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PROPOSING AN E-GOVERNANCE INTEROPERABILITY FRAMEWORK FOR NAMIBIA

MASTER'S THESIS

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Master of Science

Tallinn 2017

TALLINNA TEHNIKAÜLIKOOL

Infotehnoloogia teaduskond

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E-VALITSEMISE KOOSTALITLUSVÕIME RAAMISTIKU VÄLJAPAKKUMINE NAMIIBIALE

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Tehnikateaduse magiste

Tallinn 2017

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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08 May 2017

Abstract

The modern world we live, heavily depends on Information and Communication Technology (ICT), rapid developments in the field of ICT over the past decades have led to governments to incorporate new technologies as mechanisms of improving service delivery to citizens, simplifying public administration processes and promoting good governance. However e-Governance transformation comes with allot of challenges, especially in developing countries such as Namibia, lack of financial resources, obsolete ICT infrastructure and organizational issues are some of the issues hampering e-Government transformation. Infrastructure is one aspect, to be more specific interoperability; interoperability enables integration by interlinking disparate information systems and infrastructure to make it possible for communication & data sharing in the public domain.

The aim of this research is to examine critical factors affecting interoperability adoption in the public domain by presenting a qualitative survey, a comparative analysis of the identified interoperability frameworks will be done and select the best framework(s) meeting the requirements of Namibia. The selected framework(s) will lead to the adoption and implementation process for the interoperability framework in Namibia. Three interoperability frameworks are going to be analyzed: New Zealand, Estonia and Australia. The three e-Governance Interoperability Frameworks have been analyzed in the case studies based on: content, context and process.

This thesis is written in English and is 85 pages long, including 7 chapters, 20 figures and 23 tables.

Annotatsioon

E-VALITSEMISE KOOSTALITLUSVÕIME RAAMISTIKU VÄLJAPAKKUMINE NAMIIBIALE

Maailm, milles me elame, sõltub paljuski IT-st. Viimaste kümnendite kiired arengud IT vallas on viinud selleni, et valitsused võtavad kasutusele uusi tehnoloogiaid, mille abil parandada kodanikele teenuste pakkumise kvaliteeti. Seda eelkõige avaliku halduse protsesside lihtsustamise ja hea valitsemise edendamise teel. Samas kaasnevad e-valitsemisele üleminekuga ka paljud väljakutsed. Arengumaades, nagu näiteks Namiibias, on nende väljakutsete põhjuseks peamiselt rahaliste vahendite puudus, iganenud IT-infrastruktuur ja organisatsioonilised probleemid. IT-infrastruktuuri aspektist on olulisim murekoht koostalitlusvõime, mis kujutab endast integratsiooni seeläbi, et võimaldab kahe või enama süsteemi ja infrastruktuuri komponendi omavahelist ühendamist, tagades kommunikatsiooni ja andmete jagamise avalikus sektoris.

Käesoleva töö eesmärgiks on uurida kriitilisi edutegureid, mis mõjutavad koostalitlusvõime saavutamist avalikus sektoris ning selleks on kasutatud kvalitatiivset uuringut ja teadaolevate koostalitlusvõime raamistike võrdlevat analüüsi. Uuringu ja analüüsi tulemusena valitakse välja Namiibia vajadustele vastav(ad) koostalitlusvõime raamistik(ud), mis omakorda viib koostalitlusvõime raamistiku vastuvõtmise ja kasutuselevõtmiseni Namiibias. Analüüsimisel võetakse aluseks kolme riigi koostalitlusvõime raamistikud: Uus-Meremaa, Eesti ja Austraalia. Nimetatud riikide koostalitlusvõime raamistikke on juhtumiuuringutes analüüsitud kolmest aspektist lähtuvalt: sisu, kontekst ja protsess.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 85 leheküljel, 7 peatükki, 20 joonist, 23 tabelit.

List of abbreviations and terms

AGA	Australian Government Architecture
BRM	Business Reference Model
CIOC	Chief Information Office Committee
CIM	Computational Independent Model
CWM	Common Warehouse Meta-Model
CMM	Capability Maturity Model
DB	Database
DRM	Data Reference Model
DPSITM	Department of Public Service Information Technology Management
EA	Enterprise Architecture
EC	European Commission
e-GIF	e-Government Interoperability Framework
e-GSAP	e-Government Strategic Action Plan
EIF	European Interoperability Framework
EU	European Union
FEAF	Federal Enterprise Architecture Framework
GDP	Gross Domestic Product
GIF	Government Interoperability Framework
GRN	Government of the Republic of Namibia
G2B	Government to Business
G2C	Government to Citizen
G2E	Government to Employees
G2G	Government to Government
G2O or OG	Government to Other Government
HRMS	Human Resource Management Systems
ICT	Information Communication Technology
ID	Identification Document
IFs	Interoperability Frameworks
IFMS	Integrated Financial Management Systems
IS	Information Systems
IT	Information Technology
LISI	Levels Information Systems Interoperability
LoBs	Line of Business
MDA	Model Driven Architecture
MITU	Ministerial Information Technology Units
MKM	Ministry of Economic Affairs & Communications
MMEI	Maturity Model Enterprise Interoperability

MOF	Meta Object Facility
NDP	National Development Plan
NEA	National Enterprise Architecture
NIFs	National Interoperability Frameworks
OCL	Object Constraint Language
OMAs	Offices Ministries and Agencies
OPM	Office of the Prime Minister
OS	Operating System
PIM	Platform Independent Model
PKI	Public Key Infrastructure
PRM	Performance Reference Model
PSCOIT	Public Service Committee on Information Technology
SEI	Software Engineering Institute
SOA	Service Oriented Architecture
SOE	Service Oriented Environment
TLC	Transport Layer Security
SRM	Service Reference Model
TRM	Technical Reference Model
UML	Unified Modelling Language
UN	United Nations
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific & Cultural Organization
XML	eXtensible Markup Language

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1 Introduction

1.1 Introduction

This first chapter (introduction), introduces the background of the research topic, it outlines the problem statement, the research objectives, research questions, significance of the study, scope of the study, research methodology and concludes with a chapter summary.

The rapid developments in the field of Information and Communication Technologies, and the increase use of the internet over the past decades have enabled developments and implementation of applications such as: e-learning, e-Governance, e-commerce, e-justice, e-police, e-health and e-procurement to name a few. The idea behind e-Governance initiative is to exploit ICT, in order to deliver efficient and quality services to citizens and enhance administration processes. According to Dash and Pani (2016), the concept e-Governance refers to the use of modern technologies, in order to improve the effectiveness, accountability, transparency and the efficiency of the government. e-Government is the concept of moving services online for the citizens, with the hope to achieve objectives such as: promoting economic development, improving service delivery, reducing cost, enhancing transparency in government and accountability, facilitating an e-Society and improving public administration.

e-Governance have been one of the major focus points in the public domain, with many local municipalities and national governments all over the world trying to exploit modern technologies to improve service delivery electronically. Information and Communication Technologies has the potential to transform society. Adoption of ICT has an impact on the competitiveness, as it consist of enabling technologies, it can lead to product and process innovation, and it improves business processes in the value chain. Countries' economies can benefit in two different ways from ICT: as ICT producer, the ICT sector stimulates economic growth, by means of productivity and innovation, as ICT user, ICT facilitates innovation and also enhances the efficiency of the production processes. Thus why ICT have an impact on innovation, economic growth, and the competitiveness of an organization (Lallana, 2008). However, many

governments around the world are facing allot of challenges in adopting e-Governance, barriers such as lack of human resources to move towards an e-Society. IT infrastructure is one of the major challenges facing e-Governance adopting nations. Interoperability challenges are associated with IT infrastructure. According to Misuraca et al (2011), there are three levels of interoperability in e-Governance context, technical interoperability, semantic interoperability, and organizational interoperability. Interoperability is the ability of a group of communicating entities to be able to operate and exchange data according to set standards (Novakouski & Lewis, 2012). Using technology to automate public services can help nations save allot of money and enable citizen's to easily access public services, governments can only effectively implement e-Governance services when they have developed or adopted a government interoperability framework (GIF). A GIF can help countries in making more informed decisions when it comes to: incorporating new technologies into their existing systems, preserving electronic public records, and aid towards citizen's access to information and encouraging competition among vendors in the ICT sector for reduced prices and enable development of innovative technologies.

e-Government interoperability is a very important factor when considering investments in ICT, the need for systems to connect and exchange data and reuse of data with other ICT systems should be considered, if the e-Government initiatives is to meets its objectives. e-Government interoperability allows comprehensive online services for various stakeholders (business, citizens), by linking the different services that are provided by the different entities and enables a one stop shop delivery of public services. The flow of information between governmental agencies and citizens is made possible by e-Governance interoperability, e-Governance interoperability increases accountability and transparency, and thus why e-Governance interoperability enables good governance. Interoperability in e-Governance promotes international cooperation's between nations, ensuring interoperability between various governments also mean providing e-Governance services to various stakeholders (business, citizens) across a specific region. Interoperability should be the focus point when governments are starting planning to move towards digitize data, setting the right standards and adopting the right architecture are some of the strategies to enhancing interoperability in order to enable good governance through the utilization of ICT (Lallana, 2008). To achieve interoperability through adopting standards involves the adoption of a suitable GIF. Government Interoperability Framework is a set of guidelines and standards that

governments use to specify suitable ways that governmental agencies and stakeholders can interact with one another. Government Interoperability Framework includes basic technical specifications that all involved stakeholders relevant to e-Government implementation strategy must adopt (Lallana, 2008).

Achieving interoperability in government is a big challenge. To support this argument, Chen and Doumeingts (2003), pointed out that governments will be confronted with many issues such as legacy enterprise applications prevents cooperation endeavours between agencies, written software codes, once written and implemented is difficult to re-engineer, most applications in governments were not designed to interoperate with each other and their data models or schemas are often different. Another challenge governments are facing related to interoperability is the lack of standards, for example standards describing and orchestrating the various business process flows of the various systems. Moreover, issues of organizational interoperability, semantic interoperability, and technical interoperability will need to be considered when establishing interoperability in government. Considering the many functions and benefits that interoperability offers to governments, countries are adopting interoperability referential frameworks to aid them in meeting their e-Governance projects objectives.

Namibia just like other modern developing countries, is moving towards ensuring efficient and effective public service delivery and promoting good governance, by taking advantage of the benefits associated with implementing interoperability framework in its e-Government strategy, hence the Namibian government should ensure that interoperability exist in its agencies, if the Namibian government is to meet its e-Governance project objectives.

This research focus on analysing the possible e-Governance interoperability framework(s) suitable for Namibia and exploring the various factors that influence the successful adoption of the interoperability framework in the Namibian Public Service and how Namibia can learn from best practices in its interoperability implementation initiatives.

1.2 Problem Statement

All over the world, governments are investing allot of resources and efforts in order to improve public service delivery to their citizens and enhance their administration processes. In Namibia, the e-Governance initiative started in 2004, with the formulation

of the Information Technology Policy for the Republic of Namibia (Namibia Ministry of Information and Communication Technology, 2009). The Namibian Public Service have been facing allot of challenges in delivering efficient and effective public services to citizens. In order to exploit the benefits offered by ICT, and to enhance service delivery and improve decision making.

The Information Technology Policy for the Public Service of the Republic of Namibia was developed by the Public Service Committee on Information Technology (PSCOIT), with the objectives to co-ordinate the acquisition and utilization of ICT resources in the Namibian Public Service (NPS), and to create an environment were by governmental agencies can exploit ICT to the fullest. The Information Technology Policy for the Public Service of Namibia was developed under seven modules: open, co-operative information systems architecture, development of Information Technology infrastructure, institutional arrangements, human resource development, acquisition of hardware, software and services, and information technology personnel administration (Government of the Republic of Namibia: Office of the Prime Minister, 2017).The Cabinet approved the establishment of Information Technology (IT) units to provide computer related services to Offices, Ministries and Agencies (OMAs), OMAs are responsible for budgeting, developing, planning and implementing their own IT projects. Offices, Ministries and Agencies in accordance with the principles of division of powers, their Information Systems (IS) will be independently managed or administered by public service agencies in their assigned area of administration. Information Systems development activities undertaken by Ministerial Information Technology Units (MITUs'), are based on a bottom- up approach, Organizational Units within Offices, Ministries and Agencies are the initiators of their ICT activities. Organizational Units initiatives are usually based on their own concerns or sectorial interests, and not considering the needs of other governmental agencies. This led to the emerging information islands in the public domain and the duplication of Information Systems (Government of the Republic of Namibia: Office of the Prime Minister, 2017).

The Department of Public Service Information Technology Management (DPSITM), in the Office of the Prime Minister (OPM), carried out an e-Readiness survey within the Public Service, as a step to preparing for its e-Governance Policy formulation initiative. The e-Readiness survey concluded that Offices, Ministries and Agencies have developed incoherent Information Systems that are not able to share data with each

other, and incompatibility was a big concern in the public domain (Government of Namibia, 2013).

The 2013 e-Readiness report indicates that interoperability is a big concern in the public domain, interoperability is very low between systems, and there are no initiatives in place on how applications & data between different governmental agencies could interact smoothly with one another (Government of Namibia, 2013).

The duplication of ICT infrastructure and the island of Information Systems in the public domain makes it difficult for internal communication to take place and data exchange, lack of interoperability hinders the effective implementation of the e-Governance project.

In order to achieve the objectives of the e-Governance initiative, interoperability issues should be overcome, e-Governance initiatives have a huge potential, to contribute on how the Namibian government can deliver information and effective services to its citizens. However issues of different systems and platforms add complexity to achieving interoperability in the public domain, hence need to be solved first. The Namibian Public Service needs to adopt a suitable e-Governance Interoperability Framework, standards and guidelines for establishing interoperability.

1.3 Research Aim

The aim of this independent study was to propose an e-Governance Interoperability Referential Framework for Namibia, as the Namibian government plan to adopt an e-Governance Interoperability Framework in its e-Government strategy, the e-Government Strategic Action Plan (e-GSAP), also calls for the assessment of various e-Government Interoperability Frameworks (e-GIFs) across the world, including the ones being used in New Zealand and Estonia (Government of the Republic of Namibia: Office of the Prime Minister, 2014). For this purpose the researcher will analyse different identified interoperability Frameworks and select framework(s) meeting the requirements of Namibia. The research also aim to establish the critical factors influencing interoperability adoption in the public domain and how Namibia can learn from best practices in its interoperability implementation initiatives.

1.4 Research Questions

To achieve the mentioned objectives, this research paper aim to answer three main research questions below:

- How critical factors affect the adoption of interoperability framework in the public domain?
- How framework(s) will establish the required interoperability in the public domain?
- How Namibia can learn from best practices in its interoperability implementation initiatives?

1.5 Significance of the Study

The independent study contributes significantly towards the critical discussions surrounding e-Governance interoperability framework implementation, within the context of the Namibian Public Service, and the critical factors influencing the adoption of interoperability. The study proposes suitable interoperability referential framework(s) currently being used by some leading countries in e-Governance around the world, in order to establish interoperability within the Namibian Public Service. The study further recommends best practices for consideration, policy makers can use the study as a decision making tool in the planning and implementing of e-Governance interoperability. The study will also add to the body of knowledge in Academia. Interoperability is the foundation for a citizen centric one stop shop delivery of public services. Establishing interoperability in the Namibian public domain will enable: increase access to data and information, promote data & information sharing, enhanced public service delivery to various stakeholders, reduce service delivery costs, stimulate innovation, and enhance good governance etc.

1.6 Scope of the Study

The study focused on the various interoperability strategies, covering both Enterprise Architecture (EA), and Government Interoperability Frameworks (GIFs). The focus was based on establishing an e-Governance interoperability referential framework for the Namibian Public Service, taking into consideration the interoperability needs and the various issues of the Namibian Public Service.

To understand the requirements and principles of interoperability in the Namibian Public Service, the Namibian Public Service interoperability directives were analysed and the critical factors that may influence the implementation of an interoperability framework in the Namibian Public Service. And lastly best practices were drawn from the identified case studies.

1.7 Research Methodology

The study use qualitative research, in which explorative research was used in conjunction with case study research methods (multiple case studies) for data collection during the study.

The population sample was made up of organizations that are mainly experts and implementers of interoperability solutions, the two organizations that were part of the population sample were the e-Governance Academy and Cybernetica, all this two organizations from Estonia have implemented interoperability solutions around the world. The data was gathered using fully structured interviews and documentation analysis in order to obtain the required data for the study. Fully structured interview process was guided by an interview guide.

Case study was also used to analyse the adoption and implementation of existing interoperability frameworks. The best practices were drawn from the various case studies and incorporated in the Namibian interoperability framework and as a result the implementations process has been proposed for the selected interoperability framework(s).

1.8 Summary

This chapter (introduction), provided an overview in order to provide a better understanding to the research topic, it outlined the following aspects: problem statement, research objectives, research questions, significant of the study, scope of the study and research methodology.

The next three chapters (chapter 2, 3 & 4), provide relevant literatures in order to answer some of the research questions.

2 Literature Review

The aim of this chapter (literature review), is to review the relevant literatures, in order to create a better understanding of the research topic, the literature review aim to give a clear overview of Namibia country profile, the e-Governance concept, e-Government domains and e-Governance maturity assessment. And finally the chapter concludes with a chapter summary of the literature review.

2.1 Namibia Country Profile

According to UNESCO (2013), the Republic of Namibia is located in the south western part of Africa, with a land area covering 84 000 km2, Namibia share common borders with the Republic of South Africa to the south, Botswana to the east, Angola to the north and in the far north, Namibia share a common border with Zambia. The official language is English and the currency used is Namibian Dollars, Windhoek is the capital city of Namibia. Namibia is divided into 13 political regions and is an arid country, large parts of the country is covered by the desert. Namibia has a population of approximately 2.3 million people, Namibia is a densely populated country with a population of 2.7 people per square kilometer. Namibia is an upper middle income country; the country's GDP was estimated at USD 23.6 Billion (PPP) in 2014(Global Impact Investing Network, 2016) .

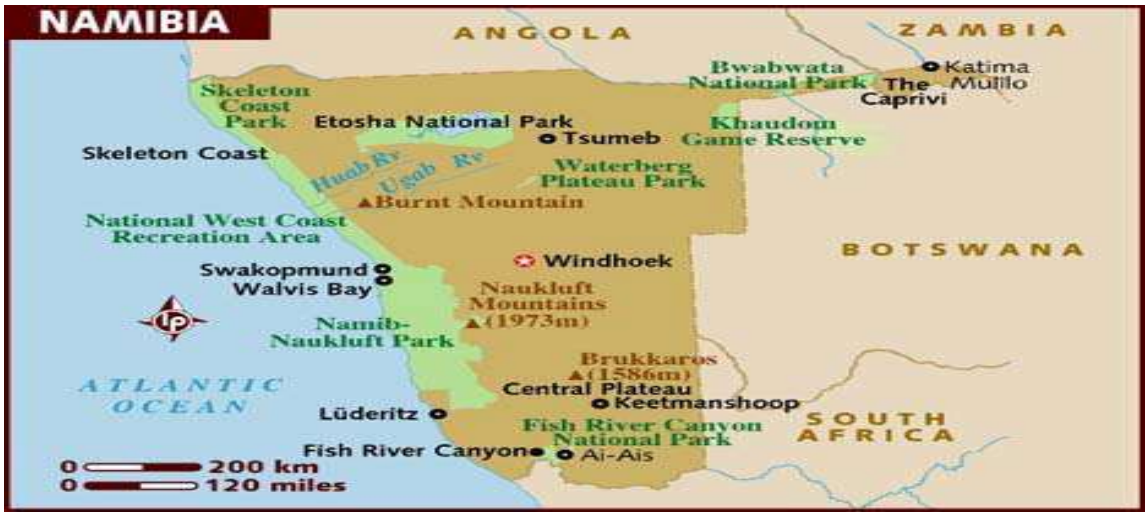


Figure 1. Map of Namibia. Source (UNESCO, 2013).

In 1878 the Walvis Bay harbor was annexed by the United Kingdom (UK), and in 1883 Germany claimed the coastal region of Namibia, in 1884 the entire Namibia was under the German rule. The colonial era in Namibia was a very unpleasant one, the Germans gained control over mineral resources and fertile land through military power and theft. During the period 1890 to 1908, allot of indigenous people in Namibia lost their lives, conflicts broke out between the Namibian people and the German troops. The German rule ended in Namibia with the outbreak of the war (World War 1). The League of Nations in 1920 gave South Africa the mandate to administer Namibia, and in 1966 the United Nations (UN) revoked the mandate of South Africa over Namibia. The Republic of Namibia gained its independence from South Africa on the 21 March 1990, after being under colonial rule for over 106 years (Government of the Republic of Namibia, 2004).

