



**E-Government Systems Interoperability Challenges**  
**Case of public sector in Rwanda**

**Sylvere MUGUMYA**

College of Science and Technology

School of ICT

Master of Science in Information Systems

2019



# **E-Government Systems Interoperability Challenges**

## **Case of public sector in Rwanda**

By

**Sylvere MUGUMYA**

217292828

A dissertation submitted in partial fulfilment of the requirements for the degree of  
MASTER OF SCIENCE IN INFORMATION SYSTEM WITH  
SPECILALIZATION IN E-GOVERNMENT

In the College of Science and Technology

Supervisor: **Dr. Shang Gao**

Co-Supervisor: **Dr. RUTABAYIRO NGOGA Said**

Submitted October 2019

## **DECLARATION**

I declare that this Dissertation contains my own work except where specifically acknowledged.

Student Name: **Sylvere MUGUMYA**, RegNo: **217292828**

Signed.....

Date.....

## **ACKNOWLEDGEMENTS**

The completion of this thesis was achieved through a combination of different efforts from different people. In this regard, I take this opportunity to express my profound gratitude and deep regards to my supervisor Dr. Shang Gao and Dr. Said Rutabayiro Ngoga for their exemplary guidance, monitoring, critiques and constant encouragement throughout the course of this project.

I would also like to thank all lecturers of e-Government from Örebro University for their advice and assistance in keeping my progress on both knowledge and social behavior.

In addition, I would like to extend my thanks to all staff members of both University of Rwanda and Örebro University especially those from School of ICT and School of Informatics for their help in offering all the necessities to complete our graduate studies.

I am particularly grateful for the advice given by my classmates that has been a great help in carrying out this research project.

Finally, I wish to thank my wife Claudine UWHIRWE and all my relatives for their support and encouragement throughout my study.

## **ABSTRACT**

The study is intended to explore e-Government Systems interoperability challenges in public sector in Rwanda. Sample of eight government agencies were selected and their current systems interoperability was explored. Data were collected through the interview. The analysis and interpretation of data was done following Scholl and Klischewski findings which helped in classification of results(challenges). According to the outcomes, e-Government Systems interoperability in Rwanda still have different challenges to overcome and the top five identified are constitutional & legal, organizational, collaborative, managerial and technological. The challenges like informational, performance, cost and jurisdictional was not significantly rated. Lack of published standards and guidelines (interoperability framework) in acquiring and developing of e-Government Information Systems was among the identified challenges.

## **KEY WORDS**

Interoperability, e-Government, Rwanda, Systems interoperability, interoperability challenges

## LIST OF SYMBOLS AND ACRONYMS

<b>ADAE</b>	: Agence pour le Developement de l' Administration Electronique
<b>CCI</b>	: Le Cadre Commun d'Interoperabilite
<b>DIM</b>	: Diffusion Innovation Model
<b>DIF</b>	: Danish eGovernment Interoperability Framework
<b>DOI</b>	: Innovation Diffusion Theory
<b>EDPRS</b>	: Economic Development Poverty Reduction Strategy
<b>E-Gov (eGov)</b>	: Electronic Government
<b>eGU</b>	: eGovernment Unit
<b>eGIF</b>	: eGovernment Interoperability Framework
<b>EIF</b>	: European Interoperability Framework
<b>IT</b>	: Information Technology
<b>ICT</b>	: Information and Communication Technology
<b>IS</b>	: Information System
<b>LODA</b>	: Local Administrative Entities Development Agency
<b>MINALOC</b>	: Ministry of Local government
<b>MIFOTRA</b>	: Ministry of Public service
<b>NICI</b>	: National Information Communication Infrastructure
<b>NIDA</b>	: National Identification Agency
<b>NPR</b>	: National Population Registry System
<b>RDB</b>	: Rwanda development Board
<b>RISA</b>	: Rwanda Information Society Authority
<b>RLMUA</b>	: Rwanda Land Management and Use Authority
<b>RURA</b>	: Rwanda Utilities Regulatory Authority
<b>SAGA</b>	: Standards and Architecture for e-government Applications

## Table of Contents

DECLARATION .....	i
ACKNOWLEDGEMENTS .....	ii
ABSTRACT.....	iii
KEY WORDS .....	iv
LIST OF SYMBOLS AND ACRONYMS .....	v
LIST OF TABLES .....	vii
LIST OF FIGURES .....	viii
1. Introduction .....	1
2. Related work and the case of Rwanda .....	3
2.1 e-Government Systems interoperability in Rwanda.....	5
3. Methods.....	8
3.1 Subjects of the study .....	9
3.2 Research Design and Data Analysis frameworks .....	9
4. Results and Discussion .....	11
4.1 Top five challenges to interoperability in Rwanda .....	12
4.2. Discussion .....	14
4.3. Practical implications .....	17
4.4. Theoretical Contributions.....	17
5. Conclusions.....	18
References:.....	20
Appendix.....	22

## **LIST OF TABLES**

Table 1: Challenges by respondent category .....	12
--	----

## **LIST OF FIGURES**

Figure 1: Current integrations points(AS-IS) .....	7
Figure 2: Interoperability barriers. Source: Based on Scholl and Klischewski (2007). .....	11

## 1. Introduction

E-government refers to the delivery of government information and services online through the Internet or other digital means. Opposed to the traditional arrangements which are hierarchical, linear and one-way; the e-government systems are non-hierarchical, nonlinear, two-way and available all the time. Those advantages of e-government systems help citizens to get served at any time of their convenience not only when government offices are open (Darrell, 2004).

