up and running which compromises on data capturing in the system.

The IBCS is also a system that provides high quality information based on the quality of the system itself. It is able to detect overstayed and prohibited immigrants. The report format of the system is also important in making the information easily read and understood by the senior officers. The system was deemed to provide accurate, reliable, complete and up to date information. This is despite the fact that the users pointed the

fact that the system has no pop-up feature to alert them on illegal and overstayed immigrants.

The system has impacted positively on individual users and also the organization (Immigration Department). This is because the users point to the fact that their individual work has improved in terms of quality, making the system an important tool to the users' work. The Immigration Department has also been helped by the system in that it provides timely customer service, helps management in decision making and achievement of goals among others. There are also a lot of benefits that have been realized which include safe record keeping and detection of illegal immigrants.

However, like any other system, it also has some shortfalls which include connectivity or network problems, hardware failure, slow response time and lack of extension to other borders. Overall, the IBCS despite some challenges is one of the systems which can be deemed to be a success story based on the Delone and McLean model.

The following are the recommendations of the study:
There is a need for continuous management support to the IBCS system.

i. Management support includes, but is not limited to, provision of funds for the purchasing of hardware and software upgrades to the system.
ii. The IBCS users need to be properly trained in the use of the system. The training can be both local and international so that they have enough exposure and also knowledge on the use of the system. Additionally, trainings should be made available to users before using the system, and troubleshooting scenarios need to be included in the manual and explained during the training sessions. On-the-job training is also essential as using the system in live scenario might provide useful information to the trainers and those maintaining the system.
iii. The system needs to be upgraded so that it has a pop-up feature which can easily alert the users on illegal immigrants, overstayed individuals and criminals on the Interpol list.
iv. The software engineers need to further look at the interface of the system especially on capturing passenger details considering that this is a key functionality of the system. Additionally, issues of interface organisation and or associated hardware need to be looked at periodically and tests need to be done under realistic conditions.

v. The government should consider implementing the system in all the border posts so that information on migration is accurate.
vi. Management should ensure that the infrastructure (hardware and software) is up to date to ensure that the system is always live.

However, the areas requiring further study are:

i. A study should be conducted to assess passenger satisfaction on the use of the IBCS which was not done in this study due to time and financial constraints.
ii. Another study should be done so as to compare the IBCS and other similar systems in the region.
iii. A further study into the issue of interface organisation and user interaction with the system is needed.

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APPENDIX

Appendix 1

Questionnaire

Assessing the effectiveness, reliability and success of the Integrated Border Control System (IBCS) in Malawi

Hello,

I am a Masters student from University of Malawi, Chancellor College, currently doing an assessment on the effectiveness, reliability and success of the Integrated Border Control System.

My desire is to collect as much data as possible so as to have valid results. Please spend some few minutes to complete this questionnaire, which will be very much appreciated.

Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can leave the question blank

Responses from this study will be handled with confidentiality and used for educational purposes only. All information will be coded and will remain confidential. Feel free to contact the following numbers 0888386488; 0992603971 or e-mails (akaonga07@gmail.com, kabaghetionge@yahoo.com) in case of doubts.

Thank you very much for your time and support.

A. Personal information

1. What is your gender ?

   Male| Female

2. What is your age

   | 18 – 29 | 30 – 39 | 40 – 49 | 50 – 59 |

3. How long have you used the IBCS?

……

…..

4. How frequently do you use the IBCS

   Daily| once a week| more than once a week| not so often

5. Did you attend a formal training on IBCS? If not how did you get to know how to operate the system.

   ……

   ……

   ……

B.

1. To determine how accessible and understandable the system is to the users.
    a. Describe your interaction with IBCS in terms of organization and how you understand the system.

    ……

    ……

    ……

    ……..

    b. What is your overall impression of the IBCS software

    ……

    ……

    ……

    ……

2. To determine how good IBCS is in terms of its characteristics.

    Please rate the systems characteristics on a scale of 1 to 5

    I. usefulness of IBCS

    (Where 5= Strongly Agree, 4= Agree, 3 = Not Sure, 2= Disagree, 1 – Strongly Disagree)

		5	4	3	2	1
1	IBCS helps me to be more effective					
2	IBCS helps me to be more productive					
3	IBCS is useful					
4	IBCS makes things I want to accomplish easier to get done					
5	IBCS saves me time when I use it					
6	IBCS meets my needs					
7	IBCS does everything I would expect it to do					

ii. Ease of use

(Where 5= Strongly Agree, 4= Agree, 3 = Not Sure, 2= Disagree, 1 – Strongly Disagree)

		5	4	3	2	1
1	IBCS is easy to use					
2	IBCS is simple to use					
3	IBCS is user friendly					
4	IBCS requires the fewest steps possible to accomplish what I want to do with it					
5	Using IBCS is effortless					
6	I can use IBCS without written instruction					
7	I do not notice inconsistencies when using IBCS					
8	Both occasional and regular users would like it					
9	I can recover from mistakes quickly and easily					
10	I can use IBCS successfully every time					

iii. Ease of Learning

(Where 5= Strongly Agree, 4= Agree, 3 = Not Sure, 2= Disagree, 1 – Strongly Disagree)