2.1.1 Namibia ICT Background

The government of the Republic of Namibia recognized the significant contributions of Information and Communication Technologies as one of the pillars to support the economy. The government formulated Vision 2030; which is a long term development plan, Namibia wants to be an industrialized nation, a nation that is competitive globally and with improved living standards for its inhabitants. Vision 2030 aim to transform Namibia into a knowledge based economy developed by her human resources. In order to achieve Vision 2030, the government formulated four (4) development plans. The desired outcome of the National Development Plan (NDP4), related to the ICT sector is to ensure that by 2017 suitable ICT infrastructure needs to be in place to enable economic competitiveness through innovation, development and research (IST-Africa Consortium, 2016).

The Namibian government envisaged that embracing ICT can benefit the country in various ways: establishing a conducive business environment for the development of ICT providers to be able to compete internationally and enable creation of employment opportunities for citizens, enable availability and access to information for citizens to help themselves in decision making and improve their living standards.

The Namibian government has made good progress in developing the Information and Communication Industry; the government has established various Information Technology policies such as Telecommunications Policy, Information Technology

Policy, e-Government Policy of 2005 and Broadcasting Communication Policy of 2009. In 2011 the Communications Regulatory Authority of Namibia was established to regulate the Information and Communication Technology industry (IST-Africa Consortium, 2016).

2.1.2 e-Governance Project in Namibia

Namibia is moving towards taking advantage of ICT, allot of initiatives at the national level are evident. Here is a brief overview of the e-Governance project (IST-Africa Consortium, 2016).

The government of the Republic of Namibia recently implemented projects under its e-Governance programme, the Department of Public Service Information Technology Management (DPSITM) in the Office of the Prime Minister (OPM), is responsible for the coordination of the e-Governance project in the Public Service. The government through the Office of the Prime Minister launched the e-Governance Strategic Action Plan (e-GSAP); the strategic action plan is a road map to facilitate effective utilization of ICT in the Namibian Public Service. In 2010 the project first phase started with the assessment of government readiness to move towards an e-journey, the e-readiness results provided the basis for the formulation of the e-Governance Strategic Action Plan, the Strategic Action Plan consist of a number of programmes and projects, and outlined the necessary financial resources to implement programmes and projects. The e-Governance Strategic Action Plan, identified Five (5) strategic thrust areas in order to realize its vision: Foundation and Support, Impact and Visibility, Consistency and Standardization, Collaboration and Networking, Training, Education and Research. The e-Government Strategic Action Plan outlined 15 programmes and ten (10) e-services were identified and piloted for the period 2014 – 2018 and consist of services such as: Integrated Tax Administration System, Hunting Permits, iRecruitment and Employee Self-service Process, Business Registration, Deeds Registration Process, Namibian Students Financial Assistant Fund, Plant and Animal Import and Export and Forestry Produce, e-Health Systems, Mining Licenses Application & Renewals and Issuing Permits-Water Effluents(IST-Africa Consortium, 2016).

2.2 Overview of the e-Government Concept

The concept of e-Government emerged during the technological revolution in the late 1990s, the technological revolution enabled the delivery of government services over the internet, and it transformed government's administration functions in various ways. Countries all over the world, irrespective of their political systems regarded e-Government as a way of modernizing their nations. Countries over the world have a different view of the meaning of e-Government, which is more related to their political systems (Sharifi & Zarei, 2004) .Various academics have defined e-Government in different ways: e-Government as a concept of implementing cheaper effective models in order for federal employees, citizens and other stakeholders to be able to do business electronically. e-Government is further defined as a technology to automate and simplify the transactions between the various stakeholders and the governments.

e-Government involves carrying out functions and achieving results by utilizing modern technologies (ICT), e-Government is expected to enable governments to perform their functions more efficiently and effectively(Government of India, 2012). In order for governments to be more effective, governments need to change (laws, processes, government ways of interacting with citizens, its outlook, regulations and rules etc.); it will also involve creating awareness to the general public about the e-Governance initiatives and capacity building in the government. e-Governance aim to create smart governance, and in doing so, it will involve the use of ICT by governmental agencies in order to: improve agency internal efficiency, reducing agency administration, improving quality of service to citizens and restructuring agency administration processes, to be able to exchange information with the relevant stakeholders (business, citizens, governmental agencies), to deliver more faster efficient public services to citizens (Government of India, 2012).

An e-Government initiative can be divided or can include these perspectives: citizen's perspective, tele cooperation perspective, process perspective, e-business perspective and knowledge perspective (Sharifi & Zarei, 2004).

e-Governance in essence aim to make the interaction between the various stakeholders, government and business (G2B), government and citizens (G2C) , government to government (G2G) more convenient, inexpensive, transparent and more friendly(Government of India, 2012 page 16).

According to Andersen & Henriksen (2006), e-Government applications are been adopted as governments are looking for data quality improvement gains, efficiency, and effectiveness. Different authors have indicated that technology does not have an impact, but it is all based on: situated change, power and choice. Information Technology is not evolving on its own, but it is all concerning decisions on how to: adopt Information Technology at the organizational level, individual level and societal level. It should be stated that e-Government strategies are reliant on technology as a driver for e-Governance initiative.

e-Governance at the other hand is considered a broader perspective than the e-Government concept; it can bring about change in the manner how stakeholders (citizens) relate to their governments and governments to citizens (Signore, Chesi, & Pallotti, 2005). The concept of adopting Information and Communication Technologies is for governments to move beyond passive information to more active stakeholder participation in the process of decision making. The e-Governance concept can bring about new concepts of citizenship, both in terms of responsibilities and citizens demands. The aim of e-Governance is to empower, enable and engage citizens (Signore, Chesi, & Pallotti, 2005). In this document, the two terms (e-Government and e-Governance) will be used. Figure 2 shows e-Governance as consisting of both socio technical and dynamic perspectives.

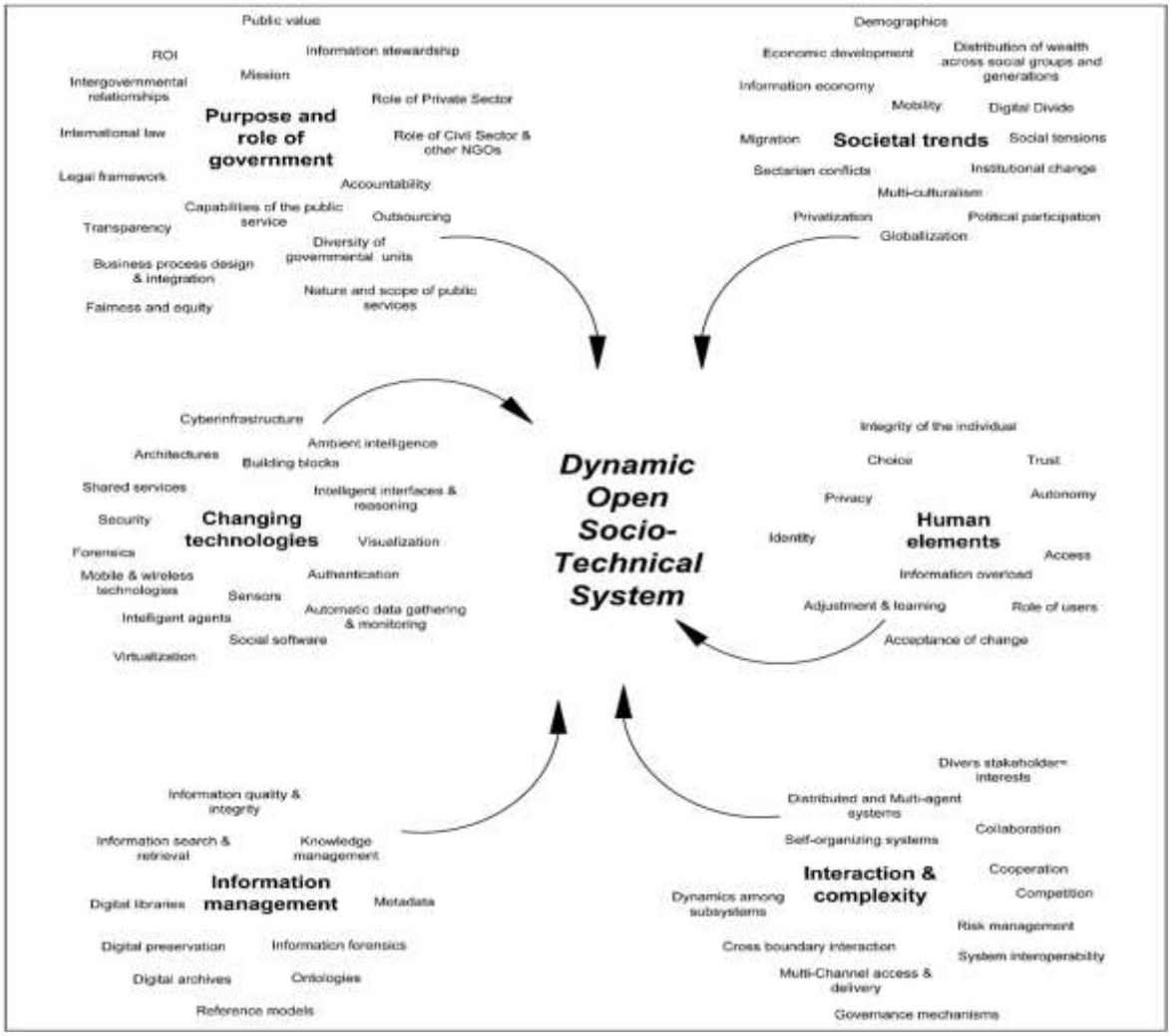


Figure 1. e-Governance as a Socio Technical and Dynamic System. Source (Dawes, 2009).

2.3 e-Governance Domains

e-Governance enables interaction between various stakeholders (government, business, and citizens); by utilizing ICT as an enabler, functions can be divided into various groups (Government of India, 2012).

- Electronic administration in government in order to provide support for policy decision makers
- And electronic democracy, to be able to facilitate electronic elections or e-voting

The following interactions between various groups in e-Governance can occur (Government of India, 2012, page 17-18).

Government to Employees (G2E):

The government as an institution is the organization that provides employment opportunities, and need to interact regularly with its employees. The interaction between

government and employees is a two way interaction. The utilization of technologies (ICT), in the interaction between government and employees is made more efficient, faster and increases high levels of satisfaction amongst the employees.

Government to Citizens (G2C):

There is an interface created between the citizens and their government, which lead to the citizens to take advantage of the efficient delivery of various public services. These enable the accessibility and availability of public services and improve the quality of service delivery in the public domain. Citizens have the different options concerning when they can interact with their governments (e.g. seven days a week or 24 hrs. a day etc.), where to interact with their government (e.g. home, kiosk, service centre etc.) and how citizens can interact with their governments (e.g. through email, face to face, internet, telephone etc.). The primary objective is to make government friendlier to its citizens.

Government to Government (G2G):

The utilization of modern technologies is used across government in order to: increase the flow of information and services between different governmental agencies and restructure processes involved in the administration of the government. The Government to Government interaction only takes place in the government domain, and can be vertically or horizontally. Vertical interaction can be between local governmental agencies, different levels within an institution, national and regional. While at the other hand horizontal interaction may take place between various functional areas within an institution or between various governmental agencies. The main objective of this interaction is to improve agency efficiency and performance.

Government to Business (G2B):

Information and Communication Technologies are used by the business sector, in order to help them in delivering effective services and goods, and to interact seamlessly with their governments. The aim is to save time, cut on operational cost and create a transparent environment when doing business with government. Government to Business interaction can be transactional, for example: revenue collection and procurement, permits and licensing. Interaction can also be facilitative, such as in the area of tourism, investment and trade. All this enables a productive environment for business to flourish and improve business performance (Government of India, 2012, page 17-18).

2.4 e-Government Maturity Assessment

According to Kachwamba & Hussein (2009), the term maturity level in e-Government refers to a state of growth and is a continuous growth process. To understand the implementation process in e-Governance and the allocation of resources and efforts in an e-Governance initiative, different authors identified various phases of implementing e-Governance, based on several measures such as web measure index in countries or governments. The stages enable the identification of the counties or government e-Governance maturity level. Maturity levels in e-Governance represent a stage or progressive growth, lower stage growth to a higher stage growth. The stages or levels of e-Governance initiative are based on various factors, such as services available on official government websites and content. Organizational and technological complexity increases as e-Governance initiative progressively grow from lower level to a higher level. Higher levels or stages of maturity are desirable, but can be very difficult to achieve, and there is no common agreement currently regarding the number of stages which an e-Governance initiative should go through, from an immature level to more advance level.

According to Shahkooh et al (2008), a citizen oriented strategy for public services delivery cannot only be successful by launching websites for citizens to use electronic services and putting processes on the internet for citizens, the e-Governance initiative is more than just putting in place websites. The e-Governance initiative is about government reforms and transforming businesses. In order to achieve successful e-Governance transformation which is able to perform the necessary transactions and interactions electronically, the e-Governance system should be able to evolve gradually, while the necessary facilities are being put in place. This leads to a step wise completion of the e-Governance system.

Developing robust infrastructure for e-Governance requires a staged methodology, which starts from the very immature stage to the most mature stage, able to provide full integration with the public administrations. The benefit of having a staged approach is the ability to develop or generate momentum maintained throughout the various stages, allowing citizens to be able to utilize online services and enabling stakeholders (citizen, business) confidence and trust in their government. The implementation of e-Governance system undergo various stages until it reach the highest potential stage which is integration. In the integration stage, the government is able to provide

information and services from the various departments from an online one stop shop (Irani, Al-Sebie, & Elliman, 2006).

Figure 3 below shows an e-Governance maturity model, stages ranges from lower to high level, high levels increases with complexity in the technology.

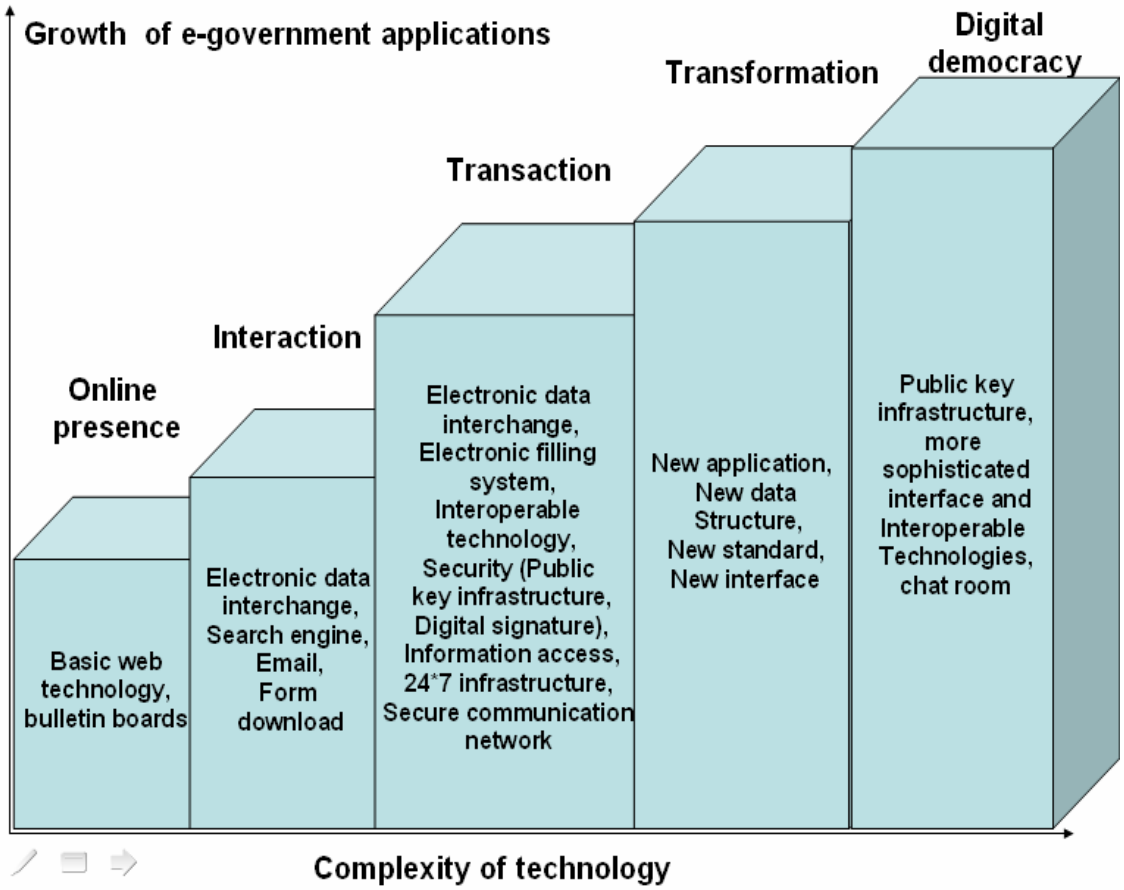


Figure 2. e-Governance Maturity Model. Source (Shahkooh et al., 2008).

Based on organizational, technical and managerial feasibilities, e-Governance is an ever gradually evolving phenomenon and calls for the e-Governance projects to be derived and implemented accordingly in four phases: phase one: cataloguing, phase two: transaction, phase three: vertical integration and phase four :horizontal integration (Layne & Lee, 2001).

Here are the stage descriptions as suggested by (Layne & Lee, 2001 page 126-133).

Stage 1: Cataloguing

In this phase, the governments are basically establishing their presence on the internet; by developing websites in order to be able to provide information on the internet, due to pressure from demanding citizens, media houses, employees who are ICT literate and want services online. Governments provide or present basic information on the internet and develop web applications to enable citizens to be able to download various forms online. Governments do not have ICT expertise at this stage, but willing to move online, as stakeholders have access to information on the internet, and expect same from their governments.

The cataloguing phase provides the least functionality to the citizen, as the stage progresses, the quantity of information posted by government's increases.

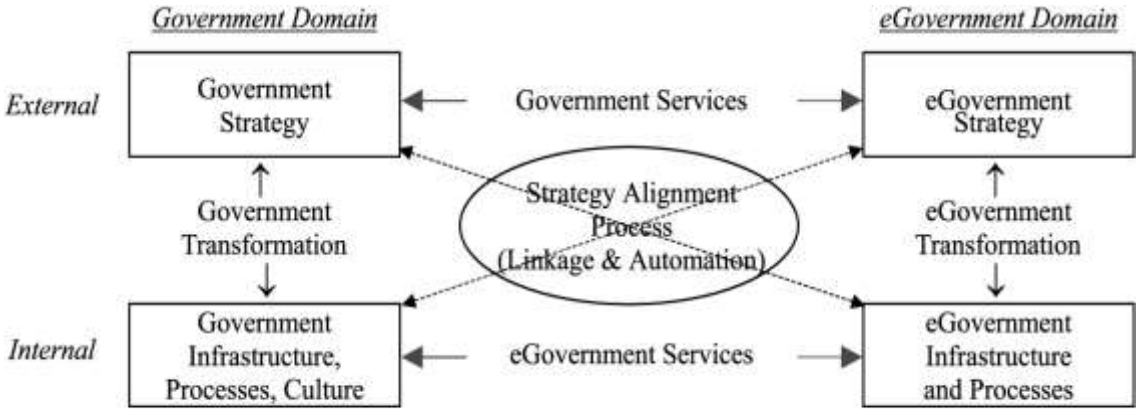
Stage 2: Transaction

In the transaction phase, the e-Governance initiatives focuses on various issues, such as connecting various internal systems in the public domain electronically and enable different stakeholders to transact with their governments over the internet. The transaction phase includes e-Governance efforts, such as putting or deploying live databases and creating links to interfaces.

Government websites evolve over time, stakeholders realize the benefit of the internet, as an alternative channel to get access to government services and exploit the use of the internet. Stakeholders are able to fulfil the requirements of their governments online, instead of physically going to governmental agencies and complete paper work manually. Electronic transactions provide improved efficiency to the various stakeholders and the governmental agencies, enable opportunities for a broader democratic process, through holding of interactive conversations and enable those stakeholders not able to part take in public hearings for various reasons.

In the transaction phase, there is a two way communication taking place between the government and the citizens, the citizens are able to transact with their governments through the use of the internet and their government respond by issuing receipts and

confirmations. Citizens play a very active role in the transaction phase by taking part in online forums as a mean of engaging their governments directly. Figure 4 shows a diagram of strategic e-Government alignment with the various e-Governance domains and various stakeholders.



Source: Henderson and Venkatraman (1993)

Figure 3. Strategic Alignment of e-Governance. Source (Davison, Wagner, & Ma, 2005).

Stage 3: Vertical Integration

In the vertical integration phase, the state, local and central governments are connected for different services or functions of the government. The focus of the vertical integration phase is to transform government services rather than digitizing and automating processes already existing. The aim of vertical integration is to enable seamless integration of local systems, federal systems with state's system for checking and cross referencing.