E-Government Systems interoperability can be defined differently however in this study, we define systems interoperability as: *The ability of distinct systems to communicate and share semantically compatible information, perform compatible transactions, and interact in ways that support compatible business processes to enable their users to perform desired tasks.*

The adoption of electronic government continues to affect the process on how the business are conducted in the society we are living in. One of the major challenges in applying e-government is the integration of fragmented systems to form a technological infrastructure to support the way services are offered to citizens, we can cite for instance the reduction or elimination of the need to access several agencies in order to receive information or services. The integration of e-government systems doesn't only mean seamless information sharing in terms of data exchange but also the integration of processes and transactions. Generally, several challenges are faced by government agencies while trying to do seamless integration. Interoperability is established through networks and systems that are able to receive, transfer and use data from different systems.

Every government strive to increase the quality of the public services offered to citizens. This is why government agencies struggle to acquire or develop systems helping in internal processes in order to deliver to their mandate. However, none coordinated computerization of internal processes may lead to the challenges in interoperation of the systems either within the agency or with other government agencies. One of the results of a non-integrated environment is tasks overload and duplication of data storage (Scholl, 2005). Consequences include but not limited to the increase of bureaucracy, high cost services and the delay in service delivery to citizens.

Interoperability allows reduction of operational costs, a higher level of information integrity and effective financial and administrative integration among the different agencies.

The highly desired outcome of electronic government is to put together computer supported government services. Following the e-government promises, the citizen and businesses expect to access government services through a single gateway or portal which integrates different e-government systems.

Interoperability of systems empowers interoperability of institutions. Systems interoperability refer to the ability of two or more systems or components to exchange information and to use the information that has been exchanged (Legner & Lebreton, 2007).

The interoperability of system can be possible only if the last are built following common standards. Standards are defined as group of specifications to which all products, processes, formats or procedures and its control have to agree (dos Santos, Reinhard, 2012). Standardization is an important action to enable information sharing in information systems. Therefore, it is necessary to define compatibility standards to be adopted among those systems (dos Santos & Reinhard, 2007).

A common approach undertaken by governments to address the problem of interoperability is the adoption of standards by agencies when developing new or upgrading existing IT systems. These technical standards, policy principles, and guidelines are generally published by governments in the form of an interoperability framework (Ray & al., 2007). The government of Rwanda supported the adoption of e-Government program and made it part of its ICT-led Socio-Economic Development Policy and Plan (NICI-Plan), from which the vision is to achieve a knowledge-based economy. The Rwandan government released a plan for Rwanda's social and economic development, with the goal of being a prosperous nation by 2020. The Vision 2020 plan is centered on "a prosperous knowledge-based economy." The plan contains six "pillars" and four "cross-cutting domains," one of which is "science and technologies, including ICTs." ICTs are mentioned as crucial components of the development of all sectors in the country.

For the past years, most of the government agencies in Rwanda have launched the initiatives helping to ease the service delivery to citizen by investing in the use of information systems in their daily activities. Digitalization of different sectors is still a priority of the government of Rwanda, and due to the said ICT digitalization initiatives, the new government institution was created and given a mandate of championing the digitization process(RISA). The survey on existing systems was done and findings show the valued effort of each and every agency to have internal processes computerized. For instance, health sector alone uses about fifteen different information systems; Education sector with more than seven Information systems; Justice sector about five Information Systems (Source, RISA survey of Information Systems, 2017).

The objective of this study is to explore the challenges in existing information systems interoperability in Rwanda, identify barriers and recommend the solution. The study was based on following research questions: *what are e-government systems interoperability challenges in public sector in Rwanda and what could be the solution for the citizen not to be bothered by the structure of government while requesting a service.* The interoperability can take two distinctive formats: information integration and process integration; the format integration requires the interoperation of eGovernment Information systems for information sharing purpose while the process interoperation requires the functional components of the organizations to be integrated to contribute to one single overarching process (Scholl & Klischewski,2007). As we are concerned with the information systems integration, in this study we will be mostly taking about information integration, process integration can be addressed in a different research study. This research will help the government of Rwanda to know where to invest more effort to have e-Government systems interoperating. All be towards the faster and effective service delivery to citizen and business with minimum cost of effort.

## **2. Related work and the case of Rwanda**

The interoperability is the most important issue of e-government; according to Goldkuhl (2008), the establishment of advanced solutions with integrated e-services and one stop government imply high demands on e-government interoperability. The importance of interoperability was also pointed out by several authors such as Cava & Guijarro (2003), Benamou, Busson, & Keravel (2004), Klischewski (2004), Bekkers (2005), Klischewski & Scholl (2006). The ideal

environment for electronic government, is to provide a unique point of access to information and services for the users. In this context, it is easy to see the need of the adoption of standards, based on the requirements of systems integration and the information sharing of the involved agencies. In addition, previous studies about information sharing for electronic government pointed out the standardization as a form of supporting compatibility is a conditioning factor in these processes. Interoperability standards play a pertinent role in information technologies field as they enable data exchange between system components or between different systems (Dos Santos & Reinhard, 2007).

The information sharing between government agencies even if is a common objective, but interoperability between those agencies is still a challenge (Dawes & Bloniarz, 2001). Thus, it is necessary to define compatibility standards to be adopted among the systems. The information sharing in information systems is enabled by an esteemed action of standardization (dos Santos & Reinhard, 2007).

Although the sharing of information presents significant benefits to policy makers, public agencies and to citizens in general, the government agencies face several barriers that constrain the effective implementation of interoperability (dos Santos, 2008).

In the process of developing interoperability, the consensus on a single standard document in each government is indispensable for e-government implementation success and this will allow the seamless information flow between institutions. A single standard profile or framework alone is not enough to respond to interoperability issue however the development of enterprise architecture should also be considered to address organizational issues. Different governments valued the importance of having a single standards profile in e-government systems implementation; It was in this regards that different e-Government interoperability initiatives started;

In the United Kingdom, the eGovernment Unit (eGU), formerly known as Office of the e-Envoy, was basing its technical guidance on the eGovernment Interoperability Framework (e-GIF), which was issued in 2000; the role of e-GIF was to elaborate specifications and policies for any

across-agency collaboration in terms of interconnectivity, data integration, e-service access and content management all for e-government service delivery (Guijarro,2007).