		5	4	3	2	1
1	I learnt to use IBCS so quickly					
2	I easily remember how to use it					
3	It is easy to learn to use it					
4	I quickly become skilful to use it					

iv. Satisfaction

(Where 5= Strongly Agree, 4= Agree, 3 = Not Sure, 2= Disagree, 1 – Strongly Disagree)

		5	4	3	2	1
1	I am satisfied with it					
2	I would recommend it to a friend					
3	It is fun to use					
4	It works the way I want it to work					
5	It is wonderful					
6	I feel I need to have it					
7	It is pleasant to use					

3. List the most negative aspects
   a) ……
   ……
   ……
   b) ……
   ……
   ……
   c) ……
   ……
   ……
4. List the most positive aspects
   a) ……
   ……
   ……

b) ……
……
……

c) ……
……
……

5. To determine if the system provides all the necessary functions for daily operations and how users utilize the systems capabilities.
    a. Does IBCS provide all the necessary features to help you in your day to day activities?

Agree	Not sure	Disagree

    b. What do you think can be included in the features to help you achieve your activities

……
……
……
……

    c. In terms of reports, does the system provide the reports as required
……
……..

6. To identify opportunities and challenges associated with the system and gather user feedback as regards the system at all levels.
    a. What do you think are the strengths/benefits of using IBCS
……
……
……
……

    b. What are the main challenges that are encountered when using the system

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

…………………

End of questions

Appendix 2

Interview guide for Repatriation Officers

1. How is IBCS important in your day to day activities
2. What type of information do you feed in the system
3. How easy is it to feed IBCS with relevant information
4. Does the system perform according to your expectations
5. What can be improved for better performance

Appendix 3

Reference Letter

PRINCIPAL
Richard Tambulasi, B.A (Pub Admin), BPA (Hons), MPA, Ph.D

CHANCELLOR COLLEGE
P.O. Box 280, Zomba, Malawi
Telephone: (265) 524 222
Fax: (265) 524 046
E-mail: principal@cc.ac.mw

10 March 2017

The Director General
Department of Immigration and Citizenship Services
P.O. Box 331
Blantyre

Dear Sir/Madam,

REFERENCE FOR MRSANNIE T. KAONGA(MSC/INF/08/11)

As per the subject matter, this reference letter is provided at the written request of Mrs. Annie Kaonga registration number MSC/INF/08/11 who is a student at Chancellor College pursuing an Master of Science degree in Informatics under the Computer Science Department. She has completed course work for her first year of study and is currently working on her thesis project. She is researching on "*Assessing the Effectiveness, Reliability and Success of the Malawi Integrated Border Control System (IBCS*".

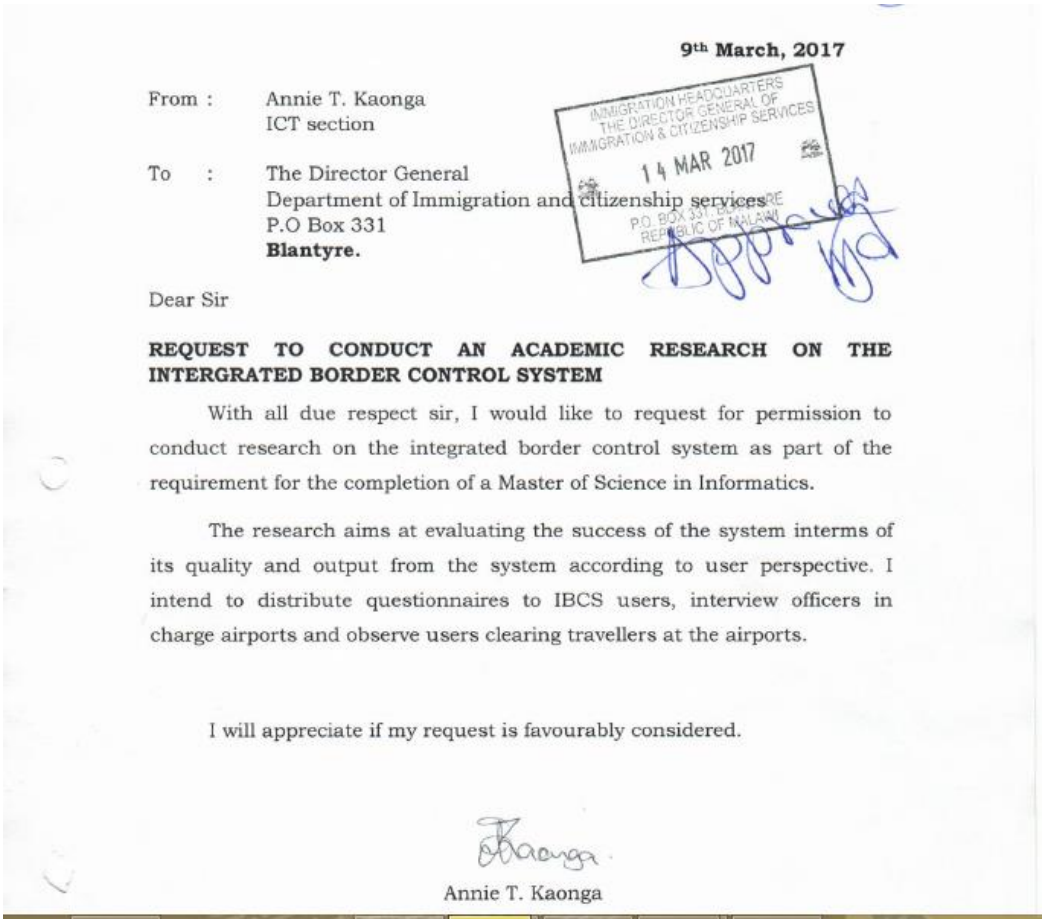
Any assistance rendered to her for the same would be greatly appreciated.