Stage 4: Horizontal Integration

Horizontal integration stage is described as the integration across all the various services and functions in government. In e-Governance development, vertical integration is first achieved before achieving horizontal integration. The potential use of Information and Communication Technology from a user (citizen) perspective can only be made possible by horizontal integration in the public domain, by integrating services across various functional areas or silos. Horizontal integration will make it possible for different databases across various functional jurisdictions to share information and communicate with each other effectively and be able to enable governmental agencies to reuse information throughout all the state functions (Layne & Lee, 2001, page 126-133).

2.5 Summary

The literature review in short provided an overview of Namibia general country profile, as this research give more emphases on Namibia.

Concepts of e-Governance covered: e-Government domains and e-Government maturity assessment. Concerning the e-Governance concept, the literature suggested that there are many definitions to e-Government, countries all over the world have different views of what e-Government is, and this have to do with their political system.

e-Government is a dynamic and socio technical system covering areas such as: purpose and role of government, societal trends, changing technologies, human elements, information management, interaction and complexity. There are various domains in e-Governance and various models of assessing e-Governance maturity exist. The literature further gathered that horizontal integration makes it possible for various databases (Db) across various functional jurisdictions to share information and communicate with each other effectively and enable agencies to reuse information throughout all the functions of the state.

The literature indicated that the implementation of e-Governance system undergo various stages until it reach the highest potential stage which is integration. Integration stage makes it possible for governments to provide information and services online from various departments, from an online one stop shop. The integration stage is made possible by interoperability which is the theme of this research.

The next chapter (e-Governance interoperability concept), provide more insight on the interoperability concepts in order to answer some of the research questions.

3 e-Governance Interoperability Concept

The aim of this chapter is to review the relevant literatures, in order to be able to answer some of the research question(s) presented in this chapter, the literature review aim to give a clear overview of the e-Governance interoperability concepts, covering areas such as: descriptive forms of interoperability, interoperability adoption factors, approaches of achieving interoperability, interoperability maturity assessment, Public Service of Namibia interoperability directives, and finally the chapter concludes with a chapter summary.

3.1Introduction

Interoperability in e-Governance context can have multiple definitions as pointed out by (Novakouski & Lewis, 2012, page 2-3).

> e-Government interoperability in its broad sense *is the ability of constituencies to work together. At a technical level, it is the ability of two or more diverse government information systems or components to meaningfully and seamlessly exchange information and use the information that has been exchanged*.

The European Commission (EC), has redefined the concept of e-Governance interoperability and according to them,

> *Interoperability is the ability of disparate and diverse organizations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organization via the business process*

> *they support, by means of the exchange of data between their respective information and communication technology (ICT) systems* (Novakouski & Lewis, 2012, page 2-3).

e-Governance interoperability is a mean and not an end in itself (Pardo, Nam, & Burke, 2011), the important goal in e-Governance initiative is to provide services to various stakeholders (citizens, business), and to improve government administrations. Whether to establish the creation of new connections amongst various networks in government, developing new service integration capabilities, or to leverage the technologies at all the levels of the government, e-Governance interoperability is regarded as a key element to determine the maturity and development of e-Governance. Interoperability is identified as a necessary element to enable seamless services of e-Governance to stakeholders (citizens, business), it enable the facilitation of transformation and innovation by e-Governance, enable information sharing, system integration and cross boundary collaboration. Interoperability is critical and has the capabilities to connect governments. Interoperability has the capability to connect governments across varies boundaries in order to be able to share information in government and integrate service delivery to stakeholders. e-Governance interoperability is the foundation to the success of a connected government objectives: efficient and effective government, collaborative and government seamless delivery of public services to citizens. Lack of e-Governance interoperability is a major obstacle to e-Governance maturity, lack of architectural interoperability and absence of interoperability standards in e-Governance hinders advance developments in e-Governance, and limit government to government (G2G) efforts in e-Governance initiatives.

Interoperability provide various benefits to governments: it enable improved access to more information, making it faster to resolve problems, enables a more connected government instead of isolated systems and reduction in transactions (Santos & Reinhard, 2012).

Interoperability aim to achieve three goals in any system: meaning exchange, process management and data exchange (Das & Mahapatra, 2012 page 43).

Data exchange: Interoperability enable basic data exchange, for example emails, phone connections, document exchanges to web form (web pages) and data exchange between

two or more computer systems where there is a mutual agreement on the size and type of data to be exchanged, the data exchanged can go back and forth, participants in the data exchange don't need to have any knowledge of the data exchanged between them.

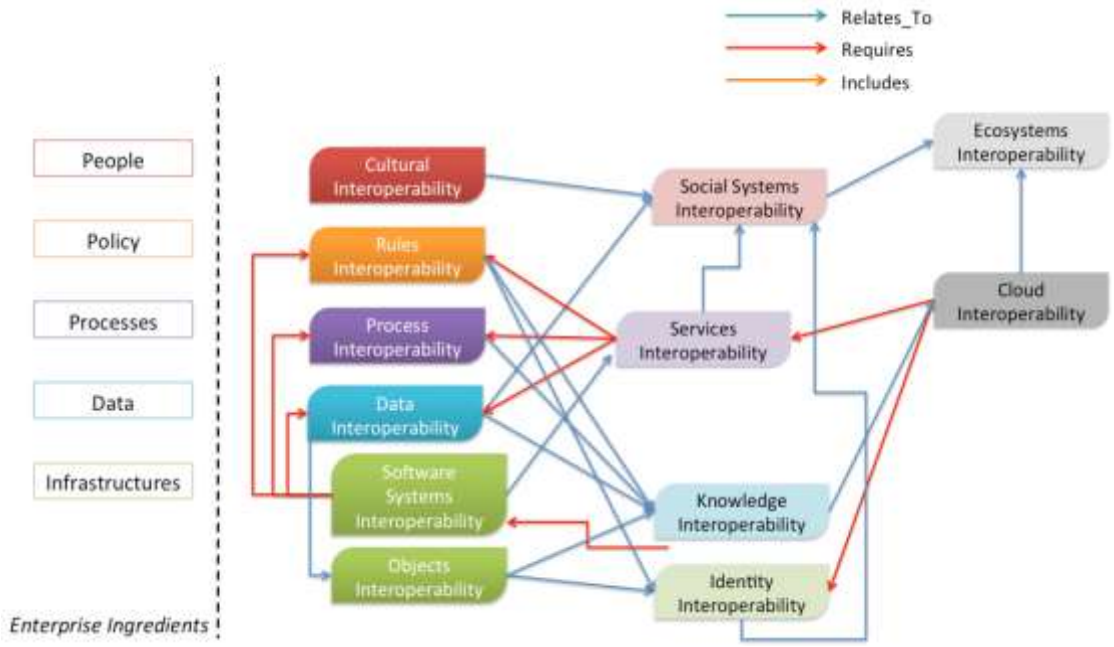


Figure 4. Enterprise Interoperability areas. Source (Koussouris S., Lampathaki F., 2015).

Meaning Exchange: Interoperability enable the exchange of meaning, all the participants taking part in a communication are assigned with the same meaning of the information being exchanged between them. The meaning exchanged is difficult as there is no guarantee that all communicating participants will interpret the meaning of data in the same manner.

Process Agreement: The final or third goal of interoperability is the agreement on how to respond or act on the information exchanged. Process agreement concentrate on action taken by participants in a communication, once information that is exchanged took place, all the participants in the communication must agree in advance concerning what to do with the received data in exchange (Das & Mahapatra. 2012 page 43).

3.2 Descriptive Forms of Interoperability

There are three strands to e-Governance interoperability from a European Interoperability Framework (EIF) perspective: semantic interoperability, technological interoperability and organizational interoperability (Misuraca et al., 2011).

Technological interoperability is concerned with both software and hardware issues, it focus on the technical aspects, such as connecting or linking information systems. Technical interoperability covers areas such as interconnection services, data presentation and exchange, and interface specifications. Technical interoperability is not specific to public administration, and that's why technical interoperability need to be enabled through the use of endorsed standards by recognized standards bodies or technical specification provided by industry (ISA/IDABC, 2010 page 23).

Technical interoperability enables the mapping to the goal of the data being exchanged in a communication. Some technical models of interoperability divide interoperability into more sublevels, in order to abstract more details of communication (Das & Mahapatra, 2012, page 44). Figure 6 shows the various levels of interoperability in the European Interoperability Framework (EIF).

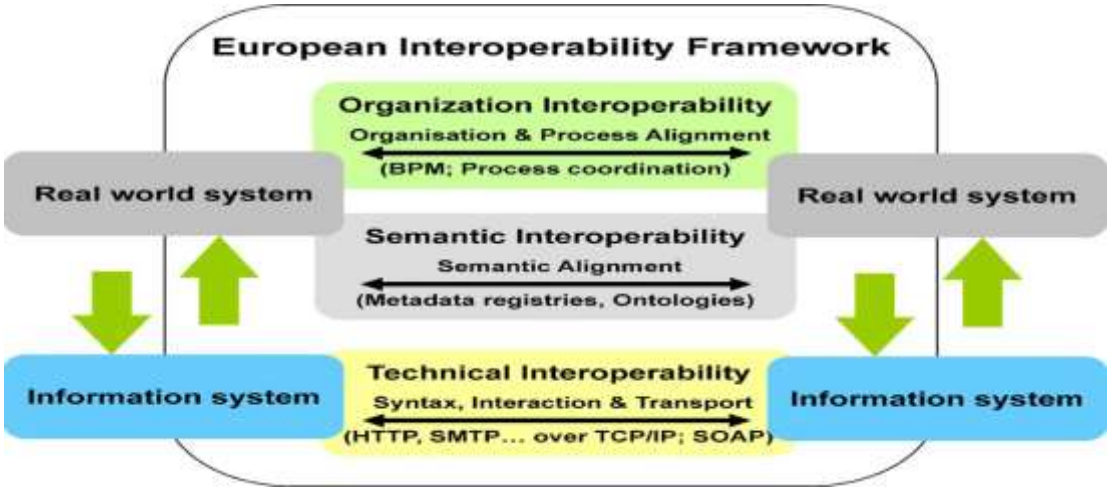


Figure 5. Levels of Interoperability in the European Interoperability Framework. Source (Vernadat, 2010).

Semantic interoperability at the other hand enables institutions to be able to process information in a more meaningful way from external sources; semantic interoperability ensures exact meaning of the exchanged information and ensures that the exchanged information is well understood and preserved throughout the different exchanges amongst communicating entities. Semantic interoperability level, in the European Interoperability Framework (EIF) concept include: Syntactic interoperability and Semantic interoperability (ISA/IDABC, 2010).

Semantic interoperability is placed on top of the technical interoperability layer for the reason of enabling exchange of meaning; semantic interoperability maps to meaning

exchange (Das & Mahapatra, 2012 page 44). Figure 7 shows an example of semantic interoperability requirements.

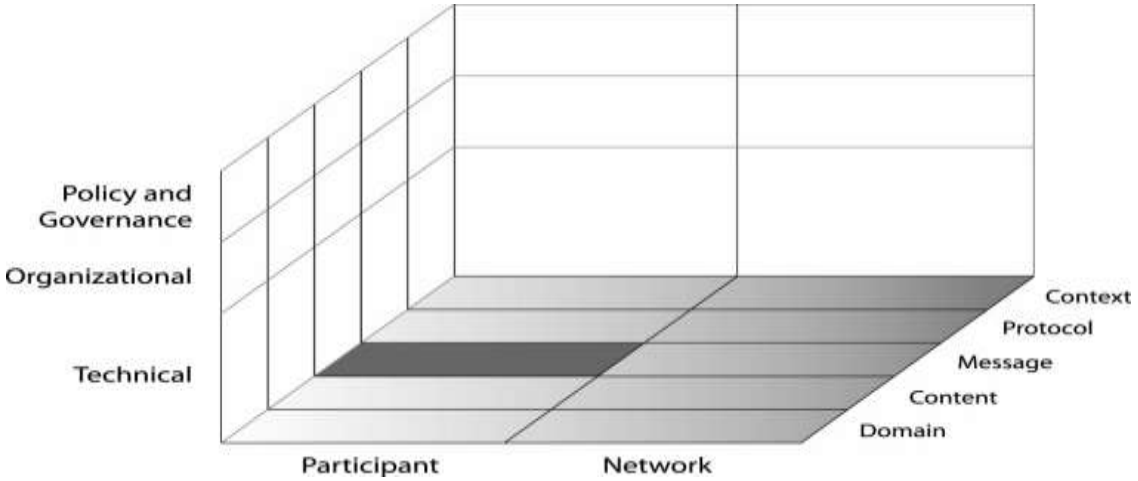


Figure 6. Semantic Interoperability Requirement Space. Source (Ojo, Estevez, & Janowski, 2010).

To achieve semantic interoperability in the European perspective requires: development methodologies for semantic interoperability assets, and agreed processes, industry specific and cross industrial communities to concur on how to use semantic interoperability.

Organizational interoperability focus on how organizations in the public domain collaborate to attain their objectives, organizational interoperability is achieved through the integration of exchanged information and various business processes (ISA/IDABC, 2010 page 21-22). Figure 8 shows an example of the relationship between e-Governance interoperation and interoperability between two different nodes.

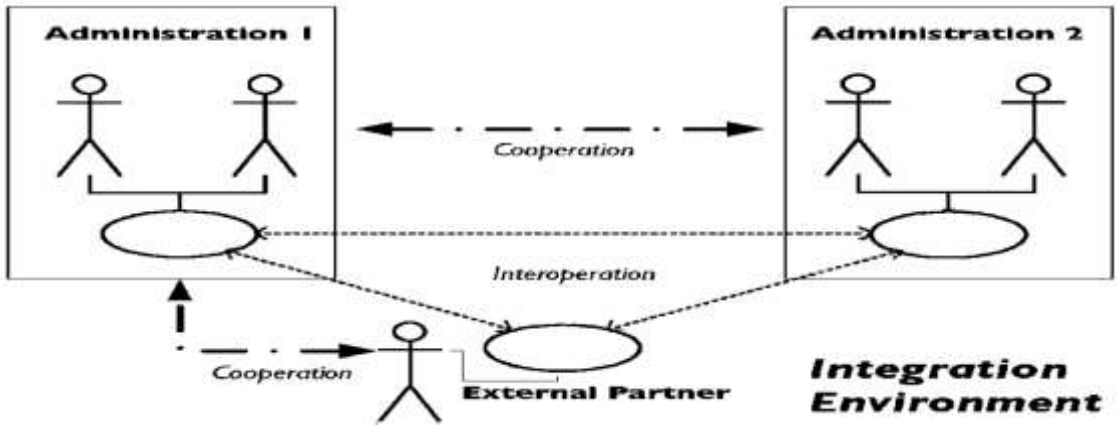


Figure 7. Relationship of e-Government Interoperation and Interoperability between two (2) Nodes. Source (Sedek, Omar, & Sulaiman, 2012).

Organizational interoperability in essence maps to process agreement goal, organizational interoperability is placed on the top phase, as process agreement is not able or cannot take place without the information exchanged, and the meaning that is exchanged to aid the communication in order to establish the process and communication. Organizational interoperability captures the scopes of both inter and intra organizational process alignments required to achieving interoperability goal in e-Governance (Das & Mahapatra, 2012 page 44). Table 1 shows examples of different layers of e-government interoperability and their descriptions.

Table 1.Different layers of e-Government Interoperability. Source (Goldkuhl, 2008).

Different layers of interoperability	Meaning
Judicial interoperability	Congruence between different laws/regulations
Organizational interoperability	Congruence in goals and work processes
Axeological interoperability	Congruence in values and goals
Cognitive interoperability	Congruence in thought and perceptions
Intra-processual interoperability	Congruence between internal work processes
Interactional interoperability	Congruence in interactions
Semantic interoperability	Congruence in used language (concepts/terminology)
Technical interoperability	Congruence in technical equipment

3.3 Interoperability Adoption Factors

Interoperability is one of the most critical aspects of e-Governance, to establish a single one stop shop, and integrated online services (e-services), imply high demands on e-Governance interoperability. Interoperability is very important in the context of e-Governance, there are barriers for institutions to achieve the required interoperability effectively, and barriers range from political issues, financial issues, organizational issues, and technical issues (Pardo et al., 2011 page 73-76) .

Some authors (Santos & Reinhard, 2012), also indicated that there are some other constraints that can have an influence on the adoption of interoperability, aspects can be

classified as: Collaborative, cost, technological, performance, constitutional, legal, managerial and informational.

The e-Governance constrains mentioned above, represents a very complex environment to enable the success of e-Governance interoperation. Technology factors are considered the least difficult barriers to fix, while legal, social and organizational factors are very difficult to address.

Interoperability is very crucial in the joining up of public administration, to be able to provide information and services over different channels and to be able to reuse the administration information and share (Laskaridis et al., 2007). Interoperability is the fundamental requirement to achieve technical and economical perspective at both national and international level, in order to enable effective and efficient development of e-services.

There are three aspects of interoperability that need to be taken into consideration: semantic interoperability, organizational interoperability and technical interoperability.

3.4 Approaches to Achieve e-Governance Interoperability

3.4.1 *Government Interoperability Framework (GIF)*

Many countries around the world have been adopting, creating and publishing their own Interoperability Frameworks (IFs), an interoperability framework in essence is a group of documents specifying: guidelines, concepts, vocabularies, recommendations, principles, standards and practice of public agencies that wish to work together in order to meet their objectives of public service delivery to their citizens. The launch of the e-GIF in September 2000, in the United Kingdom (UK) is regarded as one of the first interoperability framework published in the world. After the launch of the e-GIF in the United Kingdom in 2000, many countries followed suite, they started developing or publishing their own national interoperability frameworks, as a critical tool to facilitate interoperability in the public domain information systems, but also due to political pressures from powerful organizations such as the European Commission (EC) (Lisboa & Soares, 2014).

According to Santos & Reinhard (2012), interoperability is a very important factor in e-Governance due to the high need of public agencies information systems to be fully integrated and be able to exchange data seamlessly. One of the approaches to achieve

this is by developing a Government Interoperability Framework (GIF). The government interoperability framework is a set of guidelines and standards which outlines the manner in which organizations should agree or have agreed in order to interact with one another. The GIF covers technical specifications that all public agencies involved in e-Governance should implement.

Government interoperability framework (Ray et al (2011), represent the e-Governance architecture in a more layered approach and recommend permissible technologies for each of the layers in the architecture. Some of the interoperability frameworks in e-Governance do cover non-technical issues. Most of the very important non-technical factors relevant to electronic government are semantic and organizational dimensions of interoperability. Countries around the world have developed their own government interoperability frameworks, as a primary instrument to tackle issues of heterogeneity between public domain information systems, GIFs are developed independently by countries and do vary in the content and the approach of their development. Figure 9 show a conceptual framework for context based e-Governance interoperability development or implementation.

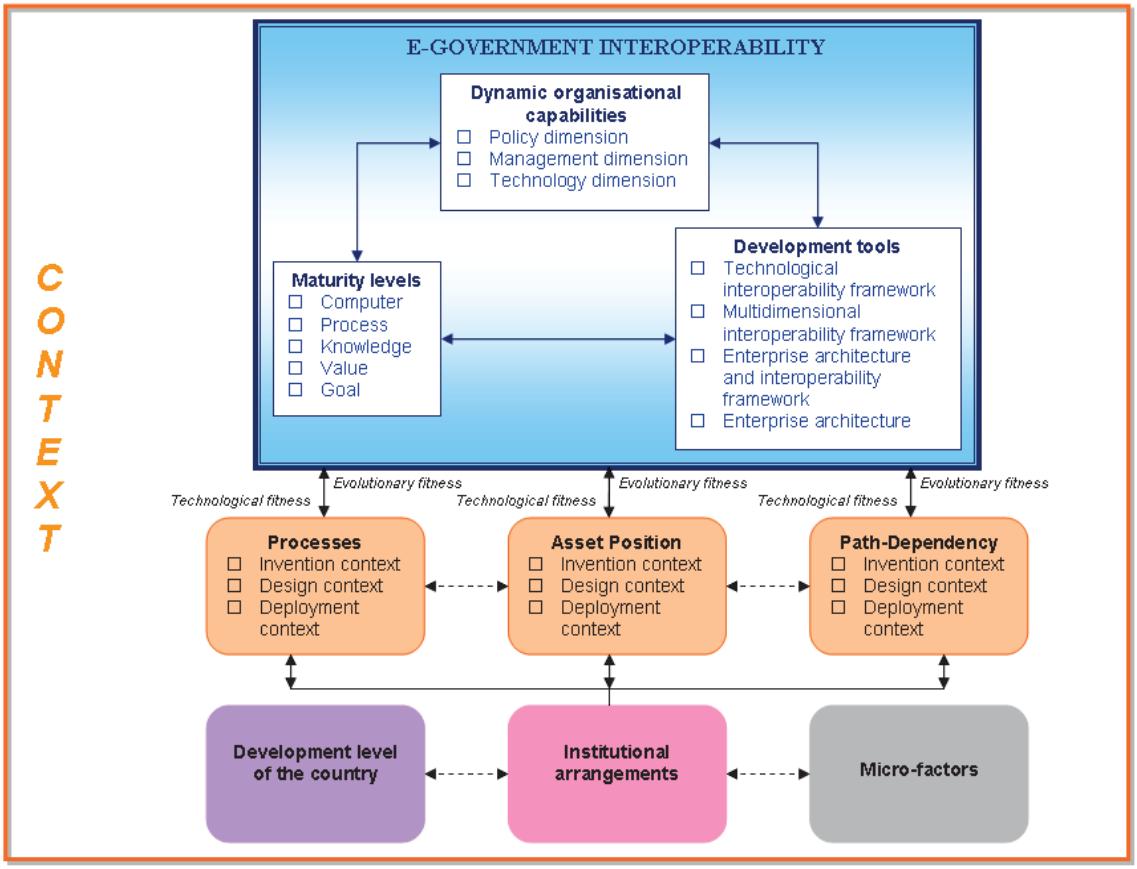


Figure 8. Conceptual Framework for Context-based e-Government Interoperability Development. Source (Malinauskienė, 2013, page 79).