The French agency ADAE (“Agence pour le Développement de l'Administration Électronique”) in January 2002 published CCI (“Le Cadre Commun d’Intéropérabilité) which consists of recommendations for strengthening public electronic systems coherence and for enabling multi-agency electronic service delivery;

The Germany’s Federal Government Co-ordination and Advisory Agency for IT in the Federal Administration in February 2003 published SAGA (Standards and Architectures for e-government Applications) which was guideline to serve as orientation aid for decision makers in the e-government teams;

In 2005, the National IT & Telecom Agency of Denmark, published DIF (Danish eGovernment Interoperability Framework) its mandate was to serve as a guideline to public agencies as they develop IT plans and projects. The e-government interoperability initiatives did not stop only at the national level in the European countries, a supranational initiative also was declared EIF (European Interoperability Framework) with the aim to support the European Union's strategy of providing user-centered eServices by facilitating the interoperability of services and systems between public administrations, as well as between administrations and the public (citizens and enterprises), at a Pan-European level"(Guijarro, 2007).

## **2.1 e-Government Systems interoperability in Rwanda**

The Government of Rwanda (GoR) strongly believes that Information and Communication Technology (ICT) can help in successfully undergo stages of industrialization. It was in that vision that GoR has integrated ICTs, through the NICI (National Information Communication Infrastructure) process, as a potential driver for socio-economic development to fast track Rwanda’s economic transformation, and consistently struggles to align the country’s development agenda to global trends in order to be competitive. Rwanda Modernization plans did not forget to include IT as the major player and it is from the said plans that e-government

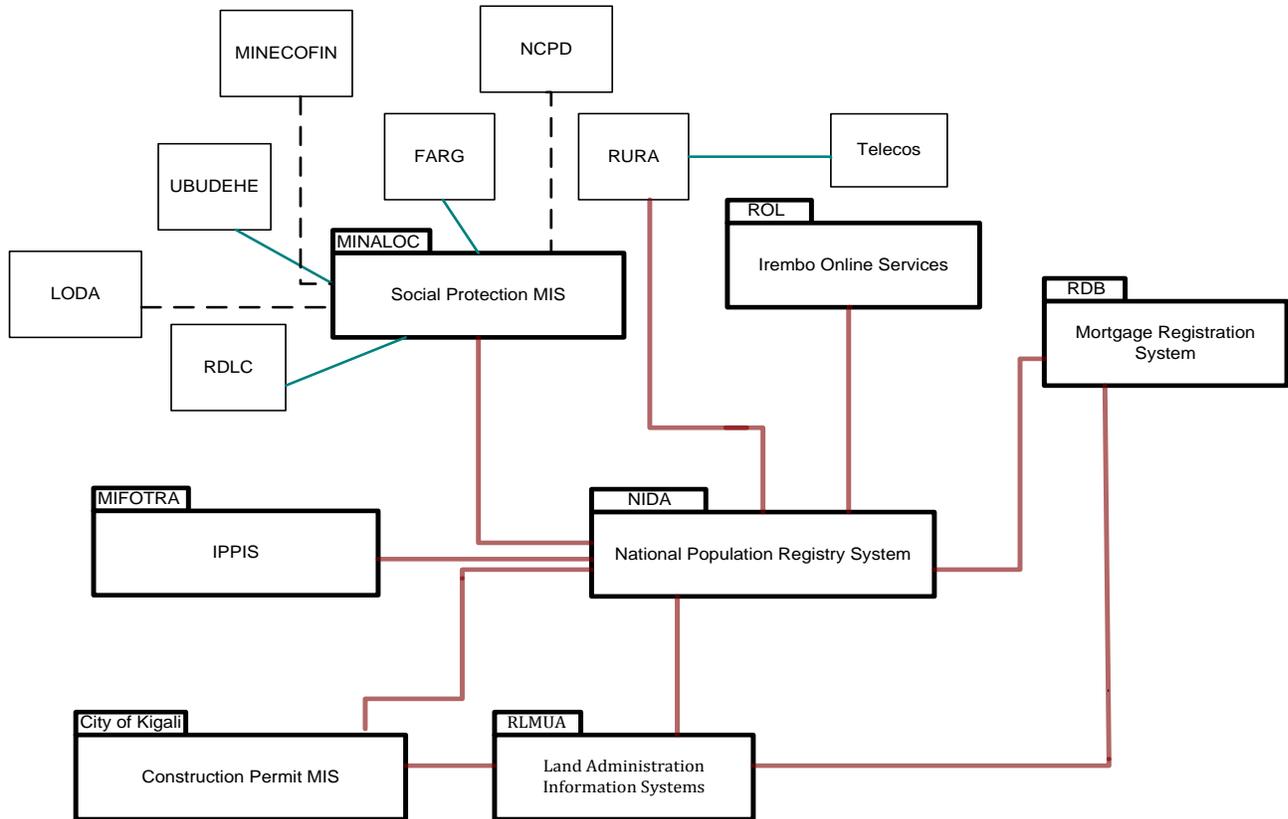
adoption was cited. The plans we are referring to includes a long-term 20 years' economic development plan "Vision 2020", Economic Development Poverty Reduction Strategy" EDPRS" and the National Information Communication Infrastructure-NICI plan (Phanuel, 2016).