Yours faithfully,

Kondwani Godwin Munthali (PhD)
Programme Coordinator, MSc Informatics
Kmunthali@cc.ac.mw- 0999387701 / 0884 112 001

Appendix 4

Approval Letter to conduct Research



9th March, 2017

From : Annie T. Kaonga
ICT section

To : The Director General
Department of Immigration and citizenship services
P.O Box 331
Blantyre.

IMMIGRATION HEADQUARTERS
THE DIRECTOR GENERAL OF
IMMIGRATION & CITIZENSHIP SERVICES
14 MAR 2017
P.O. BOX 331, BLANTYRE
REPUBLIC OF MALAWI

Dear Sir

REQUEST TO CONDUCT AN ACADEMIC RESEARCH ON THE INTERGRATED BORDER CONTROL SYSTEM

With all due respect sir, I would like to request for permission to conduct research on the integrated border control system as part of the requirement for the completion of a Master of Science in Informatics.

The research aims at evaluating the success of the system interms of its quality and output from the system according to user perspective. I intend to distribute questionnaires to IBCS users, interview officers in charge airports and observe users clearing travellers at the airports.

I will appreciate if my request is favourably considered.

Kaonga

Annie T. Kaonga

Appendix 5: Correlation Tables

Correlations

		inforQuality	systemquality	oganisational Impact	satisfaction	Individual Impact
inforQuality	Pearson Correlation	1	.785**	.549**	.426**	.711**
	Sig. (2-tailed)		.000	.000	.003	.000
	N	46	46	46	46	46
systemquality	Pearson Correlation	.785**	1	.535**	.697**	.775**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	46	46	46	46	46
oganisationalImpact	Pearson Correlation	.549**	.535**	1	.157	.521**
	Sig. (2-tailed)	.000	.000		.299	.000
	N	46	46	46	46	46
satisfaction	Pearson Correlation	.426**	.697**	.157	1	.527**
	Sig. (2-tailed)	.003	.000	.299		.000
	N	46	46	46	46	46
IndividualImpact	Pearson Correlation	.711**	.775**	.521**	.527**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	46	46	46	46	46

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		Use	inforQuality	systemquality	Individual Impact	oganisational Impact
Use	Pearson Correlation	1	.401**	.449**	.308*	.567**
	Sig. (2-tailed)		.007	.002	.042	.000
	N	44	44	44	44	44
inforQuality	Pearson Correlation	.401**	1	.785**	.711**	.549**
	Sig. (2-tailed)	.007		.000	.000	.000
	N	44	46	46	46	46
systemquality	Pearson Correlation	.449**	.785**	1	.775**	.535**
	Sig. (2-tailed)	.002	.000		.000	.000
	N	44	46	46	46	46
IndividualImpact	Pearson Correlation	.308*	.711**	.775**	1	.521**
	Sig. (2-tailed)	.042	.000	.000		.000
	N	44	46	46	46	46
oganisationalImpact	Pearson Correlation	.567**	.549**	.535**	.521**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	44	46	46	46	46

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		systemquality	inforQuality	User Satisfaction	Individual Impact	oganisational Impact
systemquality	Pearson Correlation	1	.785**	-.182	.775**	.535**
	Sig. (2-tailed)		.000	.225	.000	.000
	N	46	46	46	46	46
inforQuality	Pearson Correlation	.785**	1	-.050	.711**	.549**
	Sig. (2-tailed)	.000		.741	.000	.000
	N	46	46	46	46	46
UserSatisfaction	Pearson Correlation	-.182	-.050	1	-.039	-.201
	Sig. (2-tailed)	.225	.741		.799	.180
	N	46	46	46	46	46
IndividualImpact	Pearson Correlation	.775**	.711**	-.039	1	.521**
	Sig. (2-tailed)	.000	.000	.799		.000
	N	46	46	46	46	46
oganisationalImpact	Pearson Correlation	.535**	.549**	-.201	.521**	1
	Sig. (2-tailed)	.000	.000	.180	.000	
	N	46	46	46	46	46

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation between competence and amount of use

		competence	Use
competence	Pearson Correlation	1	-.030
	Sig. (2-tailed)		.847
	N	46	44
Use	Pearson Correlation	-.030	1
	Sig. (2-tailed)	.847	
	N	44	44