3.1.1.1 Standards in e-Governance Interoperability Frameworks (GIFs)

Interoperability frameworks consist of a technical standards catalogue, which serves as the basic guidance when implementing various e-Governance systems and services in the public domain. IT service providers should be involved in the implementation of e-Governance; governmental departments should work together with IT service providers. Public procurement guidelines or procedures should be well defined on how governments should proceed, when awarding contracts in the public domain that will lead to services implementation and the acquisitions of systems. The adoption of interoperability frameworks in the public domain provides various benefits to the government, as technical requirements are specified regarding the technical specifications that governmental agencies agreed upon collectively. The public procurement is shaped by various laws that govern various factors. One of the relevant factors is the use of technical specifications; technical specifications need to exhibit characteristics to be able to be part of public domain contract documentations. There is a link between interoperability frameworks and standardizations (Guijarro, 2009).

Table 2. Example of a Technical Standards Catalogue. Source (Guijarro, 2009).

Interoperability areas	**Specifications**	**Services**	**Voluntary industry standards**
Interconnection	IPv4 ,HTTP, S/MIME	Human computer interface services	HTML, Symbian
Data integration	XML, XSL, UML, RDF	Data interchange services	WAP, J2EE, .net, Web Services
Content management meta data	XML, eGMS	Network services	MIME, T.120, H.323
Access	DTV, mobile phone, PDA, smart card	Data management services, security services	JDBC, WebDAV S/MIME, SAML

The Government Interoperability Frameworks, make use of the adopted standards in order to ensure interoperability in the public domain. Standards are an agreement between various independent entities on how to accomplish tasks, it is a framework of specifications that is approved by standards organizations and is widely used by industry. Open standards promote interoperability in e-Governance; interoperability can

be achieved when different components are able to jointly work together in completing a business process. Open standards aid in defining the various component interfaces, and increasing interoperability, this enables simpler and quicker integration initiatives. Open standards should display some of the following characteristics: Availability, maximize end user choice, no loyalties, no discrimination, extension or subset and predatory practices. In order for standards to be considered open, standards should not be controlled by any specific vendor or group, standards should be accessible, easy to read and use, standards should be developed using a process that is transparent and easy for everyone to participate in (United Nations Develepment Programme, 2007).

Principles help guide in the development of Government Interoperability Framework and later becomes the basis for selecting standards, GIFs considers several similar key underlining principles: interoperability, scalability, reusability, openness, market support, security and privacy (United Nations Develepment Programme, 2007). Table 3 shows a comparison of examples of principles in GIFs adopted by various countries.

Table 3. Principles of various GIFs in different countries. Source (Ibm, 2007 page 6).

	Interoperability	**Scalability**	**Reusability**	**Openness**	**Market Support**	**Security**	**Privacy**
Australia	X	X	X	X	X	X	X
Brazil	X	X		X	X		
Denmark	X	X	X	X		X	
Germany	X	X	X	X			
Malaysia	X			X	X		
UK	X	X		X	X		
EU	X		X	X		X	X

3.4.2 Enterprise Architecture

Organizations around the globe are increasingly adopting Enterprise Architecture (EA), EA is very critical to e-Governance interoperability, and as such it is regarded as one of the effective measures of tackling interoperability issues, and facilitating interoperability across various agencies in the public domain(Pardo et al., 2011 page 4).

Enterprise Architecture is a comprehensive description that covers all major relationships and elements that constitute or make up an enterprise (Guijarro, 2007). An

enterprise can be a department with in a company, maybe an institution or maybe a company. The various elements to be described maybe: human resources, software components, business locations, data and network equipment's etc. The main objective of Enterprise Architecting is to align various business processes and the goals of institutions, the systems that make up the enterprise technical infrastructure and applications (Guijarro, 2007).

Enterprise Architecture (EA) provides guidance to direct the transformation and evolution of organizations with technology and may produce these deliverables:

- The current state of the Enterprise Architecture model, the future state of the Enterprise Architecture reference model and the architecture road map.
- The gap analysis identifying shortfalls in the current state, to support strategies of the business and objectives(Covington & Jahangir, 2009 page 1-3). Figure 10 shows an example of the content of Federal Enterprise Architecture model.

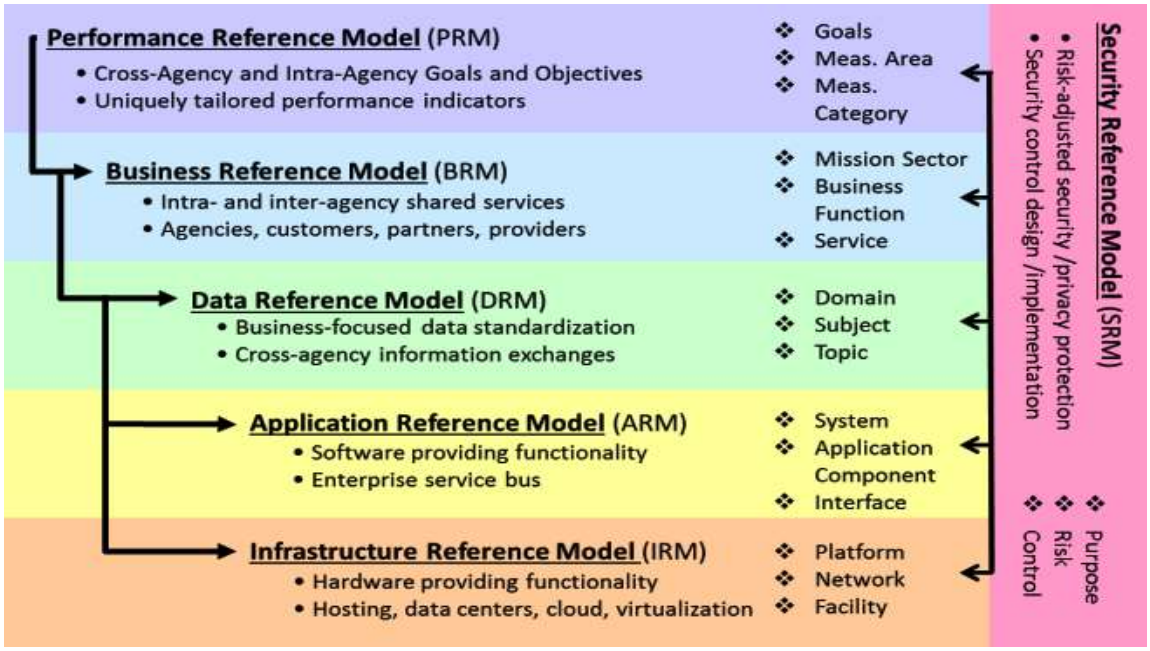


Figure 9. FEA Content. Source (CIO, 2013).

Enterprise Architecture frameworks includes: enterprise architecture content meta model, common vocabulary, taxonomy and models, recommended set of configurations and products, reference models and architectures, catalogue of artefacts and deliverables, principles, strategies and tools, prescriptive guidance (processes,

governance, implementation roadmap and architecture content). There are a number of EA frameworks existing with the aim of addressing the challenge of organizing business objectives with the technical requirements and strategies, aligning and assessing (Covington & Jahangir, 2009 page 3). Figure 11 shows various industry frameworks used in Enterprise Architecture.

Criteria	Zachman	TOGAF	FEA	Gartner
Taxonomy Completeness	4	2	2	1
Process Completeness	1	4	2	3
Reference Model Guidance	1	3	4	1
Practice Guidance	1	2	2	4
Maturity Model	1	1	3	2
Business Focus	1	2	1	4
Governance Guidance	1	2	3	3
Partitioning Guidance	1	2	4	3
Prescriptive Catalog	1	2	4	2
Vendor Neutrality	2	4	3	1
Information Availability	2	4	2	1
Time to Value	1	3	1	4

Rating Scale:
1. Very Poor
2. Inadequate
3. Acceptable
4. Very Good

Source: *Comparison of the Top Four Enterprise Architecture Methodologies* by Roger Sessions, CTO of ObjectWatch

Figure 10. Industry Frameworks used in EA. Source (Covington & Jahangir, 2009 page 4).

There are various reasons why governments across the world make use of the National Enterprise Architecture (NEA), they believe that the National Enterprise Architecture can meet some of the various objectives according to (Lallana, 2008 page18).

- Be able to achieve more efficiency in their administrations through the efficient use of their IT resources
- Enable easier access to public domain information via open interfaces between the various stakeholders
- Provide a stable platform for government administration through solid IT systems with adequate capacity
- Provide sufficient protection of public information through safer solutions for exchanging and data handling
- Enable innovative support for cross functional administration processes to ensure better coherence in information (Lallana, 2008 page18).

3.4.4.1Architectural Design Principles

Governments should consider interoperability through architecture, by adopting architectural principles to achieve interoperability goals. Governments should consider these architectural design principles (Lallana, 2008 page 19-20).

- Stimulate/breed diversity
- Stimulate sharing
- Set targets as well as constraints
- Develop modular architectures
- Develop competencies
- Develop standards infrastructure components
- Stimulate the formulation coalitions(Lallana, 2008 page 19-20).

3.4.4.2 Technical Content of EA

Open standards are the backbone of enterprise architecture, open standards ensures flexibility and enables managers to combine, match and mix, replace components without having to hire an expert to code custom connections amongst the various service components. Enterprise Architectures (EAs), can be divided into layers or technical components, the US FEA for example consist of five inter related reference models designed to: enable cross agency identification of opportunities for collaboration across agencies, and within agencies and identifying gaps. The reference models in the US FEA are: performance, business, service components, technical and data(United Nations Develepment Programme, 2007 page 25-26). Figure 12 shows a model of gaps in e-Governance Interoperability.

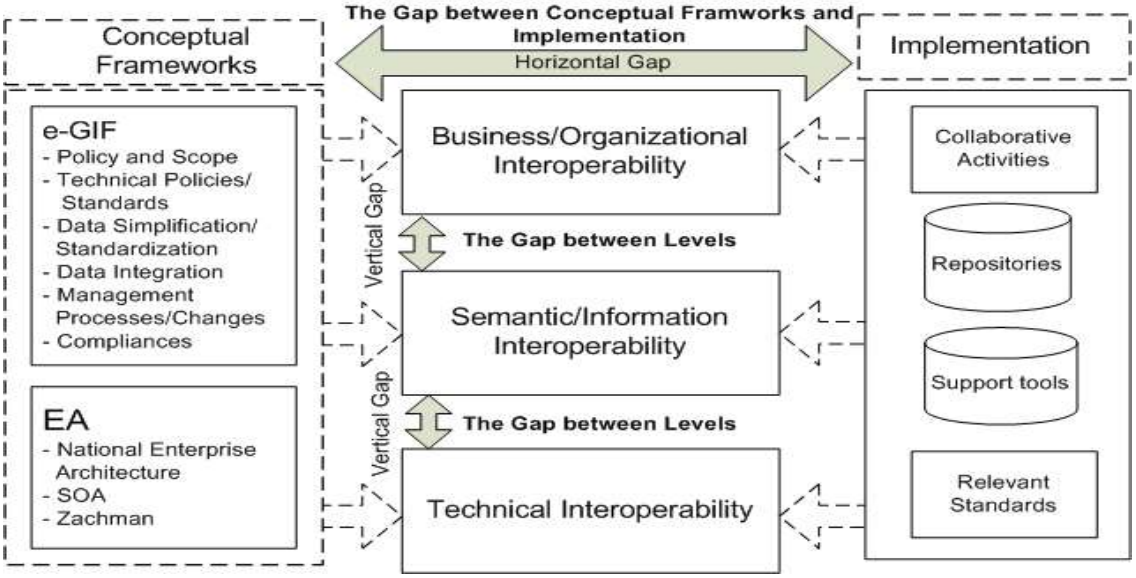


Figure 11. Model of Gaps in e-Government Interoperability. Source (Saekow & Boonmee, 2010).

3.4.1 *Model Driven Architecture (MDA) and Service Oriented Architecture (SOA)*

Some of the approaches of enhancing interoperability can be achieved through Model Driven Architecture (MDA), and Service Oriented Architecture (SOA) (Jardim-goncalves, Grilo, & Steiger-garcao, 2006). Model driven architecture allows an open approach to come up or to write specifications and to develop applications, it makes it possible to separate the application and the business functionality from the technology platform. With much diversity of software applications, data repositories, Operating Systems (OS), and programming languages, developers face allot of challenges to produce applications that are able to interoperate with each other. The Modern Driven Architecture, as a reference to achieve interoperability of enterprise models and the application software provides specifications for: the integration of systems at different layers of abstraction, and through the information system entire life-cycle. In MDA, the architecture is designed to encourage or promote interoperability of framework in use such as: operating system, programming language, repositories and data servers. The MDA is made up of three (3) main layers: the computational independent model (CIM), which is the top layer representing the abstract model of the system that describes its domain. The platform independent model (PIM), is the middle layer that defines the conceptual model that is based on the visual diagrams, the use case diagrams and the metadata. It is based on the standard Unified Modelling Language (UML), XML Meta data interchange (XMI), Common Warehouse Meta-model (CWM), Object Constraint

Language (OCL), and Meta Object Facility (MOF). The Platform Independent Model (PIM), outlines the application protocol in full scope of its functionality without constraints or platform dependencies. The bottom layer in MDA is the Platform Specific Model (PSM), and it targets specific implementation platform (Jardim-goncalves, Grilo, & Steiger-garcao, 2006).

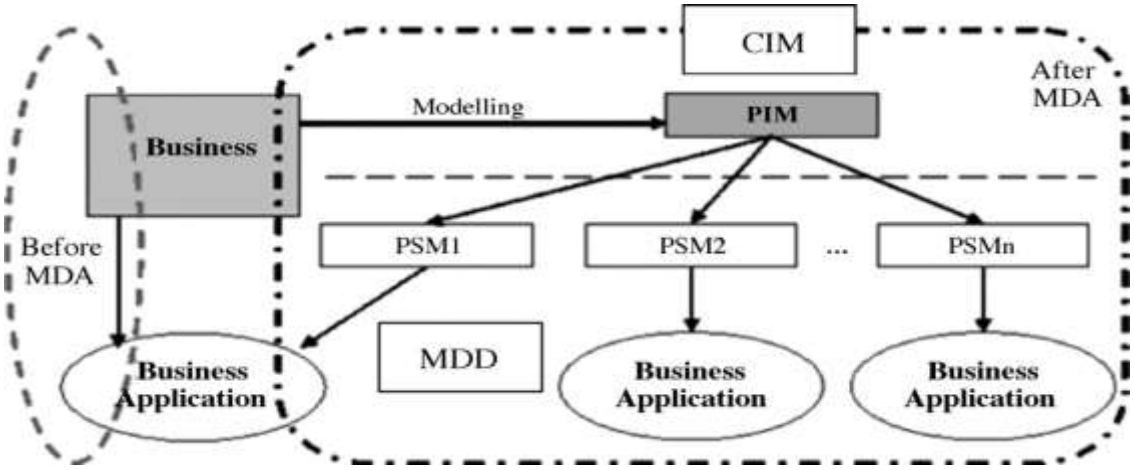


Figure 12. Model drivel architecture. Source (Jardim-goncalves et al., 2006 page 681).

Service Oriented Architecture (SOA), at the other hand establishes the software architecture concept that outlines the use of services to the basic requirements of the users, making them available as independent services to the users accessible in a more standardized manner (Jardim-goncalves, Grilo, & Steiger-garcao, 2006). Service Oriented Architecture considers technology perspective, and it propose a normalized Service Oriented Environment (SOE), that provides services registration, service description, search functionalities and publication. Service oriented architecture places emphasis on interoperability, it combines the capacity to invoke the remote functions as well as objects such as the services with a standardized mechanism for the dynamic and the universal service execution and the service discovery. Service Oriented Architecture provides a mechanism of interoperability and flexibility allowing various technologies to dynamically integrate, independent of the system platforms that are in use. SOA promotes reusability, it makes it possible for enterprises to dynamically discover, publish and to aggregate a number of Web services through the use of the internet. Thus why SOA is not constrained by specific platform and applications, making it a vital requirement for enterprises to achieve business flexibility, information technology

independence and to seamlessly integrate in a more dynamic collaborative environment (Jardim-goncalves, Grilo, & Steiger-garcao, 2006).

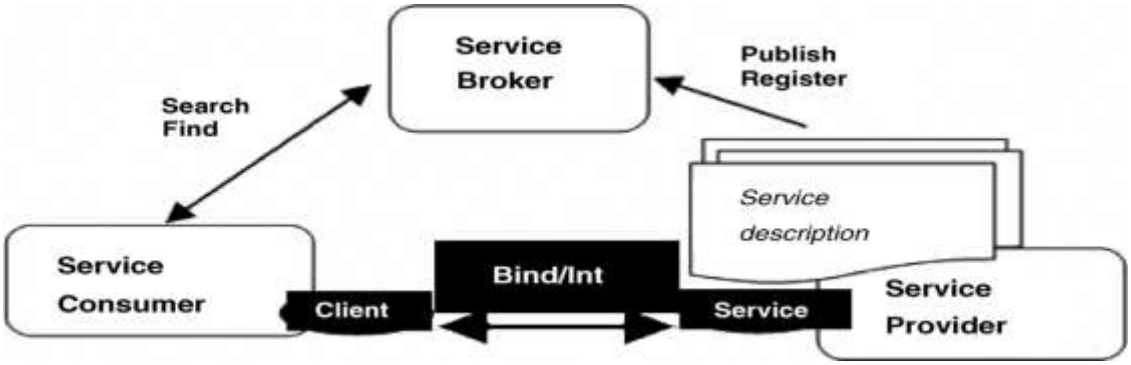


Figure 13. Service Oriented Environment that is based on SOA. Source (Jardim-goncalves et al., 2006 page 682).

3.5 Interoperability Maturity Levels

Maturity levels represent different phenomena's, from organizational life cycle, biological growth, product life cycle etc., predictable patterns exist in the growth of living organisms and growth of organizations. The stages in maturity levels are sequential in nature, are hierarchical, evolve over a range of organizational structures and activities (Gottschalk, 2009).

Different interoperability maturity models exist, various interoperability models were developed with each model adopting a unique approach, one of such is an example expressing the characteristics of interoperability capability maturity and addressing certain domains.

Interoperability can be improved, metrics for measuring the levels of interoperability exist, measuring interoperability allows organizations to be able to know their weaknesses and strengths in order to be able to interoperate with other organizations, and so prioritize their activities to improve their ability to interoperate with one another. Approaches to measure interoperability focus more on measuring the maturity of interoperability, various maturity interoperability models exist: Capability Maturity Model (CMM), was developed by the Software Engineering Institute (SEI) and is composed of five maturity levels:(Initial maturity level, Repeatable maturity level, Defined maturity level, Managed and Optimizing maturity level (Daclin, Chen, & Vallespir, 2008 page 12875). Figure 15 shows the ATHENA maturity model, it can be used to measure interoperability.