In the NICI process each plan had the focus whereby NICI I (NICI-2005 Plan) focused on creating the necessary enabling environment that would enable the establishment and growth of Rwanda's ICT sector; The NICI II (NICI-2010 Plan), focused on providing world-class communications infrastructure that will serve as the backbone for current and future communications requirements. This positioned Rwanda as a good candidate to become a regional ICT hub that can offer a wide range of competitive ICT products and services; The third plan, NICI III (NICI-2015 Plan) focused on the development of services by leveraging ICTs to improve service delivery to citizens. Among the focus of NICI III, E-Government (e-GOV) was cited and with aim to improve government operational efficiency and service delivery.

From the set plans, government agencies started acquiring systems to help in delivering fast and quality service to citizens. A survey conducted by Rwanda information society authority (RISA) in 2017 revealed more than 60 systems used by the public institutions in Rwanda. Due to the time limitation, this study aims to explore e-government systems interoperability challenges in eight governments agencies (National Identification Agency-NIDA, Ministry of Local government(MINALOC), Local Administrative Entities Development Agency(LODA), City of Kigali, Rwanda Land Management and Use Authority(RLMUA), Rwanda Utilities Regulatory Authority(RURA), Rwanda development Board(RDB) and Ministry of Public service(MIFOTRA).

Following our exploration, the selected 8 institutions for our research don't have critical interconnection between them, however one government agency(NIDA) revealed to be integrated with at least 11 eleven other systems from different agencies.

Illustrated below is the current picture of integration



**Figure 1: Current integrations points(AS-IS)**

In the integration picture presented above we can observe the following:

Too many integration points. For example, NIDA’s National Population Registry System (NPR) has seven (07) current integration points with 7 different entities. Similarly, the Social Protection MIS at MINALOC has three (3) current and three (3) planned integration points with other public entities (the current integration points depicted by a solid connecting line and planned integration points depicted by dotted lines). As more integration points are added, it will not be easy to ensure reliability of these integrations, and the government services that depend on them, becomes a complex task. In the picture one institution/agency is represented by one information system; however, one agency may have more than one information system and all of the systems need to be integrated with NIDA.

The existing integration do not meet the interoperability requirement where the data from one system could be used by another system to complete the process. The communication done

between systems is mostly data verification; that why NIDA which houses a National Identification Number is the most integrated to validate the National Identification Number and its correspondent details. We will elaborate more on the identified challenges in the results section of this paper.

### **3. Methods**

The study is based on semi-structured interviews with 24 people – Eleven (11) managers which includes 1 IT Manager from 8 selected agencies and 3 Managers from RISA, five (5) IT Specialists from RISA, and eight (8) users from eight public organizations participating in the study. All respondents are qualified with at least a bachelor's Degree and only 12 are qualified with a Master's degree.

Among the respondents, 7 are female and the remaining 17 are male. None of the respondents were below 20 or above 50 ages. More than 58% of the respondents are between 31-40 ages. The taken sample was due to the limited time frame for the research and the availability of the respondents. Among the respondents 8 are from a non IT background. All respondents work in public institutions and have relationship with the use of eGovernment information systems.

Organizations were selected based on which have most computerized services, most requested by the citizens and which links with local government (Source: Rwanda Online Monthly report). Selected government agencies – 5 in relation with local government and offers services to citizen day to day (City of Kigali, NIDA, MINALOC, ROL, RLMUA) and three that are in central government (Ministry of public service and Labour, Rwanda Development Board and RURA). To understand what are the challenges that the users meet in relation with interoperability, from each selected agency, we selected 1 non IT staff(users) with non IT background. The selection of individuals was based on the involvement in e-government systems projects and the availability to participate in the interviews.

Exploration of documents available in RISA, was also one of the method that helped us in gathering data on the existing integration. The interview questionnaire (available upon request)

was designed based on Scholl and Klischewski (2007) research findings which has identified nine barriers to interoperability.

The interviews were conducted in English and Kinyarwanda languages during the month of June 2018. All 24 interviews results were retained and judged to have sufficient information.

### **3.1 Subjects of the study**

After the journey to understand what is e-Government and its determinations: citizen centric, highly agile, accountable, effective and efficient government operations; we have got passion to know how can we reach all these goals in the government of Rwanda. To reach to the goals interoperation of independent e-Government information systems appears essential. The study explores what could be the existing challenges to the interoperability in public sector in Rwanda and following lessons learnt from other countries, how can that be answered to reach the e-government purposes.

### **3.2 Research Design and Data Analysis frameworks**

As the purpose of this study is to explore e-Government systems interoperability challenges in public institutions in Rwanda, analysis of the interviews results was done following Scholl and Klischewski findings. Different authors discussed about the importance of interoperability, however two literatures on the interoperability challenges was also consulted in this study; Andersen & Dawes (1991) in their research classified interoperability challenges in four categories political, organizational, financial and technical (Andersen & Dawes, 1991). During our study we did not choose to follow Andersen and Dawes literature due to fact that identified categories are not detailed enough to help in exploring all possible challenges of interoperability; considering also the speed of information technology evolution the challenges identified in 27 years ago may not differ from the ones of last 10 years. Considering our research needed to hear all challenges from all possible corners to use Scholl & Klischewski (2007) findings was the best choice, seeing its level of specifics and the time of its conception which reflects the recent technologies; it classifies the challenges to the interoperability in nine categories—constitutional and legal, jurisdictional, collaborative, organizational, informational, managerial, cost, technological, and performance (Figure 1).

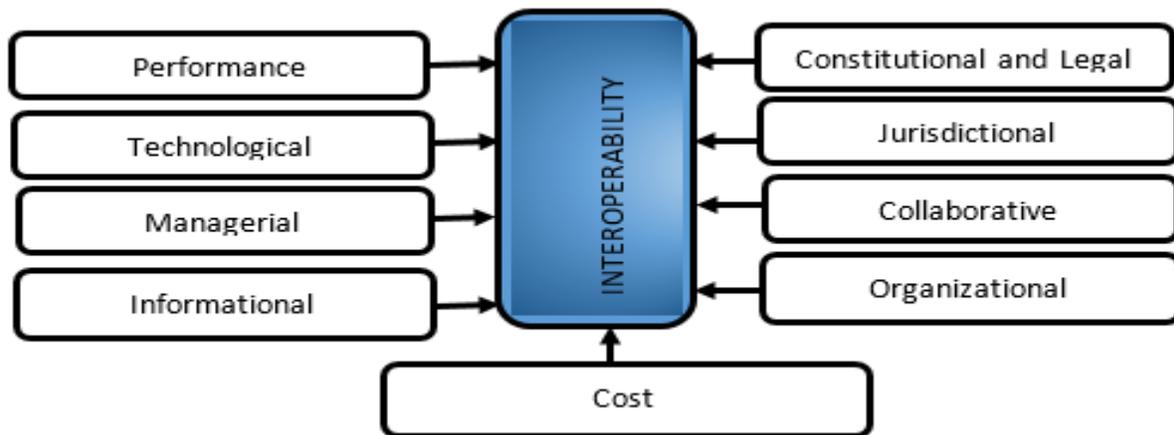
During our research Scholl and Klischewski findings was the guiding theory and it helped to explore and classify the existing challenges. **Constitutional and legal**—in this part, we expect to hear from the respondent if there exist legal frameworks allowing the interoperability of e-Government Information systems between government agencies in Rwanda.

**Jurisdictional challenge**—As the agencies operates independently and have their own information and business processes, we wanted to hear from the respondent whether the independency of each institution is the constraint for the interoperability of e-Government Information systems between the agencies.

**Collaborative challenge**—In this category we expect to hear on the readiness of the agencies for collaboration and interoperation with others. The exploration continued to the **Organizational challenge** to know whether there exists the practice of standardizing processes, systems and policies between government agencies.

**Informational challenge** helps to explore in the selected agencies if there is no worry about the information quality after the integration of systems from different sources across different domains and also on the quality standards. Among the limitations that hinder the interoperability we have also the **Managerial challenge** this category helps to hear from the respondent about the worry of putting together different partners with different interests.

We will explore the challenges related to cost (**Cost challenge**), available funds to implement the interoperability, the study explores the **Technological challenge** which help to understand if the heterogeneity of the e-Government platforms and its networking capabilities can be the limitation to the interoperability. **Performance challenge** according the performance tests, the higher the interoperations between systems the lower the overall system performance in terms of response time, we also hear if it exists such challenge between eGovernment systems in the public agencies in Rwanda. The above nine categories of challenges guided us to know what are the existing eGovernment systems interoperability challenges in the selected government agencies.



**Figure 2:** Interoperability barriers. Source: Based on Scholl and Klischewski (2007).

#### 4. Results and Discussion

The interviews were conducted in the 8 selected organizations, plus RISA as the ICT Authority. Eight (8) IT managers from 8 selected agencies and 3 Managers from RISA responded to our interview. We selected in each agency an IT manager and a non IT user. Five IT specialists from RISA responded also to the interview. The selection of IT specialists was based on who have e-government systems development and integrations in their responsibility. The total of 24 interview invitations was sent and got positive responses. All given information was found relevant and considered in the research findings.

Following nine barriers to the interoperability identified by Scholl and Klischewski (2007), in this research the same barriers was found existing in public sector in Rwanda however with different weight in percentage. Table 1 shows how much laws supporting the interoperation was the most challenge mentioned by the respondents. The results show also how much the respondent emphasized on the organizational challenge and this is all about standards, policies and guidelines. According to our respondents some challenges identified by Scholl and Klischewski was not given much weight considering the case of public sector in Rwanda, i.e Jurisdictional challenges, informational challenges, cost and performance challenges. The top five challenges mentioned by our respondents will be discussed in the following paragraphs.

<b>Challenges Category</b>	<b>IT Managers n=11</b>	<b>Users n=8</b>	<b>IT Specialists n=5</b>	<b>All respondent n=24</b>
<b>Constitutional &amp; Legal</b>	10 (91%)	8 (100%)	5 (100%)	23 (96%)
<b>Jurisdictional</b>	0 (0%)	3 (38%)	0 (0%)	3 (13%)
<b>Collaborative</b>	9 (82%)	1 (13%)	4 (80%)	14 (58%)
<b>Organizational</b>	11 (100%)	5 (63%)	5 (100%)	21 (88%)
<b>Informational</b>	1 (9%)	3 (38%)	0 (0%)	4 (17%)
<b>Managerial</b>	9 (92%)	0 (0%)	5 (100%)	13 (54%)
<b>Cost</b>	1 (9%)	0 (0%)	0 (0%)	1 (4%)
<b>Technological</b>	8 (73%)	1 (13%)	5 (100%)	14 (58%)
<b>Performance</b>	2 (18%)	0 (0%)	0 (0%)	2 (8%)

**Table 1: Challenges by respondent category**

#### **4.1 Top five challenges to interoperability in Rwanda**

According to the respondents the top challenges to systems interoperability in Rwanda include:

**Constitutional & Legal challenges:** The respondents strongly pointed out a lack of laws allowing or commending the government agencies to integrate their e-Government information systems in order to give the better services to the citizen. The integration remains the initiatives of the agency, this was identified as a gap in the laws of Rwanda. One respondent said “the interoperability should not be a choice but an obligation to all government agencies in the interest of the citizens. The laws should be in place to support the e-Government implementation especially in terms of information systems interoperation”.