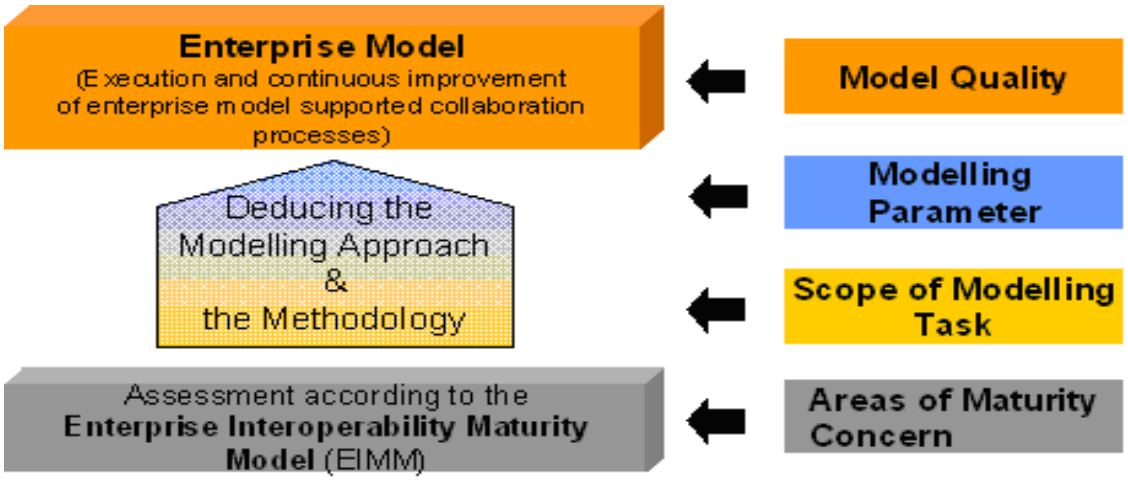


Figure 14. ATHENA Maturity Model. Source (Athena Consortium, 2006 page 2).

Several other models were developed for different disciplines, the focus was on the different layers of the enterprise, and one of such model is the Service Oriented Architecture Maturity Model, Enterprise Architecture Maturity Model, Extended Enterprise Architecture Maturity Model (IFEAD) and the Organizational Interoperability Maturity Model. All this maturity models helps organizations to evaluate their processes and identifying useful best practices (Daclin et al., 2008 page 12875). Figure 16 shows various levels of interoperability maturity in digital government.

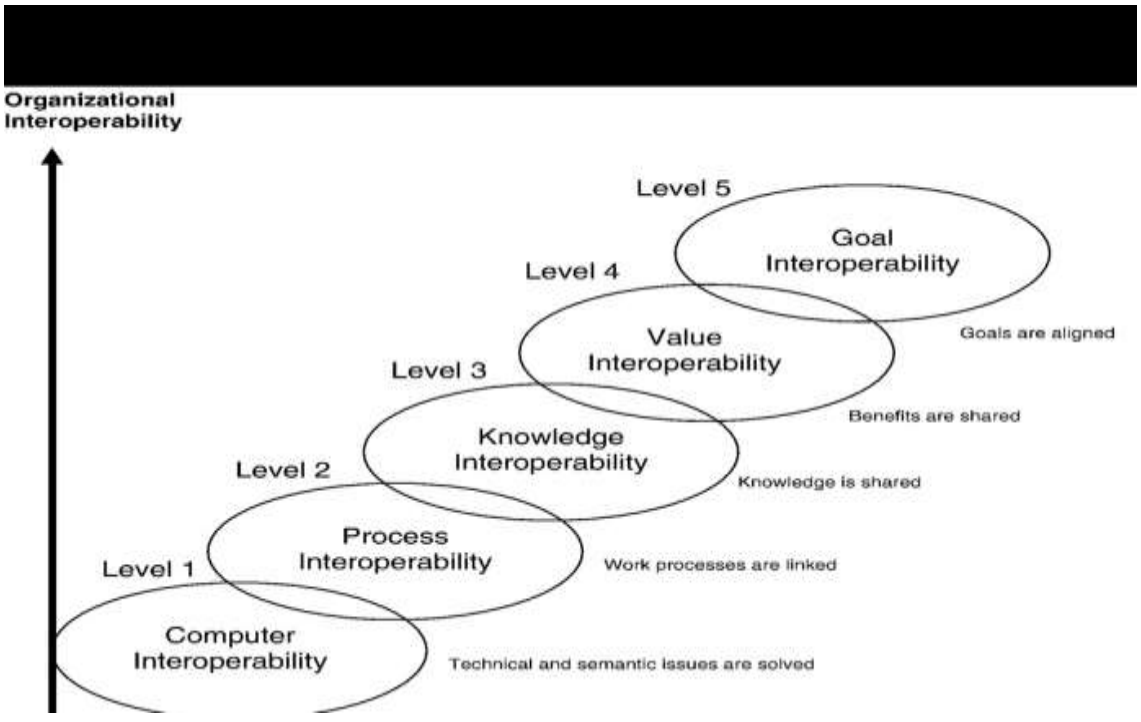


Figure 15. Maturity levels for interoperability in digital government. Source (Gottschalk, 2009).

Concerning the interoperability factors, the Levels of Information Systems Interoperability (LISI) model for measuring interoperability maturity exist, it is composed of five levels of maturity: Isolated level, connected level, functional level, domain level, enterprise level (Daclin et al., 2008 page 12875).

When organizations wants to interoperate with other organizations, various guidelines or metrics can be useful in evaluating their interoperability, and one of such tool is the Maturity Model for Enterprise Interoperability (MMEI), it can be used to detect interoperability problems. Table 4 shows a comparison between maturity levels and the interoperation environments (Wided Guedria, David Chen, 2009 page 218).

Table 4. Maturity levels vs. Interoperation Environments. Source (Wided Guedria, David Chen, 2009 page219).

Maturity Level	**Interoperation environments**
Level 4 – Adapted	Federated: No pre-defined format or meta-models. Dynamically adjust and accommodate
Level 3 - Organized	Unified: Use of meta-models allowing heterogeneous systems to map one to others
Level 2 – Aligned	Integrated: Common format (or standard) for all partners to build their system (components)
Level 1 – Defined	Connected: Simple electronic exchange of information, messaging, etc.
Level 0 - Unprepared	Isolated: Occasional and manual exchange of information (Document, fax...)

Each and every level in the Maturity Model for Enterprise Interoperability (MMEI), corresponds to the level of the degree of interoperability, ranging from the level where there is no interoperability existing, to the level where there is full interoperability. Table 5 below shows the maturity levels and the level of interoperability degree (Wided Guedria, David Chen, 2009 page219).

Table 5. Maturity levels and Interoperability Degree. Source (Wided Guedria, David Chen, 2009 page 219).

Maturity Level	**Interoperability degree**
Level 4 – Adapted	Generalized (full interoperability to any potential partners worldwide)
Level 3 – Organized	Extended (many-to-many relation, multiple heterogeneous partners)
Level 2 - Aligned	Restricted (Peer-to-peer relation, to use a

	common format or standard)
Level 1 – Defined	Limited (with only some ad hoc interoperations)
Level 0 - Unprepared	Inexistent

3.6 Public Service of Namibia Interoperability Directives

The Government of the Republic of Namibia (GRN), have put in place various policies related to interoperability, to provide the necessary guidelines and directives in the Namibian Public Service, concerning interoperability issues. The policy implementations of interoperability are provided for in the National Development Plans (NDP3) (Namibia, 2008).

The Namibian Government adopted the e-Governance Policy of 2005 for the Namibian Public Service, the e-Governance policy makes provision for interoperability framework establishment, to ensure interoperability across all governmental agencies, due to the challenge of: diverse and traverse, hardware, software and systems. The main aim is to develop an interoperability framework to make integration possible without compromising functionality, information and services delivery to citizens and security. The policy provide the necessary standards and specifications for: information access, data integration and interconnectivity (Government of the Republic of Namibia, 2005).

The Information Technology (IT) policy for the Republic of Namibia(Namibia Ministry of Information and Communication Technology, 2009), include policy statements related to: establishment of an enabling framework for Information Technology development in the Republic of Namibia, electronic government, electronic connectivity (e-Connectivity) and information sharing. Electronic connectivity provision in the policy requires a secure two way communication between the government and the citizens without compromising the functionality and service delivery.

According to the Government of the Republic of Namibia (2005), as part of its strategy, it recommended that Namibia should adopt the Gartner four stage e-Governance Maturity Model for providing various solutions according to citizen's preferences. The four model stage indicates that there is increasing value for the various stakeholders and there is also an increased level of complexity in the implementation. The fourth stage (transformation) relates to interoperability. Information systems at this stage are

integrated and the various stakeholders can get G2B and G2C services from one stop shop.

3.7 Summary

The literature provided insight into the various e-Government interoperability concepts, covering descriptive forms of interoperability, interoperability adoption factors, approaches of achieving e-Government interoperability, interoperability maturity assessment and finally the literature provided an overview of the Republic of Namibia Interoperability directives.

The literature indicated that there are various views concerning interoperability, interoperability in e-Governance context have multiple definitions; the aim of e-Governance project is to provide services to various stakeholders and to improve government administrations.

The literature further gathered that interoperability is a key element to enable seamless services of e-Governance to various stakeholders, and it enables the facilitation of transformation and innovation by e-Governance, it enable information sharing, system integration and cross border collaboration with other governments. Lack of e-Governance interoperability according to the literature is a major obstacle to e-Governance maturity, lack of architectural interoperability and the absence of interoperability standards in e-Governance limits the advance development in e-Governance and limit government to government (G2G) efforts in e-Governance projects.

The literature indicated that interoperability provide various benefits and interoperability aim to achieve three goals in any system (meaning exchange, process management and data exchange).

The literature further gathered that there are various forms of interoperability, even though there is three stands to e-Governance interoperability from a European Interoperability Framework (EIF) perspective.

Furthermore the literature indicated that there are various complex barriers affecting the adoption of an interoperability framework in the public domain, and various interoperability strategies exist to enhance interoperability. Many countries have adopted Government Interoperability Frameworks (GIFs), Enterprise Architecture (EA),

Model Driven Architecture and Service Oriented Architecture (SOA) as some of the approaches to enhance interoperability.

The literature pointed out that various interoperability maturity models exist, models were developed with various models adopting a unique approach or addressing a certain domain such as interoperability. Interoperability according to the literature can be improved and metrics for measuring the levels of interoperability exist, there are various maturity interoperability models.

And finally the literature reviewed the National Development Plans (NDPs) and government policies related to Information Technology of the Republic of Namibia, particularly concerning the area of interoperability. All this provided a deeper insight into interoperability requirements and directives of the government of Namibia.

The next chapter, chapter four (4) gives a detailed overview of the analysis of the identified interoperability frameworks.

4 Analysis of e-Government Interoperability Frameworks

This chapter aim to provide an analysis of the three identified e-Governance interoperability frameworks, in order to answer some of the research questions. The chapter covers New Zealand interoperability framework, Estonian interoperability framework and Australian interoperability framework, comparison results tables, best practices and the chapter also covers best practices drawn from the three case studies and ends with a chapter summary.

4.1 Overview of Identified Interoperability Frameworks

New Zealand adopted the e-Government Interoperability Framework (e-GIF), which was developed by the United Kingdom (UK) in 2001. The first version of the e-GIF was published in February 2002, and since 2002 several versions have been published, the current version is (v3.3), which is the tenth edition. Since the e-GIF was published, it has proven to be an important tool to enable agencies to work together, promoted collaboration between agencies, and the efficient use of resources, promoted the state services development goals of a networked, promoted coordination and accessible state services for all. The e-GIF has formed the foundation of many significant e-Government initiatives in New Zealand. The e-GIF (v3.3) is made up of three (3) documents: standards, policy and resources (S. S. Commission, 2008).

4.1.1 The New Zealand Interoperability Framework Architecture

The New Zealand Interoperability Framework Architecture is a layer model, which is used to classify functions within the IT systems. The four basic structural components of the New Zealand Interoperability Framework's Architecture are:

Network: the network layer provides details concerning data transport such as network protocols. This aspect is very important from an interoperability point of view, without the agreement on the network's standards, it will be impossible to make systems communicate.

Data Integration: the data integration layer facilitates the interoperable data exchange and processing, the standards of the data integration layer allows the data exchanged between various systems and data analysis on the receiving systems.

Business Services: business services layer supports the data exchange in particular business applications and information contexts. The standards in the business services layer are generic and cover multiple business information contexts, while other standards work with data integration standard in order to define the meaning of data and also mapping it to usable business information.

Access and Presentation: the access & presentation layer outlines how the users present and how users access business systems. Most of the standards in the access and presentation layer are available in the web Standards recommendations of the Government (S. S. Commission, 2008).

Four components are applied to the fourth layer (Access & presentation) and they are:

- *The security*: is applied to all the layers of the framework and security needs or requirements are designed into the system and it is not added as a layer on the top. e-GIF is made up of standards at the different levels designed to provide various levels of security.
- *Best practice*: it's a new component in the framework that aim to help users and readers of the interoperability framework, to be able to differentiate between the various published standards from the best practices, the codes of practices and the general or other sector focused guidance.
- *e-Government services*: the e-Government services represent the actual implementations of the Information Technology infrastructure, which the ICT branch of the State Services Commission makes it available for the public sector agencies to make use.
- *Web services*: aim to connect services together, and represents emerging set of standardized applications that connect and integrate the web-based applications over the internet.
- *Management & governance*: outlines the roles and the responsibilities for the management of the interoperability framework, in terms of its operations, review of the interoperability framework and its governance conform and is aligned with the e-government strategy in place (S. S. Commission, 2008).

Figure 17 shows the layered model of the New Zealand Interoperability Framework's Architecture, components in this model only communicate with other components at neighbouring layer in a standardized manner.

Figure 16. New Zealand Interoperability Framework's Architecture. Source (S. S. Commission, 2008).

Implementation Policy and Strategy

The e-GIF project in New Zealand was initiated by the government in 2002; the government pursued a continuous update and improvement of the interoperability framework, because of the ever changing society and the public sector in New Zealand. The introduction of the e-GIF helped agencies to collaborate effectively, resulting in more integrated services in New Zealand.

The State Services Commission in New Zealand is responsible for the e-GIF, both in terms of decision making for the e-GIF development and management. The Information and Communication Branch (ICT Branch), is responsible for the daily operations of the e-GIF, the e-GIF Management Committee is composed of senior public servants from more senior levels of the agencies that adopts the e-GIF in New Zealand. There are also working groups established, that review the technical aspects of the e-GIF on a regular basis (S. S. Commission, 2008).

4.1.2 The Estonian IT Interoperability Framework

The Estonian interoperability framework (State IT interoperability framework), was first published in 2004. It has since grown over the many years of its existence; the third version varies from the previous versions. The latest version of the framework reflects principles of the European Union (EU) interoperability strategy. The Estonian interoperability framework considers interoperability from services perspective, information systems and administrative process perspective (Communication, 2011).

The content of the framework is made up of the common agreed elements (documents), principles, dictionary, policy, understandings, guidelines, recommendations and also best practices. The document of the frameworks is then divided into four main groups: general documents, framework of interoperability dimensions and spheres, infrastructure and guidelines (Pankowska, 2008).

Estonian IT interoperability framework aim to ensure provision of services for the Estonian public administration institutions, citizens and enterprises at both national and European context. IT interoperability framework and its related documents are required to follow in order to ensure communication (mutual), between the various agencies information systems of both central and local government.

The three (3) dimensions considered in the Estonian interoperability framework:

- ***Organizational interoperability***
- ***Semantic interoperability***
- ***Technical interoperability*** (Pankowska, 2008).

Figure 18 shows the data exchange layer X-ROAD, the interoperability framework make use of X-ROAD, to improve interoperability, the framework also make use of open standards and PKI (middleware), to improve interoperability. X-ROAD is internet based, it is a secured data exchange layer, which makes it possible for various information systems to communicate effectively and exchange data with each other (Vassel, 2016).

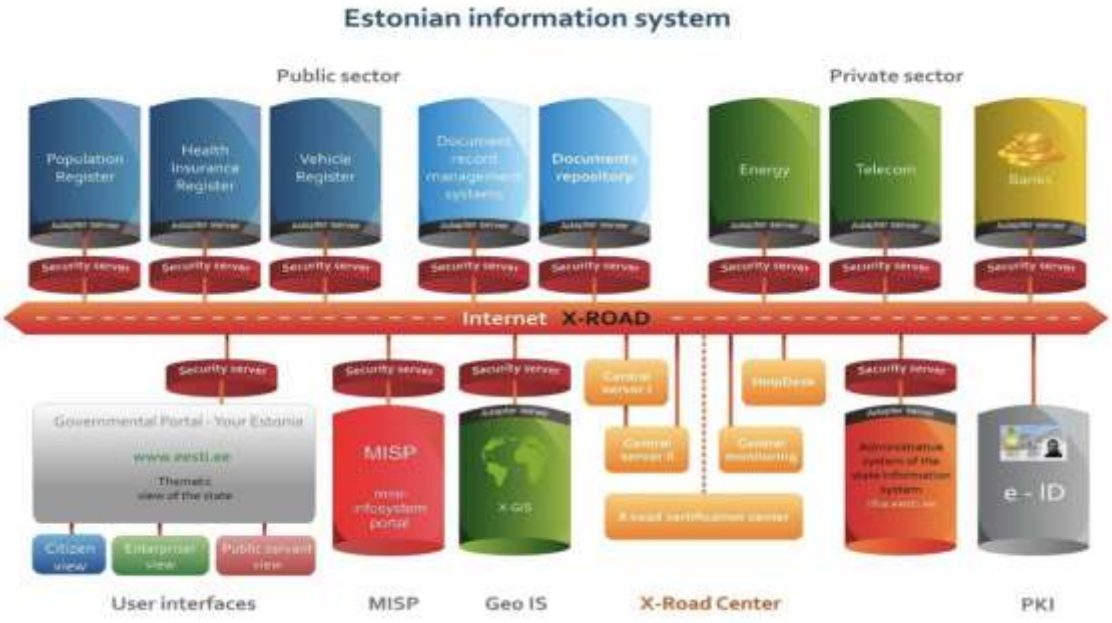


Figure 17. X-ROAD data exchange layer. Source (Vassel, 2016).

Key Components of X-ROAD (Cybernetica, 2014).

Interoperability:

- Make use of web services which is a technology that is platform and vendor neutral, web services is also commonly used making it possible for X-ROAD to achieve high levels of interoperability.
- Any information system type can interface with X-ROAD, provided that it has the capability of making use of web services or providing web services.
- Interoperability is further improved and achieved by assigning complex security processing to the various gateways.
- X-ROAD infrastructure is hidden from the application, making it much easier to develop and implement new applications

Confidentiality:

- X-ROAD security gateways make use of data encryption in order to protect against data confidentiality and external threats. The TLS protocol is used to encrypt the data that is exchanged between the various gateways.
- Encryption keys are certified by an independent external certification authorities
- A monitoring system exist to guard against users who abuse their authority, the monitoring system also detect or can be used to investigate abnormal system usage patterns

Availability and Scalability:

- The number of connected organizations (public and private) to the system does not have an impact on the load of the central servers
- One (single) central server is enough for a system to handle multiple or many organizations
- The number of transactions processed does not have an effect on central server workload
- In order to manage a large number of transactions it is possible to add a number of various gateways in parallel, which will enable greater throughput and improve reliability (Cybernetica, 2014).

Key principles of the State IT interoperability framework

- The public services are free of charge, they are provided for free for public sector institutions or organizations
- Development of information systems is internet centric based
- Encourage the wider use of open standards
- Open source solutions are considered alongside proprietary solutions in the development of information systems
- For the integration of information systems and presentation of data, XML based technologies are utilized
- Information systems (IS), provide and make use of services via (X-ROAD), which is the data exchange layer that is based on multilateral agreement between agencies
- The central government and the local government agencies work together (cooperate), to enable the provision of information, and services for the various stakeholders (citizens, business, and officials), is accessible from one stop shop (Pankowska, 2008).

Management Policy and Strategy

The first State IT Interoperability Framework was published in 2004. The Ministry of Economic Affairs and Communications (MKM), in Estonia is the ministry responsible for: developing the State information system, designing the interoperability framework and its related documents. Within the Ministry of Economic Affairs, interagency state information systems interoperability working groups exist and is responsible to advice the ministry on designing the interoperability documents.

Official and unofficial working groups are also created, regarding interoperability framework.

Administrative institutions are responsible for describing their services and information systems in the Management System of State Information System (RIHA). RIHA processes supports the continuous management of the various services and systems through the necessary changes (Communication, 2011). The IT interoperability framework and its related documents are required to be followed in order to ensure that communication take place between the various agencies information systems for both central and local government.

4.1.3 Australian Government Interoperability Framework

The Australian Government Architecture Framework (AGA), has been adapted by the government of Australia, and is based on the United States of America Federal Enterprise Architecture Framework (FEAF), which was developed in 2002. The framework has been implemented by many other countries in the world and some state governments in Australia. The framework and its reference models have been adapted (endorsed) by the Australian Government's Committee of Chief Information Officers (CIOC), in 2006 (Office, 2011). The aim of the Australian Government Architecture framework (AGA), is to aid the Australian Government in the delivery of consistent, cohesive and cost effective delivery of services to the citizens by providing a framework that is:

- To provide a common language for the various government agencies that are involved in delivering of cross agency services.
- To enhance or improve collaboration between various agencies by identifying duplication, reusable and services that is sharable.
- To help in describing and analyzing their Information Technology investments, in order for the government to review the success of the projects (IT).
- To help the government moving towards a citizen centric, market based and result oriented government (Office, 2011).