**Organizational challenges:** The respondents pointed out a lack of standards, policies and guidelines used while acquiring or developing e-government information systems in public sector in Rwanda. A respondent said: “There is a diversity and heterogeneity of developed e-government information systems in different government agencies and this is also the cause the challenge of interoperability”. In the same angle the respondents mentioned also the challenge of not having best practices standardization in developing or acquiring an e-government information system in public sector in Rwanda. Lack of eGovernment interoperability

framework and an enterprise architecture to follow was also mentioned as a challenge on this point.

**Collaborative challenges:** The readiness of the e-government information systems to collaborate was identified by the respondents as a challenge, following that the systems were constructed without any common guiding procedure, the respondents criticized its network capabilities to work together. One of the respondent said: “I don’t believe the existing systems are ready to work together however I believe it is possible with some changes” The leadership style was not mentioned as problem, following that in Rwanda all public sector uses the same style; in terms of the organization being ready to interoperate with others, the respondent did not mention this as an issue, however pointed out that this should be supported by the legal framework.

**Technological challenges:** 58 % of the respondents mentioned the challenge of existing e-Government information systems network capabilities to integrate. The respondents mentioned the challenge about the completeness of the existing systems to join the integration as some of these did not plan for the interoperability in their starting. The respondent said “Some of the systems will require more development to interoperate with others”. This was identified as a challenge as the vendor of the system may not be available, ready or willing to do further developments. We don’t have technical infrastructure(backbone) through which the interoperation could be done said the respondent.

**Managerial challenges:** The respondents pointed out the lack of dedicated governance committee to help in e-government information systems interoperability. We don’t have central governmental dedicated organization to stand in between the integration process said by the respondent; and this was identified as a barrier to interoperability. The management of different interests of different agencies was pointed out as a challenge to the interoperability. The lack of a regulatory body to prioritize and materialize the interoperability was mentioned as challenge.

In general, the jurisdictional, informational, cost and performance challenges was not given much weight as the challenges that hinder the interoperability of eGovernment information systems in government agencies in Rwanda. The managers team from the respondents was much

conversant with the subject and while responding the interest to give the contributions towards e-Government systems interoperability was noticeable. On the user's team, the subject was too technical to be understood, more explanation was required to understand the interview questions, on some question the user did not have what to answer. IT specialists team was the team that understands the subject and they show the interest to participate in the implementation of this research findings.

## **4.2. Discussion**

By categorizing the responses from the respondents helped to understand and find out the top challenges to systems interoperability in public sector in Rwanda. The results presented in the table 1 reflect the existing environment and show challenges that should be mitigated to reach e-Government systems interoperability. Every government action is backed by the law, in public sector in Rwanda the lack of the law that encourage and support the interoperation of the e-Government systems was mentioned by all the groups of our respondents. Scholl & Klischewski (2007) findings, proposed to check if the conformity of the laws in different federations is not a barrier to the systems, in this study this was not a challenge as Rwanda has one government and laws are the same to the whole country.

Most of the government always tries to solve the challenge of interoperability by encouraging all agencies to follow standards when developing new or upgrading the existing Information systems (Ray et al.,2007); 88% of respondents highlighted the lack of common standards and guidelines. This challenge goes with the lack of eGovernment interoperability framework (eGovIF) and lack of an enterprise architecture to help in aligning the government processes. Systems interoperability is a vital to the fulfilment of the information Society's massive potential to improve the lives of citizens (Proceedings of the Eighth International Conference on Electronic Business 2008). The interoperable environment benefits services consumers.

The process to interoperability have been in priorities of different governments in the EU and beyond. Since 1991, interoperability has remained an important EU goal – especially in the eGovernment context. In June 2002 the eEurope 2005 Action Plan made the development of a European Interoperability Framework (EIF) a priority component of Pan-European eGovernment strategy (Elena & Rimantas, 2009). In case of the government of Rwanda the journey is still long as 88% of our respondents mentioned the organizational challenge, which includes the lack of

interoperability standards. Considering the journey taken by other government the development of eGovernment interoperability framework was a foundation to the interoperation; government like Australia developed Australian Government Technical Interoperability Framework, version 2 in 2005. In 2007 Canada developed Government Information and Technology Standards Program with the principal objective of increasing effectiveness and economy in acquiring and administering information technology resources throughout government by promoting compatibility and interchangeability of equipment, programs, data and the characteristics of data. Denmark did the same in 2006, European Union in 2004, Germany in 2006, Hong Kong in 2007, India in 2004, New Zealand Interoperability Framework in 2007, UK (e-Government Interoperability Framework Version 6.1, March 2005) and USA (Consolidated Reference Model Document Version 2.2 July 2007); This brief history shows much different country valued the creation of interoperability framework; And this shows the foundation of 88% of our respondents claimed the lack of interoperability framework and common systems development standards in Rwanda, and qualify this as a challenge to the working systems interoperability.

We could not ignore 58% the rate given to collaborative challenge, this result means the readiness of the agencies in terms of their e-Government systems to interoperate. The respondents don't feel the existing systems are ready to interoperate and some of the reasons given are non-common standards used in the development, some of information systems still in development or used however not well completed. In addition to that there is a worry about the interoperation management where the respondents insisted should be a trusted entity or committee which currently not available. The revision for some of systems would be required when decided to collaborate and this will bring in additional work and cost.

The managerial challenges rated 54% means the respondents feel that none is responsible for the interoperability between government agencies. Currently if a government agency need to interoperate, it will approach another to request for their system integration; a trusted government committee should be in place to support in materialization of the interoperation and facilitate the agencies to enter in the collaboration.

Jurisdictional challenge rate of 13% means the independency of business processes and information for each and every government agency is not a barrier to the interoperability in Rwanda. The interoperability does not remove the ownership and independency however it expands the institution territory.

As Scholl & Klischewski (2007) agree, the quality of information becomes issue when there is an integration of information systems from different sources; this was not the case from this study where the respondents showed a minimum percentage of worries about this challenges. As long as the trusted entity governing the integration is in place the quality of information will not be questioned. The respondents did not agree with Scholl and Klischewski on the challenge of cost as this depends on how you plan. Performance challenge which is due to many systems working together, this was not found as a barrier in this study as the respondent targets the use of new technologies which can support the load balancing features.

The respondents mentioned about the operational challenges in the existing integration with regards to upgrading, moving, or changing systems on which there are integration dependencies. Changing the address of one system requires revalidating the connection of all other systems that connect to it; duplications of resources as each some entities use different databases to store data when there is possibility to re-use data already captured by another entity; And criticized the current integration between government entities which was described complex and inefficient in data sharing, potential information integrity compromise, which do have implications on service delivery and quality of services. Additional cost is borne through the maintenance of the integration which is laborious and code intensive as each integration needs to be coded separately. Another cost is incurred through the duplication of services as there are multiple data capturing points. This also means that an update of any type of data has to be done on multiple systems which might result in compromised data integrity.

We recognize that this study was mostly based on technical challenges to the eGovernment Systems interoperability, however social and culture barriers also should be explored for the next research, this will help to have a complete picture on what should be mitigated to get to the full interoperability.

### **4.3. Practical implications**

To reach the goal of having interoperable systems, various countries have developed frameworks as reference points for national efforts. These frameworks are used to assist agencies in developing strategies for cross-agency projects and to guide investments in capacity-building initiatives (Pardo & Burke, 2012). The challenges presented here are fundamentals to reach the interoperability in Rwanda; the lack of common alignment in the development of eGovernment Information systems has been shown among the challenges however this could be the easiest task to start with in answering the issue. It is obvious that the implementation of change for the old implemented systems will need time and strategy; however, this study should be the good trigger to start the change towards the development of national eGovernment interoperability frameworks which will help public agencies to start planning and work towards the interoperation.

The findings will trigger the government to assess the range of capabilities for interoperability found among entities seeking to coordinate their efforts and to identify focus areas for the development of missing capabilities. Finally, the observations and conclusions of this study will help the government to know where much effort is needed to be invested in the journey to the interoperation between eGovernment information systems. Government can start from the given guidance from the author, try to study other factors like process integration and non-technical challenges that hinder the interoperability of eGovernment information systems in Rwanda. Interoperability challenges are not particular to Rwanda and as stated earlier different countries like Australia, Canada, Denmark, European Union, Germany, Hong Kong, India, New Zealand, UK, USA and Lithuania privileged the use of eGovernment interoperability frameworks to solve the issue and reach the goals of eGovernment; this should be a good model for Rwanda to follow in order to benefit the eGovernment drives.

### **4.4. Theoretical Contributions**

Scholl and Klischewski findings used in this research have found to be detailed enough to capture challenges to Systems interoperability. The missing part in the theory is the analysis of non-technical challenges which could also hinder the e-Government systems interoperability. The nine identified barriers in the theory looks complete in the analysis of technical related challenges.

## 5. Conclusions

The importance of e-government systems interoperability is vital for the government to accomplish its mandate of provisioning one-stop, fully electronic services to businesses and citizens. Challenges to get to the interoperability are many, however Scholl and Klischewski categorized them in nine groups: constitutional and legal, jurisdictional, collaborative, Organizational, informational, managerial, cost, Technological and performance. During this research the respondents helped to rate challenges according to the situation in public sector in Rwanda. Among the evaluated nine group of possible challenges, constitutional and legal challenges were found on top, followed by Organizational challenges, technological and collaborative challenges were ranked third and then Managerial challenges. Challenges like informational, jurisdictional, performance and cost were low rated which shows the respondent did not value them as the strong challenges for this case study.

The interoperability issue is not a particular for the public sector in Rwanda; the most common approach undertaken by governments to address the problem of interoperability is by encouraging all agencies to use standards when developing new or upgrading existing IT systems. Government generally publishes such technical standards, policy principles guidelines in the form of an Interoperability Framework (Dibakar Ray et al.,2007).

The government of Rwanda should put in priority the development of the e-Government interoperability framework which will serve as the common denominator to all its agencies. Other countries which chose to first develop an interoperability framework, the management entity or committee had to be put in place, and this should not be left out in Rwanda. Laws supporting the inter-collaboration of e-government information systems should be adopted. For the citizens not to be bothered with the structure of the government, the government should help to define middleware through which the interoperation is materialized; To put in place a centralized portal through which a citizen can access all government services without visiting institution by institution. Implement a zero trip zero paper strategy which includes a full digitalization of the whole process to the service.

The integration of processes which we did not explore in this study, need also to be catered for and should be based on a clear and understandable government enterprise architecture. The given recommendations are based on the findings, however we recognize the limitation in terms of small group of respondents, time constraints and non-technical challenges that were not explored.