The Architecture of the Australian Government Framework (AGA)

The Australian Government Architecture (AGA), is made up of inter-related reference models that are designed to facilitate cross agency analysis, gaps and the opportunities for collaboration within and cross agencies. The Australian Government Architecture (AGA), is made up of five (5) reference models; the objectives of the models are exactly the same as the ones outlined in Federal Enterprise Architecture (FEA), (Office, 2011).

Here are the five (5) reference models (Office, 2011)**.**

Performance Reference Model (PRM): this reference model is outcome focused measurement framework that aim to help governmental agencies in designing and in the implementation of more effective business measurement systems and performance architecture. It can support accountability and transparency in government, promote a strong alignment between business initiatives, agencies and between government

strategies and their outcomes, it can also facilitate effective and efficient business operations.

Business Reference Model (BRM): it provides a framework that facilitates the entire government functional view of the government of Australia Lines of Business (LoBs). That is independent of the agencies performing the functions.

Service Reference Model (SRM): this reference model is business driven, it's a functional framework that classifies services according to the way they support business, and also performance objectives. This reference model aim to identify and classify vertical and horizontal service components that are supporting various agencies and their ICT investments and their assets.

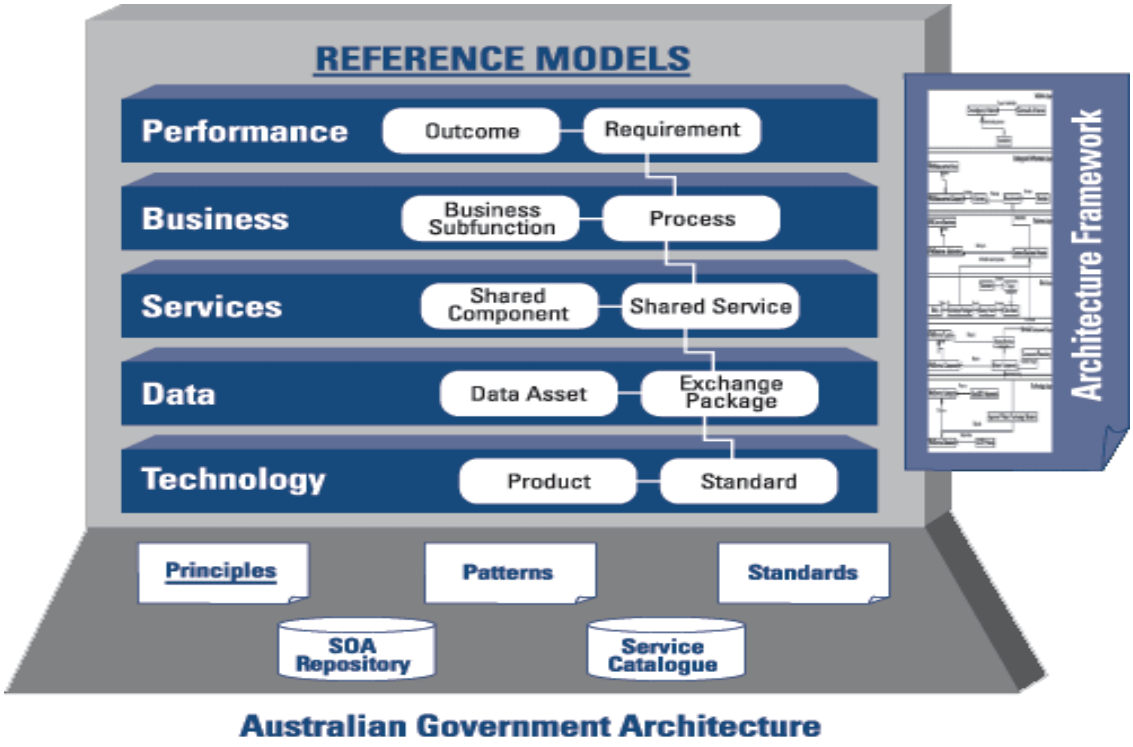


Figure 18. Australian Government Architecture. Source (Office, 2011).

Data Reference Model (DRM): is a flexible and a standard based framework that enables, information sharing and information reuse across the government via standard description and the discovery of uniform management of data practices. It provide the means for the data to be described, shared and categorized clearly.

Technical Reference Model (TRM): Is a component driven reference model, it is a technical framework categorizing: the standards and the technology that supports and the technology that enables the delivery of services capabilities, it also provide a

foundation that advances the reuse, and the standardization of technology in use and service components from the Australian Government wide perspective.

The Australian framework is also made up of principles, SOA repository, patterns, service catalogue and standards in order for governmental agencies to reuse principles and standards in the implementation of the Enterprise Architecture (EA) project in Australia (Office, 2011).

There is a second adaptation in which the Australian government supports the Australian Government Architecture (AGA), with a high level of Interoperability Framework (IF), the *Australian Government Technical Interoperability Framework* aim to ensure that protocols and standards in one specific governmental agency or network does not hamper connections in the future, with other processes and agency networks. The *Australian Government Interoperability Framework (AGIF),* is made up of three (3) components:

Business Process Interoperability Framework: this framework enables the harmonization of various common service delivery business processes

Information Interoperability Framework: the framework objective is to help improve access, re-use and sharing of information.

Technical Interoperability Framework: this framework is responsible for the development of technical standards, in order to allow information and data to be shared (Office, 2007).

Implementation Policy and Strategy

The AGA project was first initiated in 2006, and is a continuous project, the first version is (version 1.0), and the latest version is version 3.0 which was published in 2011. The Australian Government Architecture Reference Models and the AGA Metamodel, was adapted by the Chief Information Office Committee (CIOC) in April 2011.

Governmental agencies are not obliged to replace their already existing frameworks with AGA, but should be able to classify their agency architectures using AGA as a reference model for their architecture. For agencies that do not have any architecture in place or have their architecture under review agencies are recommended to adopt AGA. The Chief Information Officer's Committee (CIOC), is responsible for managing (updating and maintaining) the framework in Australia (Office, 2011).

4.2 Comparison of the Interoperability Frameworks

The comparison criteria of the selected three (3) interoperability frameworks was based on the following criteria: background, interoperability concept, and scope, basic interoperability policies, standards selection criteria, open standards definition, technology standards, standards life cycle, and management and compliance policies.

4.2.1 Background

Analysis of the chosen different Government Interoperability Frameworks (GIFs), of the three countries shows that interoperability projects were initiated by organization that are similar in nature, in the case of Estonia and Australia (Ministry of Economic Affairs and Communications – Department of State Information Systems, and Australian Government Information Management Office) . In the case of New Zealand it was initiated by the State Service Commission. The objectives of the GIFs varies from integrating information and various services across boundaries and providing easily accessible electronic governmental services for both businesses and individuals (New Zealand), assisting in delivering more effective consistent and cohesive services to the citizens and supporting cost effectiveness in delivering of Information and Communication Technologies services (Australia), and to make the operations of the public domain more effective, and improving services offered both to Estonian and European Union (EU) citizens.

The organizations that are responsible for coordinating or promoting Government Interoperability Frameworks (GIFs) of the three counties also vary in terms of authority.

4.2.2 Interoperability Concept

The three chosen GIFs define interoperability from different angles; the Estonian Interoperability Framework covers interoperability from a more comprehensive perspective both in terms of organizational, semantic and technical. In the Estonian concept, interoperability is the ability of diverse and disparate institutions to interact with one another towards mutually beneficial agreed common objectives that involves the sharing of information and knowledge amongst the institutions, through businesses processes that they support by means of exchanging data between their various Information Communication Technology systems. The aim of the Estonian Interoperability Framework is to ensure the provision of services for both public

administration organizations, enterprises and citizens both at national and European (EU) context (Communication, 2011). The Australian Governmental Interoperability Framework attempt to address interoperability from information, business process and technical perspective. Interoperability in the Australian concept is the sharing of information between various networks and redesigning of business processes in order to deliver improved outcomes and efficiencies and also to support seamless delivery of services (government). The aim of the framework is to provide a collaborative, effective and efficiency in government, and the delivering of more seamless governmental services (Office, 2007). The New Zealand GIF is more technical and governance focus. The New Zealand interoperability concept defines interoperability as the ability of governmental institutions to share information and also to integrate information and businesses by using common standards. The aim of interoperability framework here is to facilitate in delivering integrated services between the various governmental agencies in New Zealand (N. Z. G. S. S. Commission, 2002).

4.2.3 Scope

Most of the three e-GIFs cover similar scope, they all cover: Government to Government (G2G), Government to Business (G2B) and Government to Citizen (G2C). The Estonian GIF goes to the extent of covering interaction with other governments (OG) in EU context; the New Zealand GIF also considers providing services across national borders.

4.2.4 Basic interoperability policies

The three (3) e-GIFs outlines common interoperability policies such as: adoption of XML technologies for data integration and management, alignment with the internet, use of browser, and use of open standards for all the public domain information systems (IS).

The Estonian and New Zealand GIFs policies enforce mandatory use of the GIFs.

4.2.5 Standards selection criteria and Open standards definition

The common specification criteria of the three (3) GIFs are scalability, openness and security. The Estonian and New Zealand criteria is more centred on interoperability , the Estonian criteria goes miles further to include other criteria or principles such as: subsidiary and proportionality, user-centricity, security and privacy, multilingualism,

transparency, reuse, preservation of information, technology, inclusion and accessibility, administrative simplification etc.

Openness of the standards is one of the common principles used in all the three GIFs, and there is no common definition of what is open standard, the definition of open standard varies. Estonia accepts standards to be accessible to everyone at a nominal cost, while New Zealand open standards exhibit properties of: be accessible to everyone free charge and should remain accessible to everyone for free. Australia framework catalogue both open standards and proprietary standards.

4.2.6 Technology standards

All the three (3) GIFs technical architecture varies considerably, they all cover different layers of e-Government architecture, New Zealand GIF cover web services at different layers, and web service layer is also applicable to all structural layers such as: network layer, data integration layer, business services layer, access layer and presentation layer.

The security layer in the GIF of Australia is a separate layer, the GIF of Australia also incorporate various components of web services like service description language, security, protocols which are under separate levels.

At the other hand the Estonian GIF is more centred on e-services being provided over a range of channels (electronic), and the use of electronic identity.

4.2.7 Standards life cycle

To maintain the GIF it is critical to keep up with the changing technology. The New Zealand standards life cycle is composed of a detailed life cycle amongst the other GIFs of Estonia and Australia, institutions collaborating on the issue of interoperability need to agree on mapping technologies or to agree on the use of standards.

The New Zealand standard life cycle under goes the following stages:

- Under development
- Recommended
- Adopted
- Deprecated
- Future consideration

4.2.8 Management and compliance policies

The Government Interoperability Frameworks needs to be reviewed and continuously updated to remain up to date, relevant and should be aligned to new emerging technologies. The GIFs under study all go through the necessary review process, change management procedures and there is also a specific agency that is responsible for managing the technical specifications. In the case of Estonia and New Zealand it is mandatory for agencies to use the GIFs.

4.3 Comparisons Results of Government Interoperability Frameworks (GIFs)

The next tables shows some of the comparison results of the GIFs based on some of the evaluation criteria's: (scope, basic interoperability policies, standards selection criteria, management and compliance policies).

Scope:

Table 6. Evaluation results under evaluation criteria scope

Country	G2G	G2C	G2B	G2E	OG
New Zealand	x	x	x		x
Estonia	x	x	x		x
Australia	x	x	x		

Basic interoperability policies:

Table 7. Evaluation results under evaluation criteria basic interoperability policies

Country	Alignment with the internet	Adoption of XML	Use of the browser	Semantic initiatives	Use of GIF is mandatory	Make use of open standards
New Zealand	x	X	X		x	x
Estonia	x	X	X		x	x
Australia	x	X	X			x

Standards selection criteria:

Table 8. Evaluation results under evaluation criteria standards selection criteria

Country	Interoperability	Scalability	Openness	Market Support	Security	Internationally recognized	Privacy
New Zealand	x		X		x		
Estonia	x	X	X		x		x
Australia		X	X				

Management and compliance policy:

Table 9. Evaluation results under evaluation criteria management and compliance policy

Country	Specific Agency	Change Management procedures	Frequency of review	Compliance policy	Compliance responsibility	Exception of compliance procedure
New Zealand	**x**	**X**	**X**	**x**	**x**	**x**
Estonia	**x**	**X**	**X**	**x**	**x**	
Australia	**x**	**X**	**X**			

4.4 Best Practices

From the analysis of the three (3) interoperability frameworks that were adapted or implemented by the three countries in the case studies, some best practices have been identified in terms of their implementation policies of the identified frameworks (Office, 2011), (Communication, 2011) & (S. S. Commission, 2008).

- The development of the Government Interoperability Frameworks involved all the relevant stakeholders for input and considerations
- The interoperability framework projects have been launched by specific agencies or departments which are accountable and also have the corresponding decision making authority, concerning the interoperability framework ongoing development and its management (maintenance).
- The GIF document is considered to be a living document and it constantly changes as business needs and technology changes
- In order to allow better use of interoperability framework in government, most of the governments have a mandatory compliance policy in place, to enforce their agencies in using the GIFs
- Making use of XML technologies, adoption of web and internet technologies to allow easier integration of heterogeneous information systems, policies on this issues were put in place. The adoption of open standards avoids the risk of vendor lock in and a wider market to participate
- Most of the Government interoperability frameworks are aligned with their e-Government strategies
- The adoption of an interoperability framework goes through gradual adaption process in order to meet the specific requirements of the country adopting the interoperability framework
- The use of the GIFs is in compliance with regulations concerning privacy and data protection

4.4 **Summary**

The literature provided a detailed analysis of the chosen interoperability frameworks developed or adopted by Estonia, Australia and New Zealand. The literature gathered that the chosen frameworks were initiated by various agencies in the chosen countries and the interoperability frameworks gradually evolved over time.

The literature further pointed out interoperability architectures of the chosen frameworks differs, as well the guiding principles of the frameworks. The literature outlined that the objectives of the three frameworks differs considerably and frameworks define interoperability from different perspectives. Government Interoperability Frameworks can cover various scopes; interaction with other government (OG), is one of the latest scopes of GIFs according to the literature.

The literature indicated that Government Interoperability Frameworks make use of different interoperability policies, such as the adoption of XML technologies for data integration and management, alignment with the internet, use of browser as well as the use of open standards for all public domain information systems.

The literature further gathered that standard selection criteria in GIFs can differ and open standards definition varies in the chosen GIFs, GIFs technical architectures varies considerably and covers different layers of e-Government architecture.

To maintain the GIFs, the literature gathered that it is critical to keep up with the changing technologies and GIFs should be composed of a detailed life cycle. The literature further indicated that interoperability frameworks needs to be constantly updated to remain relevant and aligned to new emerging technologies. The GIFs should undergo necessary review processes, change management procedures and it's prudent to enforce mandatory use of GIFs (compliance policy).

Criteria's can be used to evaluate interoperability frameworks, measures such as: background, interoperability concept, scope, basic interoperability policies, standards selection criteria, open standards definition, technology standards, standards life cycle, management and compliance are some of the measures to evaluate frameworks. The literature provided some best practices from GIFs. The next chapter, chapter five (5) gives a detailed overview of the case study design adopted in this research.

5 Design of the Case Study

The purpose of this chapter (case study design), is to provide an overview of the research methodology used to answer the research questions in this study, it discus the procedures of data collection of both primary and secondary data used in this study. The outline of the research design covers the following elements: rationale, purpose, the case, units of analysis, theory, research questions, methods of data collection, methods of data analysis, case selection strategy, data selection strategy, replication strategy, quality assurance, validity and reliability. The chapter ends with a chapter summary.

5.1 Introduction

The case study design used in this study is illustrated in table 10. The detailed case study design is presented in the next section and was supported by the literature. The research design is linked with the research questions of the study.

Table 10. Elements of the Research Design. Source (Per Runeson et al., 2012 page 25).

Element	Example Questions Describing the element
Rationale	Why is the study being done?
Purpose	What is expected to be achieved with the study?
The case	Overall, what is being studied?
Unit of analysis	In more detail, what is being studied?
Theory	What is the theoretical frame of reference?
Research questions	What knowledge will be sought or expected to be discovered?
Propositions	What particular (casual) relationships are to be investigated?
Define concepts and measures	How are entities and attributes being defined and measured?
Methods of data collection	How will data be collected?
Methods of data analysis	How will data be analysed?
Case selection strategy	How will cases (and units of analysis) be identified and selected?
Data selection strategy	How will data be identified and selected? For example, who will be interviewed? What electronic data sources are available for use in the study? What nonelectronic, naturally occurring data sources are available for use in the study?

Replication strategy	Is the study intended to literally replicate a previous study, or theoretically replicate a previous study, or is there no intension to replicate?
Quality assurance, validity and reliability	How will the data collected be checked for quality? How will the analysis be checked for quality?

5.2 Elements of the Case Study Design

A variety of elements need to be taken into consideration in the design of any case study, if it is to be of great use (Per Runeson et al., 2012 page 24-37). The case study design elements going to be used in this study are explained into more details below:

5.2.1 The Rationale of the Study

The theme of this research is e-Governance interoperability. e-Governance interoperability plays a very crucial role in the successful adoption of e-Governance solution. e-Governance interoperability enable e-Governance systems to interoperate, and in doing so provide benefits to stakeholders and the government, establishing interoperability in the Namibian Public Service will enable: increase access to data and information, promote data and information sharing, enhanced public service delivery to various stakeholders, improve accountability, improve transparency, reduce service delivery costs and enhance governance. Interoperability is the foundation for a citizen centric one stop shop, of delivery of public services through a variety of channels.

The study was also motivated since the Namibian government have plans to adopt an e-Governance Interoperability Framework in its e-Government strategy, the e-Government Strategic Action Plan calls for the assessment of various e-GIFs across the world, including the ones been used in New Zealand and Estonia (Government of the Republic of Namibia: Office of the Prime Minister, 2014).

5.2.2 The objective of the Study

Through this study, the researcher aim to propose an e-Governance interoperability referential framework for the Republic of Namibia, as it plan to implement an e-Governance interoperability framework in its e-Government strategy. For this purpose the researcher will analyse the identified interoperability frameworks (IFs), and select framework(s) meeting the requirements of the Republic of Namibia. The research also

aim to examine the critical factors affecting interoperability adoption in the Namibian Public Service, and how Namibia can learn from best practices in its interoperability implementation initiatives.

5.2.3 Cases and Units of Analysis

In these research, three countries were selected, countries that have successfully developed and implemented their National Interoperability Frameworks (NIFs), and are globally well known for their e-Governance initiatives. The researcher will analyse the National Interoperability Frameworks (NIFs) of the selected countries, based on their National Interoperability Frameworks content, context and how they implemented their National Interoperability Frameworks (process). The analysis of the NIFs of the different countries will than lead to the selection of the framework(s) that meets the Namibian government interoperability requirements, to be adopted by the Namibian government. The criterion for the analytical framework is based on examining the content, process and context of the various National Interoperability Frameworks supported by the literature. Three countries have been identified for this research: Estonia, New Zealand and Australia. The selections of these countries is based on the fact that these countries have successfully developed and implemented their National Interoperability Frameworks (NIFs), but have also been well ranged in terms of the United Nations (UN) e-readiness index over the years, and are prominent or advanced in their e-Governance initiatives. This countries have implemented different interoperability frameworks, the diversity of frameworks will enable selection of the framework(s) suitable for Namibia.

Multiple units of analysis will to be adopted in this study.

5.2.4 Theoretical Framework

There are not well established theories in the field of software engineering (Per Runeson et al., 2012 page 29), for this reason there is no explicit theory for this study. The researcher is going to use related previous research as a framework of reference. This study is partly a replication; previous studies formed the frame of reference for this study. The researcher conducted a thorough literature review to build a solid foundation on the research topic. The comprehensive literature review provided the necessary input to address the research questions, concepts, propositions and their measures, and more

insights into how other previous researchers conducted and designed their research related to interoperability frameworks.

There is a lack of an analytical framework of measuring or evaluating Government Interoperability Frameworks (Ray et al., 2011), and to address this problem they proposed an analytical framework that is based on three (3) core dimensions which are:

- Context
- Content
- Process

The explanations of the three (3) core dimensions:

- ***Context*** :the context defines the *why* aspect of the framework
- ***Content*** :the content defines the *what* aspect of the framework
- ***Process***: the process defines the *how* aspect of the framework

All the three dimensions contains sub dimensions for evaluation or assessment, some of the various sub dimensions are based on already existing work done in interoperability frameworks, especially work done by the United Nations Development Programme (UNDP), (Ray et al., 2011).

Context sub dimensions:

Table 11. Context sub dimensions. Source (Ray et al., 2011 page 123-124).