## References:

1. Chen, Doumeingts, Vernadat (2008). Architectures for enterprise integration and interoperability: Past, present and future. *Computers in industry*, 59(7), 647-659.
2. Chen, Daclin (2006, March). Framework for enterprise interoperability. In Proc. of IFAC Workshop EI2N (pp. 77-88). Bordeaux.
3. Clark, Jones (1999, June). Organisational interoperability maturity model for C2. In Proceedings of the 1999 Command and Control Research and Technology Symposium. ISO 14258, Industrial Automation Systems—Concepts and Rules for Enterprise Models, ISO TC184/SC5/WG1, April 14, 1999.
4. C.J. Petrie (1992), *Enterprise Integration Modeling*, The MIT Press, Cambridge, MA, 1992.
5. Dos Santos, Reinhard (2007). Setting interoperability standards for e-government: an exploratory case study. *Electronic Government, an International Journal*, 4(4), 379-394.
6. Dos Santos (2008). Implementing interoperability standards for electronic government: An exploratory case study of the E-PING Brazilian framework. *International Journal of Electronic Government Research (IJEGR)*, 4(3), 103-112.
7. Dos Santos, Reinhard (2009). The Challenges in Establishing a Government Interoperability Framework: The e-PING Brazilian Case.
8. European Commission, (2004), *European Interoperability Framework for pan-European eGovernment Services*, Working document of the IDA programme, Available: <http://ec.europa.eu/idabc/servlets/Docd552.pdf?id=19529>.
9. Guijarro (2007). Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States. *Government Information Quarterly*, 24(1), 89-101.
10. Murenzi, p. (2016). *A comparative study on the utilisation of e-government by selected municipalities in south africa and rwanda: development of a model for effective and efficient online service delivery* (Doctoral dissertation, Bloemfontein: Central University of Technology, Free State).

11. Pardo, Nam, Burke (2012). E-government interoperability: Interaction of policy, management, and technology dimensions. *Social Science Computer Review*, 30(1), 7-23.
12. Ray, Gulla, Dash (2007). Interoperability of e-government information systems: a survey. Towards next generation and e-government, 12-25.
13. State Services Commission. (2007). New Zealand e-government interoperability framework.
14. Scholl & Klischewski (2007). E-government integration and interoperability: framing the research agenda. *International Journal of Public Administration*, 30(8-9), 889-920.
15. Scholl (2005). Interoperability in e-Government: More than just smart middleware. In *System Sciences, 2005. HICSS'05. Proceedings of the 38th Annual Hawaii International Conference on* (pp. 123-123). IEEE.
16. Santos & Reinhard (2012). Electronic government interoperability: Identifying the barriers for frameworks adoption. *Social Science Computer Review*, 30(1), 71-82.
17. Scholl, Kubicek, Cimander, Klischewski (2012). Process integration, information sharing, and system interoperation in government: A comparative case analysis. *Government Information Quarterly*, 29(3), 313-323.
18. Vitkauskaite, Gatautis (2008). eGovernment interoperability issues in Lithuania. In *ICEB-2008: proceeding of the Eight International Conference on Electronic Business “Enriching Global Business practices* (pp. 80-87). eGovernment interoperability issues in Lithuania. In *ICEB-2008: proceeding of the Eight International Conference on Electronic Business “Enriching Global Business practices* (pp. 80-87).

## Appendix

### INTERVIEW QUESTIONNAIRE

#### A. INTRODUCTORY LETTER TO RESPONDENTS

Dear Sir/ Madam,

I am a Masters student in Information Systems / E-Government Option at University of Rwanda. Part of the requirements for the award of a Master's degree in this program is to conduct research. My research is entitled: “*eGovernment Systems Interoperability Challenges: Case of public sector in Rwanda*”. Within this context, I would like to invite you to assist with this project by agreeing to be involved in an interview. No more than 20 minutes on one occasion would be required. Any data you provide shall be anonymous and confidential. It will be for academic purposes only.

Your cooperation is highly appreciated.

Yours faithfully,

Mr. Sylvere MUGUMYA

N.B.: For any question, contact me on 0788838384 or at email: [smugumya@gmail.com](mailto:smugumya@gmail.com)

## A. BACKGROUND INFORMATION OF RESPONDENTS

In this section you are requested to tick the right answer about your background

A1. Sex: Male  Female

A2. Your age group:

Below 20

Between 20-30

Between 31-40

Between 41-50

Above 50

A3. From which department do you work?

IT Department

Non-IT Department

### QUESTIONS ABOUT E-GOVERNMENT SYSTEMS INTEROPERABILITY

*Notes: In this research e-Government systems interoperability means the ability of independent or heterogeneous information systems or their components controlled by different jurisdictions/administrations or by external partners smoothly and effectively work together in a predefined and agreed upon way.*

*The purpose of this research is to find out challenges of e-Government Information Systems interoperability in public sector in Rwanda. (Your institution was selected to participate in this research). I will appreciate your answers about the following nine questions.*

#### Question 1:

Is there any Law/policy guiding the integration of eGovernment Information Systems in Rwanda?

**Question 2:**

Each and every government institution in Rwanda works independently and has its own information and business processes; Do you think this independency be the challenge to the eGovernment information systems interoperability between the government agency?

**Question 3:**

How ready are your eGovernment Information Systems to collaborate with others in different government agencies (If you are from RISA you can refer to the public sector in Rwanda)?

**Question 4:**

When developing or acquiring eGovernment information System for your institution, do you have any systems standards, policies or guidelines to follow? Are there any best practices of standardization while acquiring new information systems in public sector in Rwanda?

**Question 5:**

Would you mind of the quality of information resulted from the integrated eGovernment information systems? (If IS interoperability is well established between government agencies would you believe the quality of information resulted from the integration?)

**Question 6:**

Do see any challenge in the management of the integrated eGovernment information systems? (Would you have any worry about that?)

**Question 7:**

Do you think the availability of funds to use in the implementation of the interoperability of eGovernment information systems is an issue for the public sector in Rwanda (or for your institution)? Do you think the cost of implementation should be mentioned as the barrier to the interoperability?

**Question 8:**

Diversity and Heterogeneity of the eGovernment information systems in different agencies, do you think is this a barrier to the interoperability? What do you think of network capabilities of your eGovernment information systems? According to you, can that be a challenge to the interoperability?

**Question 9:**

Have you once thought about (or mate) the performance challenge in terms of response time once eGovernment information systems integrated with some many others?

**Thank you very much for taking your time to answer these questions!!!!**