Context sub dimensions
○ Background ○ Scope

Content Domain:

Table 12. Content sub domains. Source (Ray et al., 2011 page 123-124).

Content sub Domains
○ Basic interoperability policies ○ Standards selection criteria ○ Open standards definition ○ Technology standards

Process Domain:

Table 2. Process sub domains. Source (Ray et al., 2011 page 123-124).

Process sub Domains
○ Standards life cycle ○ Management and compliance policies

The Government Interoperability Frameworks are than evaluated qualitatively based on nine (9) criteria's, the background criteria captures the GIFs background information. To compare technology standards under the criteria of technology standards, the six layered analytical framework is proposed for e-Government architecture. Besides the background criteria and technology standards, the rest of the criteria's measures are developed for measuring presence or absence of Government Interoperability specific features. The nine (9) criteria for evaluating Government Interoperability Frameworks (GIFs):

- Background
- Interoperability concept
- Scope
- Basic interoperability policies
- Standards selection criteria
- Open standards definition
- Technology standards
- Standards life cycle
- Management and compliance policies

Detailed explanation of the nine (9) criteria's as suggested by (Ray et al., 2011 page 123-124).

Table 3Evaluation criteria background. Source (Ray et al., 2011 page 123-124).

Background
▪ Context of a GIF is captured in free flow text

Table 15. Evaluation criteria interoperability concept. Source (Ray et al., 2011 page 123-124).

Interoperability Concept

▪ Interoperability definition – descriptive
▪ Interoperability dimensions - (presence of an attribute is marked as present)
  ▪ Organizational
  ▪ Semantic
  ▪ Technological

Table 16. Evaluation criteria scope. Source (Ray et al., 2011 page 123-124).

Scope
Scope - (presence of an attribute is marked as present) ▪ Government to Government (G2G) ▪ Government to Citizens (G2C) ▪ Government to Business (G2B) ▪ Government to Employees (G2E) ▪ Other Governments (OG)

Table 17. Evaluation criteria basic interoperability policies. Source (Ray et al., 2011 page 123-124).

Basic interoperability policies
Basic interoperability policies - (presence of an attribute is marked as present) ▪ Alignment with the Internet – all the information systems in the government ministration must be in line with the main specifications used in the Internet and the World Wide Web ▪ Adoption of XML as the primary standard for data integration and data management ▪ Use of browser as the key interface for all government information and services ▪ Use of metadata for government information resources ▪ Use of semantic initiative like a controlled vocabulary to be used as an encoding scheme for the metadata standards. ▪ Mandatory use of GIF ▪ Use of open standards

Table 18. Definitions of open standards. Source (Ray et al., 2011 page 123-124).

Definition of open standards
Definition of open standards - (presence of an attribute is marked as present) ▪ Interoperability (IN) – standards and specifications recommended must be relevant for interoperability at different e-Government layers ▪ Scalability (SC) – standards selected should not be a limiting factor and should be capable of supporting a small system evolving into a nationwide application ▪ Openness (OP) - specifications must conform to open standards principles ▪ Market Support (MS) - selected specifications should have wide ICT industry support ▪ Security (SE) - standards must ensure reliable exchange of information that can take place conformity with an established security policies ▪ International recognized (IR) – use of such standards would make information exchange across international boundaries easier ▪ Maturity (MA) - A standard is mature if it has reached its full natural growth or development

- Privacy (PR)- The standards must guarantee privacy

Table 19. Evaluation criteria open standards definition. Source (Ray et al., 2011 page 123-124).

Open Standards Definition
Open Standards Definition - (presence of an attribute is marked as present) ▪ Accessible to everyone free of charge (FC) ▪ Remain free for perpetuity(FP) ▪ Unambiguous documentation - document everything in detail (DC) ▪ Free redistribution (FR) ▪ Free Reuse (RE) ▪ The intellectual property of a standard or of parts of the standard must be accessible without payment or royalty (IP) ▪ Developed based on Open Collaborative decision making process (OC) ▪ All interested parties are given the opportunity to participate in the standards development (PA) ▪ Recommended/Ratified/Approved/Maintained by International Standard Bodies (SB)

Table 20. Evaluation Criteria technology standards. Source (Ray et al., 2011 page 123-124).

Technology Standards
Technology standards – (specifications described in the GIFs have to be classified into the following groups to see completeness) ▪ Presentation ▪ Content management ▪ Application integration ▪ Data exchange ▪ Interconnection ▪ Security

Table 21. Evaluation criteria standards lifecycle. Source (Ray et al., 2011 page 123-124).

Standards lifecycle
Standards lifecycle - (presence of an attribute is marked as present) Emerging – ▪ Future Consideration - A standard not yet reviewed but probably having potential. ▪ Under Review - A standard that is actively under assessment by GIF for future adoption Current – ▪ Adopted - These standards are mandated and represent the preferred solution. ▪ Recommended- These standards are emerging from the development and review. Recommended standards are generally more recent, based on newer technologies or standards. The difference from "Adopted" is that of degree of maturity. Fading - ▪ Undergoing Transition – not recommended because it does not meet one or requirements of the selection policy. It is included in the GIF due to its existing significant use, and would be deactivated as soon as another specific is available to replace it. New use of this standard is discouraged. ▪ Deprecated- represents standards those have been abandoned or superseded by a better solution at the adopted or recommended levels. Agencies should plan to migrate away from solutions involving the standard as soon as practical. New use of this standard is discouraged.

Table 22. Evaluation criteria management & compliance policies. Source (Ray et al., 2011 page 123-124).

Management and compliance policies
Management and compliance policies - (presence of an attribute is marked as present) ▪ Specific agency responsible for managing technical specifications (AG) ▪ Change management procedure. (CM) ▪ Frequency of review (FR) ▪ Compliance policy (CP) ▪ Compliance responsibilities (CR) ▪ Exemption of compliance procedure (EX)

5.2.5 *Research Questions*

To achieve the study objectives, the research paper aim to answer the following three main research questions:

- How critical factors affect the adoption of interoperability framework in the public domain?
- How framework(s) will establish the required interoperability?
- How Namibia can learn from best practices in its interoperability framework implementation initiative?

5.2.6 Methods of Data Collection

For this study the researcher conducted direct interviews with interoperability experts from the e-Governance Academy and Cybernetica, the interviews were fully structured, all interview questions were planned in advanced and followed a sequence. Interviews were then supplemented by independent documentation analysis of the various Government Interoperability Frameworks of the three identified countries, and other related documentation. The data collection was guided by the three (3) principles of data collection as proposed by (Per Runeson et al., 2012 page 32): making use of multiple sources of data collection, creating a case study database for the case study and validating data and maintaining the chain of evidence. Multiple data sources were used in this study (interviews and independent documentation analysis etc.), a case study data base was created to provide evidence of the data collected, and to enable ease of access to data and for reporting purposes, and to strengthen the repeatability of the study. All used documentations and findings were properly cited. Table 23 shows an overview of the interviews, interviews were fully structured for this study.

Table 23. Overview of Interviews. Source (Runeson & Höst, 2009 page 146).

	Unstructured	**Semi-Structured**	**Fully Structured**
Typical Focus	How individuals qualitative experience the phenomenon	How individuals qualitatively & quantitatively experience the phenomenon	Researcher seeks to find relations between constructs
Interviews Questions	Interview guide with areas to focus on	Mix of open and closed questions	Closed questions
Objectives	Exploratory	Descriptive and explanatory	Descriptive and explanatory

The following phases were involved in the interviews process, for collecting qualitative data from the identified experts from the two organizations (Runeson & Höst, 2009 page145-147).

- The ***first phase*** (Planning Phase), involved the identification of who to interview and what data to collect
- ***Second phase,*** presented the research objectives of the interview to the audience (interviewees), and explained to the interviewees how the data from the interview is going to be used.
- ***Third phase,*** presented the main interview questions to the interviewees and ensured the interviewees confidentiality and trust. During the interviews the researcher took notes, and all major findings from the interviews were summarized by the researcher at the end of the interviews sessions. The Researcher provided the interview findings to the interviewees for review, in order to avoid misunderstandings and to ensure quality of information. During the interview sessions, audio recordings were used, to capture interview process and to use audio recordings as evidence to the study.

5.2.7 Methods of Data Analysis

One of the main objectives of this study was to derive to conclusions in the data collected. Since the study adhered to the principles of data collections as proposed by (Per Runeson et al., 2012 page 32), principles such as making use of multiple data sources (triangulation), creating a case database and maintaining chain of evidence.

Maintaining the chain of evidence throughout the study means that the audience will be able to know how the researcher derived to certain conclusions based on the collected data in the case database. For this study the researcher carried out data collection and data analysis in parallel, in order to accommodate new findings. The researcher also make use of triangulation in the study, as a strategy to confirm the hypothesis. The qualitative data analysis for this study followed a series of steps as proposed by (Per Runeson et al., 2012 page 63). The iterative process then led to the generalization and the formulation of the body of knowledge related to the interoperability framework, which were the final findings of the study.

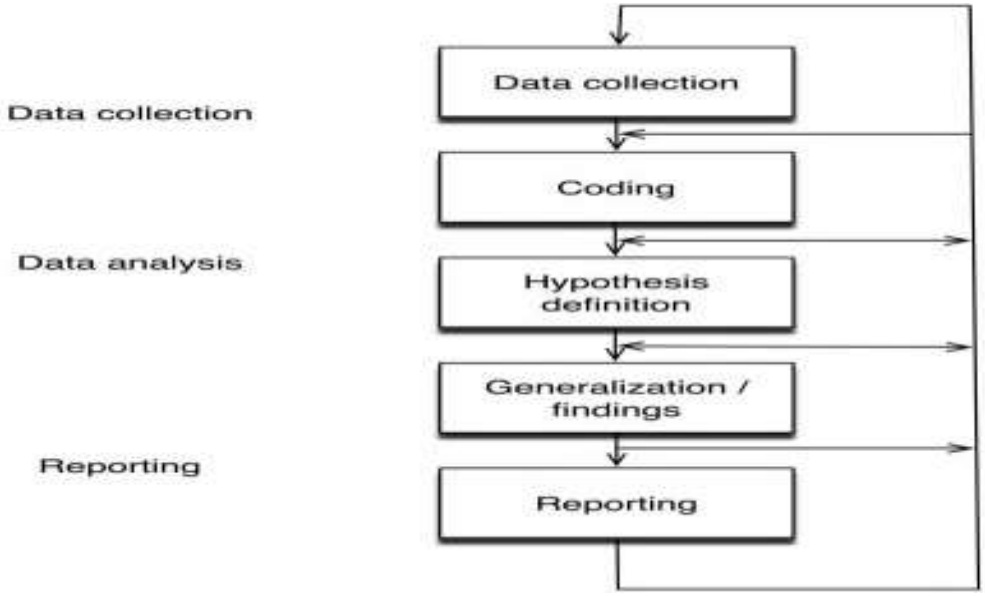


Figure 20. Steps in data analysis. Source (Per Runeson et al., 2012 page 63).

5.2.8 Case Selection Strategy

For this study, a comparison case study was conducted, three e-Government Interoperability Frameworks of identified countries were analysed, countries that have successfully developed, published or implemented their interoperability frameworks in their governments, countries whose interoperability initiatives are internationally known, are advanced in their e-Governance initiatives, and their GIFs documentation is freely available. The comparison included the National Interoperability Frameworks of Estonia, New Zealand and Australia. The comparison of the identified Government Interoperability Frameworks was based on three (3) core areas of interoperability: Content, Context and Process. The context defines the why aspects of the framework, Content defines the what aspect of the framework and process defines the how aspect of

the framework (Ray et al., 2011page117). The context domain, content domain and process domain are than evaluated based on 9 criteria's, Context Domain: (background and scope), Content Domain: (the basic interoperability policies, the standards selection criteria, open standards and technology standards) Process Domain: (the standard life cycle, management and compliance policies) (Ray et al., 2011 page 117).

5.2.9 Data Selection Strategy

For this study, the study make use of interviews as a source of data collection, data was collected from four interoperability experts, through fully structured interviews, two experts from the e-Governance Academia in Estonia and two experts from Cybernetica in Estonia. The interviewees involved in the interviews were experts that have hands on experience in the implementation of interoperability solutions, and able to contribute significantly to the study, due to the vast experience they have in this domain. The study also make use of documentation analysis, various published articles on interoperability were used for the study.

Regular interviews were conducted over a period of two weeks, involving the identified interoperability experts from the two organizations.

5.2.10 Replication Strategy

This study was based on previous studies done in the area of interoperability, previous studies influenced the design of this study. This study replicated work done by (Ray et al., 2011), who developed the analytical framework based on three dimensions: content, context and process. The three dimensions consist of sub dimensions or domains for assessment. The Government Interoperability Frameworks was then evaluated qualitatively based on nine criteria's which are: Background and scope, basic interoperability policies, standard selection criteria, open standards, technology standards, standards life cycle, management and compliance (Ray et al., 2011page 117). Based on this existing analytical framework, the study use the analytical framework to analyse the identified Government Interoperability Frameworks, and propose interoperability framework(s) that best meets the requirements of the government of the Republic of Namibia.

5.2.11 Quality Assurance, Validity and Reliability

This study took into account various considerations, in order to ensure the validity and reliability of the study during all the case study phases. The study used different data sources during the study, interviewing only relevant interoperability experts, and making sure that sufficient number of interviewees were represented for the study. The study also used documentation analysis of the various interoperability frameworks. Regular interviews were planned over a period of two weeks, and interview findings were communicated to interviewees for clarifications and to avoid misunderstanding or misinterpretations. The interview sessions were recorded and a case database was created as evidence for the study.

To ensure the reliability of the qualitative case study, the researcher adopted four measures or criteria's that are considered to enhance the trustworthiness of a study (Shenton, 2004 page 64-72): ***Credibility***, ***transferability***, ***dependability*** and ***conformity***.

Credibility: The study only analyse what it was intended to cover; all what was not part of the scope of the study was excluded. The following provisions were taken into consideration by the researcher, in order to promote confidence that the researcher accurately covered the phenomena under investigation: Adopting a research methodology that is well established for both information science and qualitative investigation, and incorporating operational measures for the concept under investigation. The study use fully structured interviews and documentation analysis of the identified Government Interoperability Frameworks, and published article as a method of data collection for the study. The study also make use of an analytical framework that was used in previous related studies to measure or asses GIFs and thus an independent researcher can derive at the same results using such an analytical framework.

The researcher developed an early familiarity with the organizations involved in the data collection, before the data collection took place, the researcher approached the involved organizations and outlined the purpose of the study, clarify what data is required and who will be required to provide the data on a voluntary basis. All this was done with the aim of collecting quality data from participants involved in the study.

The researcher use triangulation; various sources of data were used for the study in order to enhance the reliability of the study. The study make use of documentation analysis; individual interviews with relevant interoperability experts. To ensure

transparency and reliability of the data collected, the researcher summarized the research findings and invited input from the participants, to verify the data they provided. During the phases of the study regular debriefing sessions took place between the researcher and the supervisor, to address issues at hand and also to get supervisors holistic view. The researcher provided the research work to colleagues for their scrutiny. The researcher provided a thorough description of the phenomena under investigation in order to promote credibility; the researcher conducted a thorough literature review for this purpose. Past studies related to interoperability frameworks findings were assessed, to see to what extent the study findings conforms to the past studies.

Transferability: For this study the researcher ensured that sufficient contextual information was collected from the different sources (interviews, documentation analysis), in order to enable the audience to make such a transfer. The researcher provided sufficient description of the phenomenon under scrutiny to enable audience to have a better understanding of the phenomenon under investigation in order to enable the audience to compare the various aspects of the phenomenon outlined in the research report, with those that have emerge during their own situations. The researcher outlined to the audience the scope of the study in order to help better understand the situation under investigation, and provided the following information from the onset to the audience: the number of institutions that were involved in the study and where this institutions are based, different organizations that were involved in the data collection for the study, roles of people involved in the study, the methods of data collection techniques used for the study, the number and duration of the data collection sessions. The researcher made use of multiple case studies, not only for variation reasons but to enable better understanding of the research findings to the audience.

Dependability: To enable dependability of the study, the researcher make use of overlapping methods of data collection, fully structured interviews were conducted with the identified participants from the e-Governance Academy and Cybernetica in Estonia and documentation analyses method was also used as a data collection method. The researcher ensured that the processes within the research were well documented and reported in depth to ensure future researchers doing research work in the same area of study to arrive at the same conclusions.

Conformability: To achieve conformability aspects of the study, the researcher took into considerations various aspects into account, in order to ensure that the study findings were a true reflection of the actual study carried out, and not the preferences of the researcher. Data triangulation was used for this study; various data sources were used for this study, individual interviews, and also make use of published articles on interoperability in order to avoid biasness. The researcher provided study shortcomings, methods and their possible effects, a detailed methodological description was outlined in order to enable the audience to determine the degree of how far the data and the constructs that have emerged from it is acceptable or not.

5.2.12 Summary

This chapter (case study design) gave a detailed overview of the methodology, as it was the preferred methodology adopted for this study. The chapter covered: rationale, purpose, the case, theory, research questions, methods of data collection, methods of data analysis, case selection strategy, data selection strategy, replication strategy, quality assurance, validity and reliability.

The findings of this exercise then served as the basis for discussion in the next chapter (chapter 6).

6 Evaluation of Results

The focus in this chapter is centred on the analysis of the data gathered through fully structured interviews and documentation analysis. The analysis of the data is outlined within three (3) sections relating to the research questions, the chapter finally concludes with a chapter summary. The literature review was reported in section 3.3 (Interoperability adoption factors), interview responses in section 6.1 (interview responses), how framework will established the required interoperability in section 4.2 and best practices in section 4.4.

6.1 Interview Responses

6.1.1 How Critical Factors Affects the Adoption of Interoperability Framework in the Public Domain?

The data gathered was analysed based on interviewee's perceptions on the factors affecting the adoption of an e-Government interoperability framework in the public domain. The interview questions were drawn from various literatures related to interoperability. Below is a summarized list of interoperability adoption factors based on the interview responses.

6.1.1.1 Organizational interoperability

Organizational interoperability is one of the most critical factors affecting the adoption of interoperability framework; technical interoperability can be achieved much easier than organizational interoperability. One key question about organizational interoperability is how central or decentralize is the e-Government model of the country. It is always difficult to corporate between different ministries, ministries are relatively independent and how to motivate different departments or ministries to do some horizontal corporation can be an issue. It's a general question of coordination. The necessary laws should exist and there should be money in order to coordinate the harmonization of technical integration.

The issue of roles of organization involved is key, it will be necessary to agree on roles of organizations, ministries should have people responsible for interoperability, IT management, electronic ID, address systems, digital maps, and document management etc.

Ministries have different goals and specific goals of ministries which are treated much vertical, interoperability has horizontal goals, and this is like how to put horizontal and vertical strategies together. Interoperability strategies are horizontal and strategies of ministries are very vertical and how to take from these horizontal strategies and some components becomes an issue.

One key question is leadership; leaders need special training, special training for change management and interoperability. Integration becomes more difficult to manage when there are various stakeholders involved with different expectations and interest; this can have an impact on interoperability project. From the interviewees responses and the literature (Vernadat, 2010), there is a link between the literature and the interviewees responses. Organizational interoperability challenges ranges from coordination, different organizational processes and organizational structures.

6.1.1.2 Semantic interoperability

Semantic interoperability describes ontologies, interoperability framework implementation starts with ontology's, ontology's are not so important, but as the system is growing then it would be good to have descriptions on how different data is connected with other data, ontology is dealing with meaning of the data related to metadata, this is important in some phases of interoperability implementation, in order to support collaboration, information sharing, knowledge and to support cooperation.

Interoperability is about integration of business processes, is there any clear rules how to change business processes, it is an issue of change management, but at the end interoperability is not much about technology but how to integrate different business processes and how to implement services. It is important to have a standard way of describing business rules or business processes, because it might be that different ministries are describing it in a different ways which might be a key question. Communicating systems might not share information in a consistent manner. What the literature (Vernadat, 2010) is saying is corresponding to the interview responses, the interviewees goes further to include issues related to change management (clear rules to change business processes) as other factors affecting interoperability.

6.1.1.3 Technical interoperability

It is usually difficult to implement interoperability framework in situations where there is allot of legacy systems, old technologies are difficult to integrate.

Technical interoperability is not the most critical form of interoperability, because it is influenced by the accompanying platforms, but the strategy will be good to integrate existing platforms because of possible vendor lock in and technology locks.

The need to agree on general standards like open systems or system that use interfaces becomes important, standards can be implemented as standard blocks and train people how to use technologies.

Data formats should be unified, like how to use addresses, data formats standardization in service description should be agreed on.

Technical interoperability facilitates in communication, data exchanged and message passing between various application systems, without this it would be difficult to implement a framework. There is a link with the literature (Vernadat, 2010), and the interviewees responses concerning technical interoperability issues affecting interoperability adoption, the common factors range from legacy systems which are difficult to integrate and the use of different data formats can limit interoperability initiatives.

6.1.1.4 Cost/Finance

How much interoperability technology can cost from an investment point of view, there are different options such as open source, freeware etc., main cost might be on customization, training and the implementation side, the cost might be very critical to motivate people to start to use services produced by interoperability framework or architecture. Limited budget does have an effect on interoperability project reaching its objectives. The literature (Santos & Reinhard, 2012), and the interviewees responses is corresponding, financial constrains factors concerns the availability of necessary funds to implement or invest in an interoperability framework.

6.1.1.5 Performance

It concerns the conceptual side of the e-Government architecture, how the architecture is build. Transporting big amounts of data from one point to another may need allot of bandwidth and high capacity networks. Low bandwidth might make processes very slow.

In cases where people are making use of example document management systems, systems becomes very slow, usage become very complicated and system response time is one of the key aspects. The infrastructure should be designed in a way that it can be used in real time, in order to avoid delays. The more the number of interoperating

entities are involved, the slower the system performance. The literature (Santos & Reinhard, 2012), relates or corresponds to the interviewees responses, performance issues relates to the number of entities involved, the more entities are involved the slower the system performance. The interviewees went further to include aspects of e-Government architectures as other factors affecting interoperability adoption; infrastructures should be designed in such a manner that it can be used in real time to avoid delays.

6.1.1.6 Constitutional/Legal

Constitutional or legal constraints refers to different regulations that might impact on the interoperability project, regulations such as: personal data protection, digital signatures, legal value of data, regulation on databases and information systems, issues related to security, such as data security, regulation on addresses, semantic interoperability, electronic identity, digital maps. All these issues are usually regulated, personal data protection is a human right. People are afraid of privacy issues, the success of interoperability project is dependent on people trusting the system, without trust they will not use the system, which can have a negative impact on the adoption of the interoperability framework. Process ownership is a challenge and ownership should be distinguished, in order to enable smoother integration. Process ownership is the most common aspect corresponding with the interviewees responses and the literature (Santos & Reinhard, 2012). Interviewees went further to include aspects such as different regulations: personal data protection, digital signatures, databases and information, electronic identity and regulation on addresses to be some of the critical factors affecting the adoption of an interoperability framework.

6.1.1.7 Jurisdictional

Different ministries operate independently; they own their processes and information. Separate laws need harmonization. Something common in public law is public information law, it demands that all entities in the public domain should make information public (open data). Organizations from different jurisdictions become a challenge, especially when there are a large number of different organizations involved in an interoperability project. The common factor from the literature (Santos & Reinhard, 2012) and the interviewees responses is the independence of entities, entities owns and operate on their own, information sharing with other entities becomes a challenge. Interviewees went further to include the absence of public information law

which will make public information public (open data), as one of the factors affecting interoperability framework adoption.

6.1.1.8 Informational

In general all public data is public, except private data that have restrictions to use (religion, health, political views) etc. The quality of data, integrity of data, and the legal value of data is key if people are to use an interoperability framework, this is a challenge for governments to make sure that data is correct and that data is protected in order to remain authentic. Information quality is one of the common aspects corresponding to the interviewees responses and the literature (Santos & Reinhard, 2012), but the interviewees went further to include aspects such as legal value of data, integrity of data, authenticity of data etc. to be some of the other critical factors.

6.2 How Framework Will Establish the Required Interoperability?

The data gathered was analysed based on the available documentations of the chosen Government Interoperability Frameworks, and related published articles. A qualitative GIFs comparison was conducted based on an analytical framework which is based on three areas (context, content and process). The framework further used the following criteria and measures for evaluation: background, interoperability concept, scope, basic interoperability policies, definition of open standards, open standards definition, technology standards, standards lifecycle and management and compliance policies. Here is a summary of findings based on the framework(s) analysis criteria, to determine how framework(s) will establish the required interoperability. The literature was reported in chapter 4, section 4.2, (Analysis of e-GIFs).

6.2.1 Background

The analysis of the three GIFs shows that the interoperability initiatives were initiated or owned by agencies with the necessary authority. These authorities have the necessary capacity and power to enforce compliance of interoperability frameworks to ensure that agencies use the GIFs. The Estonian Interoperability Framework objective is to ensure the provision of services for both public administration, organizations, enterprises and citizens both at national and European (EU) level; this covers a wider perspective when it comes to service delivery at both national and across borders.

6.2.2 Interoperability Concept

The Estonian Interoperability Framework covers all the required aspects to achieve interoperability, it covers aspects of organizational, technical and semantic interoperability. The other frameworks don't really cover all these aspects.

The concept of interoperability from the Estonian perspective is more comprehensive, it is the ability of diverse and disparate institutions to interact (electronically), with one another towards mutually beneficial agreed common objectives that involves the sharing of information and knowledge amongst the various institutions through business processes that they support by means of exchanging data between their various information communication technology systems. The aim of the Estonian interoperability framework is to ensure the provision of services for public administration, organizations, enterprises and citizens both at national and European (EU) context.

The Estonian interoperability concept and objectives is more related to the Namibian Public Service directives, which aim to ensure interoperability across all governmental entities due to the challenge of: diverse and traverse hardware, software and systems. The aim is to develop an interoperability framework to make integration possible without compromising the functionality, information and services delivery to the citizens.

6.2.3 Scope

All the three (3) Government Interoperability Frameworks (GIFs) covers similar scope in terms of Government to Government (G2G), Government to Business (G2B) and Government to Citizens (G2C). Both the Estonian and New Zealand framework goes to an extend of covering interactions with other governments (OG), or considers providing services across their national borders which is a good consideration in current environment were governments establish good relationships with neighbouring countries to provide services or promote business trade amongst each other. Having a wider scope will be beneficial for Namibia and a wider scope of service provision is prudent.

6.2.4 Basic interoperability policies

The three (3) interoperability frameworks outline common high level policies on which their interoperability initiatives are based. The common policies are: adoption of XML technologies for data integration and management, alignment with the internet and use

of browser. The New Zealand and Estonian frameworks make use of open standards for all their public domain information systems and the use of the GIFs is mandatory which a critical factor if agencies are to use GIFs and so promote interoperability.

6.2.5 Standards selection criteria and open standards definition

The common specification criteria for the three interoperability framework are scalability, openness and security. The New Zealand and Estonian specification criteria are more centred on interoperability, making the two frameworks favourable in achieving interoperability. The frameworks meet most of the standards selection criteria such as: interoperability, scalability, openness, security and privacy, even though other standard selection criteria's need to be addressed such as market support, internationally recognized and maturity.

Openness of the standards is the common principle used in the three interoperability frameworks. The Estonian framework under the open standards definition criteria meets most of the criteria such as free access, free redistribution, free reuse, without royalty, open decision making and opportunity to participate.

6.2.6 Technology standards

The New Zealand interoperability framework covers all the necessary technological dimensions of e-Government, making it to be more interoperable. The security layer is applied to all layers of the security framework, the e-Government services represents the actual implementation of the IT infrastructure which is made available to the various agencies.

The web services layer is applicable to all the structural layers such as the data integration layer, business services layer, access and presentation layer. The web services component aim to connect various services together, while the management and governance component outlines the roles and responsibilities for the management of the interoperability framework in terms of: review of the framework, framework operations, to ensure framework governance conforms and aligned with the e-Government strategy.

Providing Web services at different separate layers in the New Zealand case provide more comprehensive specifications for technology at a single point to deal with heterogeneity and so enhancing interoperability.

6.2.7 Standard life cycle

Comparing the standard life cycle of the three GIFs, the New Zealand stand life cycle is more detailed and meet most of the standard life cycle criteria. It goes through various stages such as, emerging (future consideration, under review), current (recommended, adopted), and fading (deprecated). The New Zealand standard lifecycle does not meet one of the recommended stages, which is the undergoing transition stage which is a sublevel of fading.

6.2.8 Management and compliance policies

The three Government Interoperability Frameworks undergo various necessary review processes, change management procedures and there are also specific agencies that are accountable for managing technical specification aspects.

Based on the management and compliance policy criteria, New Zealand and Estonia meet most of the criteria in terms of: specific agency, change management procedures, compliance policy, and frequency of review and compliance responsibility.

The compliance policies of New Zealand and Estonia also make it clear that the use of the Government Interoperability Framework is mandatory, mandatory use of the GIFs will ensure that all agencies will use the GIFs and this can allow faster adoption of the interoperability framework and by doing so enhance interoperability in the public domain.

6.3 How Namibia Can Learn From Best Practices In its Interoperability Implementation Initiatives?

The data gathered was analysed based on the available documentation of the chosen Government Interoperability Frameworks (GIFs). Best practices were drawn from the identified interoperability frameworks and incorporated in the proposed Namibian framework implementation. The literature was reported in section 4.4 (Best Practices). Here is a summary of best practices drawn from the identified frameworks:

- The development and implementation processes of the Government Interoperability Frameworks (GIFs) was inclusive, it involved all the relevant stakeholders for their input and considerations
- To ensure quality of data and information, formal agreements over the management of data and information quality were put in place as part of the interoperability agreements.

- The interoperability framework projects were launched by specific agencies or departments which are accountable and have the corresponding decision making authority concerning the interoperability framework ongoing development and its management (maintenance).
- The GIF document is considered to be a living document and it constantly changes as business needs and technology changes
- In order to allow better use of interoperability framework in government, most of the governments enforced mandatory compliance policy, to enforce their agencies to use the GIFs.
- Interoperability Frameworks, make use of XML technologies, and adoption of web and internet technologies to allow easier integration of heterogeneous information systems. The adoption of open standards avoids the risk of vendor lock in and allow a wider market to participate.
- Most of the Government interoperability frameworks are aligned with their e-Government strategies
- The adoption of an interoperability framework goes through gradual adaption process, in order to meet the specific requirements of the country adopting the interoperability framework
- The use of the GIFs is in compliance with regulations concerning privacy and data protection

6.4 Summary

In this chapter the researcher discussed the evaluation of results based on the research questions of the study. *Critical factors affecting the adoption of an interoperability framework ranges from*: organizational interoperability & constitutional are the two most critical factors affecting interoperability adoption in the public domain, semantic interoperability, technical interoperability, finance, and performance, jurisdictional and informational are the other critical factors affecting the adoption of interoperability framework in the public domain. The researcher new findings through interviews, also gathered the following critical factors affecting interoperability adoption in the public domain: *clear rules to change business processes* (change management), e-Government

architecture, the infrastructure should be designed in such a manner that it can be used in real time to avoid delays. Different regulations, regulations on *personal data protection, digital signatures, databases and information, regulation on electronic ID and regulations on addresses* should be in place if an interoperability project is to be successful. The absence of *public information law* which will make public information open (open data), *legal value of data, integrity of data* are some of the new critical factors affecting interoperability adoption in the public domain , the researcher established this new finding through interviews.

How framework will establish the required interoperability, the Estonian and New Zealand interoperability framework prove to provide the required interoperability. Under the set evaluation criteria (background, interoperability concept, scope, basic interoperability policies and standard selection criteria, technology standards, standards life cycle, and management and compliance policies) both frameworks prove to be favorable as they all meet some of the aspects of the evaluation criteria if not all. Under the interoperability concept evaluation and open standard definition criteria, Estonia prove to be more favorable, while under technology standards and standard life cycle New Zealand meet most of the criteria's. Under the following evaluation criteria's: background, scope, basic interoperability policies and management and compliance policies the Estonian and New Zealand frameworks scored equally.

How Namibia can learn from best practices in its interoperability implementations, the implementation process should be transparent and involve all relevant stakeholders, formal agreements over the management of data and information should be in place. Mandatory compliance policy on the use of interoperability frameworks should be in place, to enforce agencies to make use of GIFs, GIFs should be aligned to the e-Government strategies and the use of the government interoperability framework should be in compliance with privacy and data regulations.

7 Conclusions & Future Work

This chapter (conclusions), aim to demonstrate the final conclusions of the research, the key findings of this study are based on the literature review that is reported in chapter 3 and 4 and the fully structured interviews. This chapter is outlined as follows: summary of recommendations, a summary of findings, limitation of the work, as well as the researcher future work.

7.1 Recommendations

On the basis of the thorough analysis of the three (3) interoperability frameworks, their adaptations and best practices drawn from the three cases of Estonia, New Zealand and Australia, the researcher provided recommendations to the government of the Republic of Namibia for consideration, to successfully adopt and implement its interoperability framework.

- As noticed in the analyzed three cases, when implementing the interoperability framework, a central agency with the necessary authority need to be in place, the central agency should take care of issues of e-Governance coordination and implementation, the central agency should develop, monitor and promote standards, protocols, various technologies and policies, maintain and take ownership of the e-Governance project concerning interoperability. The government of the Republic of Namibia should put in place the necessary structures (agency), which will be accountable for the interoperability framework implementation and management.
- Public policies need to be very effective in order to support interoperability initiatives, mandatory requirements must be in place and compatibility should be one of the factors or criteria when selecting software from various vendors.
- The researcher observed that stakeholder involvement in the development of the interoperability framework in the three cases was

mandatory, and in some cases in order to enhance compliance, compliance can be achieved based on an incentive approach. Namibia should put strategies in place to reward agencies complying with interoperability framework.

- To successfully implement the interoperability framework, the central agency should have the required skills. And it is important to educate and train personnel in government on the interoperability framework and its related standards. Continuous political support should exist and cooperation agreements between the various governmental agencies needs to be in place.
- As noticed, Government interoperability Frameworks should contain a statement of the guiding principles to which the interoperability framework adheres to, the Namibian interoperability framework should adhere to the following principles: accessibility, scalability, interoperability, privacy, security, openness, market support, maturity, internationally recognized and transparency.
- As observed by the researcher, the core of the Government Interoperability Frameworks is the catalogues of technology standards. To interoperate effectively, the specifications should cover all the layers of the e-Governance architecture such as: presentation, content management, application integration, data exchange, interconnection and security.
- To ensure interoperability, the Namibian government should adopt open standards, in the three cases, standards were adopted across governments in order to promote interoperability and GIF should be aligned with the e-Governance strategy.
- In order to accommodate changing technology land scape and ever changing requirements, it is necessary to have a well-documented standard life cycle. The Namibian framework standard life cycle should consist of a detailed standard life cycle consisting of the following stages: emerging (future consideration, under review), current (adopted, recommended), fading (undergoing transition, deprecated).

- As noticed in the three cases, all the interoperability frameworks went through the review and the necessary consultation procedures, in most cases it is mandatory to make use of the GIFs (compliance policy). In order to encourage and promote fast use of the GIF in the Namibian Public Service, it will be prudent to enforce mandatory use of the GIF by all governmental agencies; compliance policy should indicate that compliance is mandatory.

7.2 Conclusions

Moving government to a more service oriented style (online), is mandatory for all governments around the world to exploit Information and Communication Technologies capabilities fully. But however, implementing e-Governance initiatives remain a challenge, the e-Governance project face various barriers in which organizational & constitutional issues remain the most critical aspects. Interoperability barriers caused by heterogeneity of Information and Communication Technology solutions in the public domain is one of the technical barriers, other barriers impacting the implementation of interoperability framework range from semantic interoperability, cost, performance, jurisdictional and informational. However, some other barriers should also be taken into consideration, barriers such as privacy restrictions, integrity issues, continuous training and awareness, regulation on: public information, digital signatures, electronic ID, address system and personal data protection.

All this barriers calls for strategies to allow full implementation of interoperability framework in the public domain. Strategies to enhance interoperability ranges from, Government Interoperability Frameworks (GIFs), Enterprise Architecture (EA), Model Driven Architecture (MDA) and Service Oriented (SOA). Interoperability can also be achieved through architecture by adopting architectural design principles to achieve interoperability goals. Architectural principles should: stimulate sharing, develop modular architecture and develop standards infrastructure components.

After a thorough analysis of the various identified interoperability initiatives, two (2) frameworks have been identified to provide the required interoperability, the frameworks identified to provide the required interoperability are those of New Zealand and Estonia (hybrid). The Namibian interoperability framework should be a hybrid

framework, composed of best characteristics from the two frameworks (Estonia & New Zealand). But short comings of the suggested frameworks should be addressed, frameworks under the standards selection criteria must meet criteria such as market support, internationally recognised and maturity. This frameworks will make it possible to allow interoperability across the public domain in Namibia, allow information sharing, and enable electronic connectivity and electronic government, all this requirements are catered for in the interoperability directives of Namibia.

The evaluation criteria or measures used for this study (comparative analysis), were based on the following: background, interoperability concept, scope, basic interoperability policies, standard selection criteria, open standard definition, technology standards, standard life cycle, management and compliance. This were the measures used to determine how framework(s) will establish the required interoperability. The framework(s) characteristics and the Namibian interoperability requirements (interoperability directives) were taken into consideration, for the implementation of the Namibian interoperability framework. The adoption of the interoperability framework should go through gradual adaptation process in order to meet the requirements of Namibia, and enable successful implementation of the interoperability framework.

Different e-Government interoperability Frameworks (e-GIFs), reflects their unique national circumstances, but e-GIFs should lay out the necessary guiding principles such as: openness, security, privacy, interoperability, transparency, scalability, market support and should also develop a working definition of open standards defining openness in the development, openness in the implementation and openness in use.

7.3 Limitations

Even though this study achieved its main objectives, and has answered all the main research questions, the researcher was presented with some limitations during the research.

- Analyzing and interpreting data through qualitative analysis is more susceptible or prone to researcher biasness. But however this was overcome through regular consultation, discussions and peer reviews.
- The findings in this study have been affected by the lack of a proven theoretical framework of reference in the area of e-Governance interoperability. The clear

framework of reference could have make the context of the case study much clear and helped those reviewing the study results, but however adapting an existing analytical framework at the beginning, helped the researcher to reduce the effect of the lack of theoretical framework of reference, and established the theoretical basis of the study.

- The study only managed to get two responses (interviews), from the two organizations involved in the data collection process, and not four responses as planned, and as such the researcher overcome this short comings by having a thorough literature review, and regular peer reviews to make sure that data gathered is relevant.
- The research paper was limited to a number of pages, and as such the researcher left out some parts of the study which could have provided more insight on the research.

7.4 Future Work

The study was conducted in order to propose an e-Governance interoperability framework for the Public Service of Namibia.

The research only concentrated on interoperability framework adopted in Europe, Zealandia and Australia, as a limitation of this study, the study outcome cannot be generalized beyond its boundaries. But however countries with a similar context can benefit immensely from the study findings, it could have been very useful if an interoperability framework comparative study was conducted across countries in Africa or sub-Saharan African region. The researcher intend carrying out similar research involving a number of African countries that have successfully implemented their interoperability frameworks, and further investigate more in depth on the new critical factors affecting interoperability that emerged during the study.

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Appendix 1 – Interview Template

*NAME OF PARTICIPATING ORGANIZATION:*_____

*PARTICIPANT ROLE/OCCUPATION:*_____

*DATE OF INTERVIEW:*_____

The following are some of the critical factors that the researcher identified, factors that impact or affect the adoption of an interoperability framework in the public domain.

1. ORGANIZATIONAL INTEROPERABILITY

1.1 How different human, organizational behavior and cultures or method of work influence (enable or limit) collaborative or interoperability efforts?	
1.2 How different organizational processes/procedures influence (enable or limit) collaborative efforts?	
1.3 How leadership and strategic direction of management influence (enable or limit) interoperability efforts?	
1.4 How different organizational goals influence (enable or limit) interoperability efforts?	
1.5 How stakeholder management influence (enable or limit) collaborative or interoperability efforts?	

2. SEMANTIC INTEROPERABILITY

2.1 How syntactic & semantic heterogeneity of information influence interoperability efforts?	
2.2 How business rules influence (enable or limit) interoperability efforts?	

3. TECHNICAL INTEROPERABILITY

3.1 Why legacy systems can influence interoperability efforts?	
3.2 How heterogeneity of ICT solutions from different vendors (operating systems, application servers, database systems, computer networks etc.) can have an impact on interoperability efforts?	
3.3 Why lack of technological standards can (enable or limit) interoperability efforts?	
3.4 How different data formats in use may influence (enable or limit) interoperability efforts?	

4. COST/FINANCE

4.1 What specific financial constrains may influence (enable or limit) interoperability efforts?	

5. PERFORMANCE

5.1 What specific performance constrains may influence (enable or limit) collaborative or interoperability efforts?	

6. CONSTITUTIONAL /LEGAL

6.1 What specific constitutional constraints can influence (enable or limit) collaborative efforts?	

7. JURISDICTIONAL

7.1 What specific jurisdictional constraints can influence (enable or limit) collaborative efforts?	

8. INFORMATION

8.1 What specific information constraints can influence (enable or limit) collaborative efforts?	

9. ANY ADDITIONAL INFORMATION